APPENDIX 1

PUBLIC PARTICIPATION PROCESS

Appendix 1.1:	I&AP database
Appendix 1.2:	Notification letter, Background Information Document and Registration / Response Form
Appendix 1.3:	Advertisements
Appendix 1.4:	I&AP correspondence
Appendix 1.5:	Issues and Responses Trail
Appendix 1.6	I&AP notification of EMP comment period

APPENDIX 1.1

I&AP DATABASE

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NOTE: Secretary of West Coast Rock Lobster Industry Association

South African Sea Products Ltd

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South African Squid Management Industrial Ass.

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South African Squid Management Industrial Ass.
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VM Young Visserye Bk

V Young (Vincent)
VM Young Visserye Bk
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U Donaggi ()
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Weskus Vissersunie

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West Coast Rock Lobster Industry Association

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Western Cape Commercial Linefish Association

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Western Cape Marine Conservation Society

H Steyn (Hymie)
Western Cape Marine Conservation Society
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Wildlife & Environment Society of SA (WESSA)

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Wildlife & Environment Society of SA (WESSA)
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World Shipping Agencies

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WWF South Africa

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Manager WWF South Africa
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NOTE: Aaniyah Omardien no longer works for the company July12

158 names listed

APPENDIX 1.2

NOTIFICATION LETTER, BACKGROUND INFORMATION DOCUMENT AND REGISTRATION / RESPONSE FORM

An04/Let-30 Jan13

30 January 2013

Dear Sir / Madam

ANADARKO PETROLEUM CORPORATION - APPLICATION FOR AN EXPLORATION RIGHT TO UNDERTAKE OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF THE WEST COAST OF SOUTH AFRICA: PROJECT NOTIFICATION AND REGISTRATION PROCESS

This letter and attached Background Information Document (BID) provides information on an application for an Exploration Right to explore for oil and gas reserves in Block 2C situated off the West Coast of South Africa and the opportunity to register as an interested and affected party (I&AP) on the project database and comment on the proposed project.

Anadarko Petroleum Corporation (Anadarko) has applied to the Petroleum Agency of South Africa (PASA) in terms of Section 79 of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA) for an Exploration Right in Licence Block 2C. Anadarko is proposing to explore for oil and gas using various methodologies which may include:

1. 2D/3D seismic surveys; and
2. Seafloor geochemical surveying consisting of mutlibeam bathymetry, seafloor sampling and heatflow measurements.

In terms of the MPRDA, a requirement for obtaining an Exploration Right is that an Environmental Management Programme (EMP) must be compiled in terms of Section 39 of the MPRDA and submitted to PASA for consideration and for approval by the Minister of Mineral Resources. Anadarko has appointed CCA Environmental (Pty) Ltd (CCA) to compile an EMP to meet the relevant requirements of the MPRDA and the Regulations thereto. A BID providing preliminary project details has been compiled and is enclosed for your information.

If you or your organisation wish to register as an I&AP and/or wish to raise any issues or concerns regarding the proposed project, please make use of the attached Response Form and forward it to Jeremy Blood of CCA (contact details below) **no later than 20 February 2013.**

Should you have any queries in this regard please do not hesitate to contact our Jeremy Blood or the undersigned.

Yours sincerely

Jonathan Crowther Pr.Sci.Nat., CEAPSA
CCA ENVIRONMENTAL (PTY) LTD

Encl.

An04ss/corr/I&APs/let – Notification & Registration Rev 0 30 Jan13

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Tel +27 (21) 461 1118/9 • Fax +27 (21) 461 1120 • email: info@ccaenvironmental.co.za • website: www.ccaenvironmental.co.za
Directors: J Crowther F Fredericks • Associate: J Blood • Reg No 2003/019026/07

5.1 Seismic survey

Seismic surveys are conducted during marine oil and gas exploration in order to investigate sub-sea geological formations. During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a vessel. Signals reflected from geological discontinuities below the sea floor are recorded by towed hydrophones. Analyses of the returned signals allow for interpretation of subsea geological formations. Seismic surveys are undertaken to collect either two-dimensional (2D) or three-dimensional (3D) data.

A seismic vessel would travel along transects of a prescribed grid within the Block 2C licensed area, which is selected to cross any known or suspected geological structures in the area. During surveying vessels would travel at a speed of 4 to 6 knots.

A 2D survey typically involves a towed airgun array and a single streamer, whereas 3D surveys use multiple streamers. A single array can be up to 10 000 m long. The airguns are commonly towed some 100 m behind the vessel at a depth of 5 to 10 m below the surface. A surface tail-buoy with radar reflectors is connected to the end of the streamer. A typical 3D seismic survey configuration is illustrated in Figure 2.

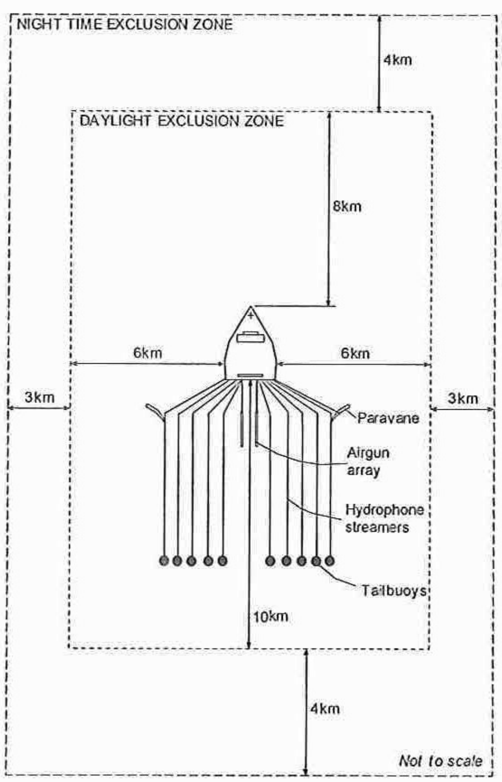

Figure 2: Typical configuration for a 3D seismic survey operation. Safe operational limits applicable to both 2D and 3D surveys are also shown.

The airgun is an underwater pneumatic device from which high-pressure air is released suddenly into the surrounding water. On release of pressure the resulting bubble pulsates rapidly producing an acoustic signal that is proportional to the rate of change of the volume of the bubble. The frequency of the signal depends on the energy of the compressed air prior to discharge. Arrays of airguns could typically produce sound levels in the region of 250 dB re 1 mPa @ 1 m. The majority of energy produced is in the 0 to 120 Hz bandwidth, although energy at much higher frequencies is also recorded.

The sound source is fired at approximately 10-20 second intervals and the sound waves are reflected by boundaries between sediments of different densities. Returned signals are processed by computer after being recorded by the hydrophone streamer.

The acquisition of high quality seismic data requires that the position of the survey vessel and the array be accurately known. Seismic surveys consequently require accurate navigation of the sound source over pre-determined survey transects. This, and the fact that the array and the hydrophone streamers need to be towed in a set configuration behind the tow-vessel, means that the survey operation has little manoeuvrability while operating. Under the Merchant Shipping Act (No. 57 of 1951), a seismic survey vessel that is engaged in surveying is defined as a "vessel restricted in its ability to manoeuvre" and requires that vessels engaged in fishing shall, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre. It should also be noted that under the Marine Traffic Act (No. 2 of 1981), a seismic survey vessel and its array of airguns and hydrophones fall under the definition of an "offshore installation" and as such it is protected by a 500 m safety zone. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for 2D and 3D surveys are illustrated in Figure 2.

5.2 Seafloor Geochemical Survey

A seafloor geochemical survey combines high-resolution Multibeam Bathymetry, sub-bottom acoustic profiles, navigated sea-bottom piston cores and seabed heatflow measurements.

5.2.1 Multibeam Bathymetry Survey

A multi-beam bathymetry survey may also be conducted in Block 2C license area. This survey produces a digital terrain model of the seafloor. A survey vessel is equipped with a deep water multi-beam echo sounder and a sub-bottom profiler to obtain a digital terrain model of the structure and geology of the seafloor (see Figure 3).

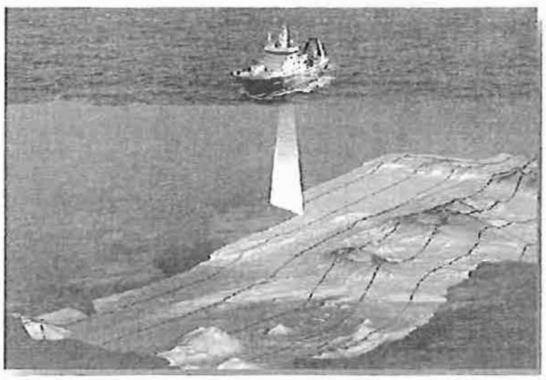

Figure 3 Illustration of a vessel using multi-beam depth/echo sounders (http://www.gns.cri.nz/).

Note that this type of survey typically does not require the vessel to tow any cables. However, due to the operational nature of this work would be "restricted in her ability to manoeuvre".

The multi-beam echo sounder emits a fan of acoustic beams from a transducer at frequencies ranging from 10 kHz to 200 kHz and typically produces sound levels in the order of 207 db re 1µPa at 1m (approximately 1 000 time less than the seismic survey). The sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 3 kHz to 40 kHz and typically produces sound levels in the order of 206 db re 1µPa at 1m.

5.2.2 Seafloor Sampling Programme

The seafloor sampling program would consist of collecting seafloor sediment samples for laboratory geochemical analyses in order to determine if there are any naturally occurring hydrocarbons are present.

Today, piston coring is one of the more common seafloor sampling methods. A piston coring device with ultra-short baseline (usbl) navigation would be used to collect the seafloor samples (see Figure 4). The piston corer is lowered over the side of the survey vessel and allowed to free fall from about 3 m above the seafloor to allow good penetration. The USBL navigation system is used to accurately track the position of the core through the water column and position the core over the desired target for sampling.

The program would likely utilize core barrel capable of retrieving sediment samples that are up to 6 m in length and 6.7 cm in diameter. Recovered sediment samples would be visually described and sampled for geochemical analysis.

It is anticipated that up to 200 core samples would be collected across Block 2C. Each individual core would have a disturbance volume of 0.02 m^3, respectively, resulting in a total disturbance volume of approximately 4.23 m^3, respectively. The number of cores samples and the exact location would be identified following the analysis of the multi-beam bathymetric survey results.

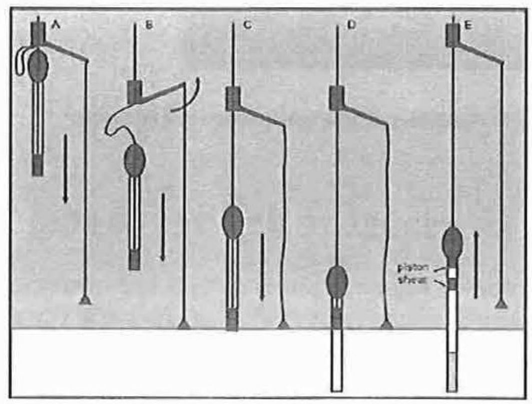

Figure 4 Schematic of a piston core operation at the seabed.

5.2.3 Seabed Heatflow Measurements

Seabed heatflow measurements can be taken simultaneous with the seafloor sampling, and are deployed by the same methods. The probe is navigated to specific target sites using the USBL navigation described in the previous section. The primary goal of this program is to measure the thermal conductivity of the sea bed sediments in numerous locations throughout the survey area to provide a representative dataset.

The heatflow probe is normally 3 m in length and has 16 sensors (see Figure 5). The first eleven measure temperature within the probe at 30 cm intervals down into the sediment. The remaining sensors measure the water temperature, internal temperature of the probe, the tilt of the probe from vertical, water pressure, as well as a reference resistor. The probe is lowered into the sea bed for a minimum of 20 minutes. A heat pulse is applied thru the probe which allows the thermal conductivity of the sediments to be measured. No material is removed from the sea bed, and the entire probe is retrieved at the end of the measurement. It is anticipated that up to 50 separate heaflow measurements may be taken during this programme within the Block 2C license area.

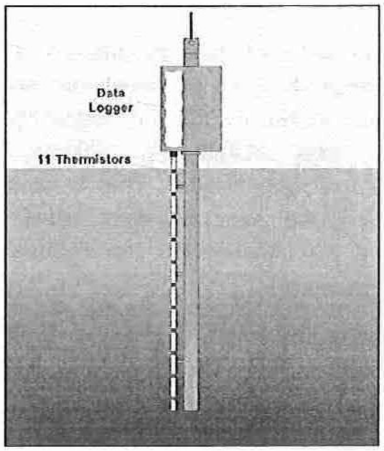

Figure 5: Heat flow probe schematic (TDI-Brooks).

6. KEY ISSUES TO BE INVESTIGATED

The following key issues have already been identified in relation to seismic and seafloor geochemical survey consisting of multibeam bathymetry, seafloor sampling, and seabed heatflow measurements:

- Noise effects on marine fauna from seismic and multi-beam bathymetry surveys, and seafloor sampling;
- Potential effects on the fishing industry due to temporary displacement of fishing activities;
- Interference with marine recreational facilities and transport routes; and
- Waste discharge to sea and atmosphere.

These potential impacts will be addressed in the EMP for the proposed activities in Block 2C.

- **YOUR INVITATION TO COMMENT AND PARTICIPATE IN THE PROCESS**

If you or your organisation wishes to register as an Interested and Affected Party (I&AP) and/or to raise any issues or concerns regarding the proposed project, please contact Jeremy Blood of CCA at the contact details below. An I&AP Registration and Response Form has been attached for registration and commenting purposes.

For comments to be included in the EMP they should be forwarded to CCA **no later than 20 February 2013.**

Attention: Jeremy Blood
CCA Environmental (Pty) Ltd
PO Box 10145, Caledon Square, 7905
Unit 35 Roeland Square, 30 Drury Lane, Cape Town, 8001

Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: jeremy@ccaenvironmental.co.za

cca
ENVIRONMENTAL

APPLICATION FOR AN EXPLORATION RIGHT TO UNDERTAKE SEISMIC AND SEAFLOOR GEOCHEMICAL SURVEYS IN LICENSE BLOCK 2C, WEST COAST, SOUTH AFRICA

INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?

Yes ________ **No** ________

Name:

Organisation:

Postal address:

Email address:

Telephone number: **Fax number:**

Do you or your organisation have any issues or concerns regarding the proposed exploration in Block 2C?

Yes ________ **No** ________

If yes, please provide details below:

Please forward to:
CCA ENVIRONMENTAL (PTY) LTD
Attention: Jeremy Blood
Unit 35, Roeland Square, 30 Drury Lane, CAPE TOWN, 8001
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
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Comments must reach CCA Environmental no later than 20 February 2013.

CCA ENVIRONMENTAL (PTY) LTD

ACKNOWLEDGEMENT FORM
LETTERS POSTED

Project:	ANADARKO PETROLEUM CORPORATION - APPLICATION FOR AN EXPLORATION RIGHT TO UNDERTAKE OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF THE WEST COAST OF SOUTH AFRICA: PROJECT NOTIFICATION AND REGISTRATION PROCESS
Letter Reference:	AN/04/SS
Number of letters posted:	39
Date posted:	30 JANUARY 2013
Post Office:	Mill Street Post Office, Cape Town

Signed:

CCA Environmental (Pty) Ltd
Director

30/1/2013
Date

Signed:

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2013 -01- 30
Ph: 021-465 1013

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Date

CCA ENVIRONMENTAL

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Jeremy Blood - CCA Environmental

From: Mandy Kula <mandy@ccaenvironmental.co.za>
Sent: 30 January 2013 02:37 PM
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Cc: 'Jonathan Crowther - CCA Environmental'; jeremy@ccaenvironmental.co.za; gary.sparks@anadarko.com; terry.bentley@anadarko.com
Subject: NOTIFICATION OF APPLICATION FOR OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF WEST COAST
Attachments: Let I&AP - Notification and registration Rev 0 30 Jan13.pdf; 2C BID Rev 4 30 Jan13 .pdf

Dear Interested and Affected Party

ANADARKO PETROLEUM CORPORATION- APPLICATION FOR AN EXPLORATION RIGHT TO UNDERTAKE OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF THE WEST COAST OF SOUTH AFRICA: PROJECT NOTIFICATION AND REGISTRATION PROCESS

Please find attached a covering letter with a Background Information Document (BID) regarding the above mentioned application.

Should you have any queries in this regard, please do not hesitate to contact Jeremy Blood or the undersigned.

Kind regards

Mandy Kula for
Jonathan Crowther

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Unit 35 Roeland Square 30 Drury Lane Cape Town 8001 • PO Box 10145 Caledon Square 7905
Tel + 27 (21) 461 1118/9 • Fax + 27 (21) 461 1120 .
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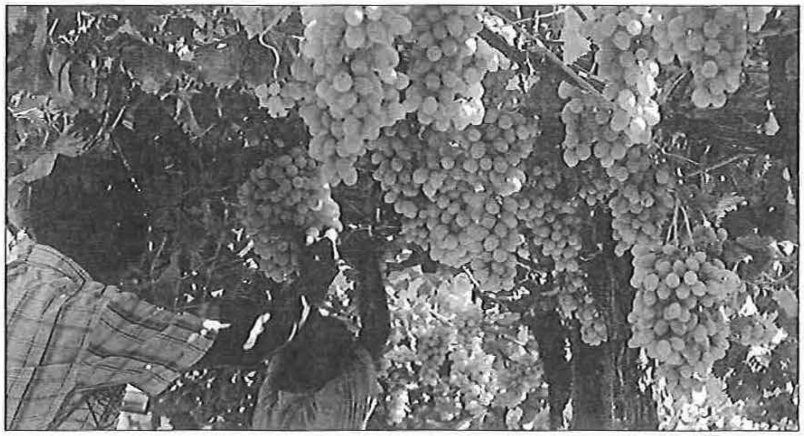
Directors: J Crowther F Fredericks • Associate: J Blood • Reg No 2003/019026/07

APPENDIX 1.3

ADVERTISEMENTS

LESSONS LEARNT

What has been gleaned from the strike?



HARVEST TIME: These two farmworkers, who refused to have their names published, have returned to work on a farm near De Doorns. Some Hex River Valley farmers have agreed to pay workers R105 a day. *Pictures: JEFFREY ABRAHAMS*

> One of the losses was the violence between police and the community

> Nothing has been gained out of this. None of the workers really got much out of this

Farmworkers in De Doorns went back to work last week and production at some farms returned to normal after a deal of R105 a day was agreed on by unions and farmers. Wage agreements at other farms are yet to be finalised but it is understood they could be signed off by the end of the week. The strike was on intermittently for three months as workers demanded R150 a day. XOLANI KOYANA spoke to those who had been involved or affected by the strike to find out what lessons were learnt.

ZIKHONA MAQONA, a farmworker at the De La Haye in De Doorns:

"I have learned that it is not a good thing to go about things in a violent way because people have been killed and some have lost their eyes in the strike. Others are in jail because of all the violence. I think the next time we as workers have to sit down with farmers to negotiate our own wage increases and if they don't want to then we can go to unions for help.

"I feel like we have not gained anything because people are still confused as to how much we will be paid.

"We hear that some farmers are still offering R69 but we are told that we have to go back to work."

SANDILE KENI is the Food and Allied Workers' Union provincial organiser:

"What we have managed to achieve is that workers' voices have been heard. Communities sympathise with them because they believe that being paid R69 is not fair.

"One of the losses for the strike was the violence between police and the community. Those are the things that that can tarnish an organisation's image.

"I think this will teach unions to properly communicate with members so that there are not conflicts that will lead to violence. That will also help us avoid our struggle being hijacked by hooligans and criminals."

MICHAEL LOUBSER is a farmer and spokesman for the Hex Valley Table Grape Farmers Association:

"Farmers have lost out quite a lot, having their vineyards burnt and property damaged.

"Nothing has been gained out of this.

"None of the farmworkers really got much out of this.

"I think the only positive that came from this strike is that farmworkers' voices have never been heard as much as they did in the last few months.

"I hope that the government and South Africans realise that it is not only farmers who benefit from agriculture but farmworkers also."

GERRIT VAN RENSBURG is MEC for Agriculture and Rural Development.

"In South Africa there are tensions between certain groups, in particular foreigners.

"I think in future we must learn to deal with those conflicts. We can find solutions to problems if we just sit around a table and talk about them. It was very sad to watch what unfolded in the last few months; vineyards, property and vehicles being burnt.

"I really hope that farmworkers earn more. But we as government have to do a lot to ensure the profitability of farms.

"That will translate to better wages for farmworkers."

NOSEY PIETERSE is Bawsi Agriculture Workers' Union of SA general secretary:

"In the absence of unions, farmers were left at the mercy of lawlessness because people were not subjected to an organisation's rules.

"For us it was difficult leading people who were not subjected to our organisation's rules and discipline. We as unions will no longer be kept outside the farm gates because we have gained a significant number of members.

"I think the victory for the workers is they managed to have the sectoral determination reviewed this year. The current minimum wage would have been reviewed in three years' time."

Caution urged when using Gumtree

Aziz Hartley

BE CAUTIOUS when you are about to conclude a transaction with someone you have met on classified advertising websites such as Gumtree.

This is a warning the police repeated yesterday after an incident in Kenilworth on Sunday when a woman was allegedly held at gunpoint by a man who had responded to an advert she had placed on Gumtree.

"People must realise that there are dangers associated with transactions taking place after responding to advertising in this manner. Always make sure you know who you're dealing with. Always go with someone you know and never go alone. It is safer to meet at a police station," police spokesman FC van Wyk said.

On Sunday a woman who had advertised a wristwatch on Gumtree met someone who gave his name as Clint and who had shown an interest in buying the item, Van Wyk said yesterday. The meeting place was at a fast food outlet in Wetton.

"When she arrived he said he did not have enough money on him and asked if she could take him to a nearby ATM. The woman told police that when he was in the car, he took out a firearm and threatened her," Van Wyk said.

He said the woman was pushed out of the car when she waved at an armed response vehicle.

"Several shots were fired by the suspect and by the security guard. He drove away and later the woman's car was found some distance away. He managed to flee the scene, but the guards say they believe he has been wounded. The investigating officer will check at hospitals."

He said police were investigating a hijacking case.

Armed robbers go hammer and tongs in daring casino heist that ends in gun battle

Botho Molosankwe and Brendan Roane

JOHANNESBURG: Ten minutes.

That's all it took for 20 heavily armed robbers to cut open the Carnival City Casino cash counter with hammers and grinders – taking the cash inside.

All around them, scared patrons and employees of the casino lay on the floor after being instructed to do so by the robbers.

After cleaning the safe, the men fled the casino only to be confronted by security guards and police officers. A fierce gun battle ensued.

When it was all done, two security guards and a reservist constable had been shot and seriously wounded. Countless cartridges scattered everywhere bore witness to the violence.

None of the robbers was injured.

Spokeswoman for the provincial police Captain Julia Claassen said the heavily armed men gained entry into the casino by using the staff entrance around 12.30am. Using five vehicles – a white BMW, white Toyota Hilux, silver Navara, silver Mercedes Benz and an unidentified vehicle – the men were allegedly armed with AK47s and R5s.

At the gate, some of the robbers allegedly held up the guards while the others went inside the casino.

From there, they used different entrances to get to the casino so as not to arouse suspicion.

"Once inside, they placed themselves strategically. They told the patrons to lie down and not make a noise. They then went to the cash desk where people exchange their money for chips and vice versa and pointed guns at the people manning it.

"The safe has burglar bars around it and the robbers used hammers and grinders to cut it open. The entire incident took about 10 minutes. After taking the money, they shot at police and security guards as they fled. A reservist constable was shot as well as two security guards," Claassen said.

Claassen could not say whether the men were wearing masks but said police were scrutinising CCTV footage for clues.

The white Toyota Hilux was found abandoned on Lourens Street in Delpark Extension nine, Brakpan.

"Police found a hammer and live ammunition inside. Further investigations into the vehicle revealed it had been reported stolen in Douglasdale last year October," Claassen said.

An undisclosed amount of cash was taken. Derek Panaino, Carnival City general manager, said they were still assessing how much was stolen.

"We are co-operating fully with the SAPS who are investigating the circumstances surrounding the robbery. All security surveillance equipment functioned exactly to form and has been made available to investigators. Trauma counselling has been offered to staff, customers and anyone else affected by the incident," he said.

The incident comes just five days after a group of suspected bank and casino robbers were acquitted in Durban. They were accused of carrying out robberies at Sibaya Casino near Umhlanga, Black Rock Casino in Newcastle and the Windmill Casino in Bloemfontein in 2010. The gang faced eight counts of robbery and two of attempted murder.

MIDDELWEERSTANDIGE TUBERKULOSE

Nuwe middel bring genesing

'Ek wens ander se uitkoms is so goed'

Elsabé Brits

KAAPSTAD. – Nadat sy 'n rukkie terug 'n drie hoes gehad het, het 'n X-straal gewys "daar sit 'n bal(?) groot gat in my long". [illegible]

Binne twee dae na die X-straal het dr. Dalene von Delft (30) gehoor sy het middelweerstandige tuberkulose (MDR-TB).

[illegible]

Van Delft en haar man, Arne, ook 'n dokter, [illegible]

[illegible]

Nuwe middel

Bedaquiline is pas in Amerika goedgekeur vir gebruik, al is die laaste toetsfase nog nie afgehandel nie. Die Suid-Afrikaanse Medisynebeheerraad het onderneem om die middel so vinnig moontlik hier te registreer.

"Die lys van die vreeslike newe-effekte is so lank soos my arm," het Anne gesê. [illegible]

> Die lys van die vreeslikste newe-effekte is so lank soos my arm.
> – ANNE VON DELFT

[illegible]

Dr. Dalene von Delft, wat middelweerstandige tuberkulose aangesteek het in 'n staatshospitaal waar sy gewerk het, saam met haar man, dr. Arne von Delft, in hul huis op Somerset-Wes. Foto: YUNUS MOHAMED

[illegible]

Akteur se kar met klippe bestook

André Damons

BLOEMFONTEIN – [illegible]

[illegible]

Jacques Gombault met sy dogter, Vanja, in sy arms, wys waar die klip gelukkig nie getref het nie. By hom is sy vrou, Renata. Foto: [illegible]

SA is 69ste op lys van vryste lande

Jody Nel

JOHANNESBURG. – Nieu-Seeland is die vryste land ter wêreld, terwyl Suid-Afrika slegs die 69ste plek op die vryheidsindeks van 123 lande kon haal.

[illegible]

Fonds dien lesers al meer as 50 jaar

KAAPSTAD. – Die Burger-kersfonds bestaan al 55 jaar en die afgelope vyf dekades lewer die fonds in samewerking met die Wes-Kaapse onderwysdepartement (WKOD) 'n waardevolle diens in ons leesingsgebied.

[illegible]

Erkennings

[illegible]

APPENDIX 1.4

I&AP CORRESPONDENCE

APPLICATION FOR AN EXPLORATION RIGHT TO UNDERTAKE SEISMIC AND SEAFLOOR GEOCHEMICAL SURVEYS IN LICENSE BLOCK 2C, WEST COAST, SOUTH AFRICA

INTERESTED AND AFFECTED PARTY (I&AP) REGISTRATION AND RESPONSE FORM

Would you or your organisation like to become a registered I&AP and continue to receive information on the proposed project?

Yes * **No**

Name: F H RICE (MRS)

Organisation: DOLPHIN ACTION & PROTECTION GROUP

Postal address: P O Box 22227
FISH HOEK 7974

Email address: mwdapg@mweb.co.za

Telephone number: 021 782 5845

Fax number:

Do you or your organisation have any issues or concerns regarding the proposed exploration in Block 2C?

Yes **No** Not yet

If yes, please provide details below:

Please forward to:
CCA ENVIRONMENTAL (PTY) LTD
Attention: Jeremy Blood
Unit 35, Roeland Square, 30 Drury Lane, CAPE TOWN, 8001
PO Box 10145, Caledon Square, 7905
Tel: (021) 461 1118/9 Fax: (021) 461 1120
Email: jeremy@ccaenvironmental.co.za

Comments must reach CCA Environmental no later than 20 February 2013.

Jeremy Blood - CCA Environmental

From:	Mandy Kula <mandy@ccaenvironmental.co.za>
Sent:	04 February 2013 11:08 AM
To:	jeremy@ccaenvironmental.co.za
Subject:	FW: Fw: NOTIFICATION OF APPLICATION FOR OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF WEST COAST
Attachments:	Let I&AP - Notification and registration Rev 0 30 Jan13.pdf; 2C BID Rev 4 30 Jan13 .pdf

From: Joseph Booysen [mailto:joseph.booysen@inl.co.za]
Sent: 04 February 2013 10:43 AM
To: mandy@ccaenvironmental.co.za
Cc: jeremy@ccaenvironmental.co.za
Subject: Fwd: Fw: NOTIFICATION OF APPLICATION FOR OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF WEST COAST

Dear Mandy

I am writing a business article for tomorrow's Cape Argus based on the application notification by Anardarko Petroleum Corporation and would greatly appreciate comment on the issue including:How big is this operation in SA and which companies have already been granted licences to operate, how much revenue and jobs does the industry create in SA and what environmental impact does the operation have on the area? Would it be possible to get back to me by 2:30 pm?

Kind regards

Joseph Booysen
Consumer Reporter
Cape Argus
Tel: 021 488 4791
Cell: 082 483 2584
e-mail: joseph.booysen@inl.co.za

---------- Forwarded message ----------
From: **Ryan Cresswell** <ryan.cresswell@inl.co.za>
Date: 31 January 2013 22:50
Subject: Fwd: Fw: NOTIFICATION OF APPLICATION FOR OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF WEST COAST
To: Joseph Booysen <joseph.booysen@inl.co.za>

Good one for Tues

---------- Forwarded message ----------
From: **Joseph Booysen** <joseph.booysen@inl.co.za>
Date: 1 February 2013 08:47
Subject: Fwd: Fw: NOTIFICATION OF APPLICATION FOR OIL AND GAS EXPLORATION ACTIVITIES IN BLOCK 2C, OFF WEST COAST
To: Ryan Cresswell <ryan.cresswell@inl.co.za>

APPENDIX 1.5

ISSUES AND RESPONSES TRAIL

ISSUES AND RESPONSE TRAIL

Method of receipt: [letter icon] = Letter/Fax/Response Form [e-mail icon] = E-mail

NO.	ISSUE	NAME (AND ORGANISATION)	METHOD AND DATE RECEIVED	COMMENT	RESPONSE
1.	Public participation process				
1.1	Request for additional information	Mr J. Booysen (Cape Argus)	[e-mail icon] 4 Feb 13	I am writing a business article for tomorrow's Cape Argus based on the application notification by Anadarko Petroleum Corporation and would greatly appreciate comment on the issue including: How big is this operation in SA and which companies have already been granted licences to operate, how much revenue and jobs does the industry create in SA and what environmental impact does the operation have on the area? Would it be possible to get back to me by 2:30 pm	Mr Booysen was referred to the information available in the Background Information Document and was requested to contact Anadarko directly for information pertaining to their organisation.
1.2	I&AP registration	Mrs FH Rice	[letter icon] 1 Feb 13	Requested to be registered on the project database and continue to receive information on the proposed project.	Mrs Rice is registered on the project database (see Appendix 1.1).

APPENDIX 1.6

I&AP NOTIFICATION OF EMP COMMENT PERIOD

cca
ENVIRONMENTAL

AN04/Let–1Mar13

1 March 2013

Dear Sir / Madam

ANADARKO SOUTH AFRICA (PTY) LTD - PROPOSED OIL AND GAS EXPLORATION PROGRAMME IN BLOCK 2C, OFF THE WEST COAST OF SOUTH AFRICA: AVAILABILITY OF ENVIRONMENTAL MANAGEMENT PROGRAMME FOR REVIEW AND COMMENT

Our previous correspondence of 30 January 2013 has reference. This letter provides information on the availability for comment of the Environmental Management Programme (EMP) prepared for the above-mentioned proposed project.

Notice is hereby given in terms of the Minerals and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA) that the EMP is available for a 30-day public review and comment period from **Friday 1 March 2013 to Wednesday 3 April 2013** (which make provision for the public holidays on 21 & 29 March 2013 and 1 April 2013). The EMP is available on the CCA Environmental website (www.ccaenvironmental.co.za). A copy of the Executive Summary of the EMP is enclosed for your reference.

If you or your organisation would like to submit comments on the EMP you should do so by **no later than Wednesday 3 April 2013** using the contact details provided below. A Response and Comment Form has been enclosed to facilitate this process. All comments received will be incorporated, and responded to, into an Issues and Responses Trail, which will be appended to the final report.

Should you have any queries on the above, or require any further information, please do not hesitate to contact us.

Yours sincerely

Jeremy Blood Pr.Sci.Nat., CEAPSA
CCA ENVIRONMENTAL (PTY) LTD

Encl.

ANA04SS/Corr/I&APs/let – EMP comment period Rev 0 (1 Mar 13)

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Deputy DG: Energy Planning & Hydrocarbons
Department of Energy
Private Bag X19
ARCADIA
0007

Mrs W Oppel
Department of Env. Affairs & Nature Conservation
Private Bag X16
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Mr R Cullen
Programme Manager
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Mr PP Rabe
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A Pouraulis
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Saint Helena Bay Fishing Industries
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Mr P Carstens
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Chairman
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Mr S McGeoch
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Ms F Shaik
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H Steyn
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From: Jeremy Blood - CCA Environmental [mailto:jeremy@ccaenvironmental.co.za]
Sent: 01 March 2013 08:19 AM
To: 'Mandy Kula'; 'admin@sadsaa.com'; 'admin@tunahake.co.za'; 'admin@tunahake.co.za'; 'adriana.garcia@bhpbilliton.com'; 'ajboyd@environment.gov.za'; 'alastair.milne@shell.com'; 'alex.miya@transnet.net'; 'alex@thombopetroleum.com'; 'alison.futter@petrosa.co.za'; 'andrew@kaytrad.co.za'; 'apulfrich@pisces.co.za'; 'aqfishing@mweb.co.za'; 'Bakkies52@gmail.com'; 'boating@telkomsa.net'; 'bronwyn@gmail.com'; 'carl.vanderlingen@gmail.com'; 'cattwood@mweb.co.za'; 'ccwu@mofa.gov.tw'; 'chris@africantuna.com'; 'ckotze@jmss.co.za'; 'clyde@molimoman.co.za'; 'craig@hdpbrokers.co.za'; 'cthomas@emgs.com'; 'dan@new.co.za'; 'dcolly@samsa.org.za'; 'deepsea@iafrica.com'; 'destadler@lando.co.za'; 'don@comfish.co.za'; 'edwardb@npa.co.za'; 'fani@sapia.co.za'; 'favanzyl@hotmail.com'; 'ftea@telkomsa.net'; 'gclemitson@gmail.com'; 'hans@bigcatch.co.za'; 'hydrosan@iafrica.com'; 'ian.mclach@gmail.com'; 'iorpty@iafrica.com'; 'jappy@iafrica.com'; 'jessica.courtoreille@petrosa.co.za'; 'jllanghus@forestoil.co.za'; 'jmutyorauta@ncpg.gov.za'; 'JohannAU@daff.gov.za'; 'john.hall@spectrumasa.com'; 'johnp@ij.co.za'; 'judianbruk@telkomsa.net'; 'julius.koen@gmail.com'; 'kobusm@seaharvest.co.za'; 'l.oberholzer@bowman.co.za'; 'ladymfishing@telkomsa.net'; 'landuse@capenature.co.za'; 'larry.ward@bhpbilliton.com'; 'lesley.roos@debeersgroup.com'; 'lhutchin@deat.gov.za'; 'major.smith@bhpbilliton.com'; 'marek.ranoszek@anadarko.com'; 'mario@lusitaniafishing.co.za'; 'marta.henriques@sasol.com'; 'martsternlaw@mweb.co.za'; 'mcopeland@ob.co.za'; 'mfishing@mweb.co.za'; 'mgalimberti@sahra.org.za'; 'michaeld@premfish.co.za'; 'millss@petroleumagencysa.com'; 'Mmeyer@environment.gov.za'; 'mpotgieter@ob.co.za'; 'msands@bluecon.co.za'; 'mushwanas@petroleumagencysa.com'; 'muzi.mkhize@energy.gov.za'; 'mvdh@pioneerfishing.co.za'; 'mwdapg@mweb.co.za'; 'nassarg@ij.co.za'; 'neil.fraser@aurumar.co.za'; 'ngesip@petroleumagencysa.com'; 'nigel.rossouw@shell.com'; 'nils.warner@worldshipping.co.za'; 'nivalda@yant.co.za'; 'nusum@new.co.za'; 'pandanet@global.co.za'; 'patrick@wessa.co.za'; 'pbest@iziko.org.za'; 'peter.dekker@sasol.com'; 'peter@vikingfishing.co.za'; 'ppkuttel@iafrica.com'; 'priscauys@yahoo.com'; 'procher@bluecon.co.za'; 'randallct@cs.com'; 'rball@iafrica.com'; 'robyn.hollick@msgroup.net'; 'romar@environment.gov.za'; 'russellh@seaharvest.co.za'; 'rventura@bluecon.co.za'; 's.obrien@smit.com'; 'safish@new.co.za'; 'sata@mweb.co.za'; 'sbyc@imaginet.co.za'; 'shaunb@premfish.co.za'; 'simon.elwen@gmail.com'; 'solomon@sungusungugroup.com'; 'southafrica@gacworld.com'; 'spetersen@wwf.org.za'; 'taiyoct@mweb.co.za'; 'thovhakalea@petroleumagencysa.com'; 'tim@selectafish.co.za'; 'tpstraut@marpro.co.za'; 'trachandler@telkomsa.net'; 'trevor@thombopetroleum.com'; 'varsha.singh@petrosa.co.za'; 'vincentm@transhex.co.za'; 'vincentm@transhex.co.za'; 'visko@mweb.co.za'; 'WadeT@daff.gov.za'; 'wblyth@offshoreafrica.co.za'; 'WillemB@daff.gov.za'; 'joseph.booysen@inl.co.za'
Cc: 'Jonathan Crowther - CCA Environmental'; 'gary.sparks@anadarko.com'; 'terry.bentley@anadarko.com'; Ranoszek, Marek (Marek.Ranoszek@anadarko.com); 'Grant, Jim'; sarah@capfish.co.za; apulfrich@pisces.co.za
Subject: PROPOSED OIL AND GAS EXPLORATION PROGRAMME IN BLOCK 2C, OFF THE WEST COAST OF SOUTH AFRICA: AVAILABILITY OF ENVIRONMENTAL MANAGEMENT PROGRAMME FOR REVIEW AND COMMENT

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Should you have any queries on the above, or require any further information, please do not hesitate to contact us.

Yours sincerely

Jeremy Blood Pr.Sci.Nat., CEAPSA
Associate

CCA ENVIRONMENTAL (Pty) Ltd • Consulting Services
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Tel + 27 (21) 461 1118/9 • Fax + 27 (21) 461 1120 • jeremy@ccaenvironmental.co.za • website: www.ccaenvironmental.co.za
Directors: J Crowther F Fredericks • Associate: J Blood • Reg No 2003/019026/07

APPENDIX 2

SPECIALIST STUDIES

Appendix 2.1:	Convention for assigning significance ratings to impacts
Appendix 2.2:	Fishing Industry Assessment
Appendix 2.3:	Marine Faunal Assessment

APPENDIX 2.1

CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

Specialists must consider seven rating scales when assessing potential impacts. These include:

1 Extent;
2 Duration;
3 Intensity;
4 Significance;
5 Status of impact;
6 Probability; and
7 Degree of confidence.

In assigning significance ratings to potential impacts before and after mitigation specialists are instructed to follow the approach presented below:

- The core criteria for determining significance ratings are "extent" (Section 1), "duration" (Section 2) and "intensity" (Section 3). The preliminary significance ratings for combinations of these three criteria are given in Section 4.

- The status of an impact is used to describe whether the impact would have a negative, positive or zero effect of the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

- Describe the impact in terms of the probability of the impact occurring (Section 5) and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge (Section 6).

- Additional criteria to be considered, which could "increase" the significance rating if deemed justified by the specialist, with motivation, are the following:
  - Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
  - Potentially substantial cumulative effects; and
  - High level of risk or uncertainty, with potentially substantial negative consequences.

- Additional criteria to be considered, which could "decrease" the significance rating if deemed justified by the specialist, with motivation, are the following:
  - Improbable impact, where confidence level in prediction is high.

- When assigning significance ratings to impacts *after mitigation*, the specialist needs to:
  - First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and
  - Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:
    - Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;
    - The technical and financial ability of the proponent to implement the measure; and
    - The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.

The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be "low" or "very low", the importance of these impacts to local communities or individuals might be extremely high. The importance which Interested and Affected Parties (I&APs) attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance rating	Effect on decision-making
Very Low; Low	Would not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
Medium	Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
High; Very High	Would strongly influence the decision to proceed with the proposed project.

1. EXTENT

"Extent" defines the physical extent or spatial scale of the impact.

Rating	Description
LOCAL	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.
REGIONAL	West Coast. Specialist studies to specify extent.
NATIONAL	South Africa
INTERNATIONAL	

2. DURATION

"Duration" gives an indication of how long the impact would occur.

Rating	Description
SHORT TERM	0 - 5 years
MEDIUM TERM	6 - 15 years
LONG TERM	Where the impact would cease after the operational life of the activity, either because of natural process or human intervention.
PERMANENT	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient.

3. INTENSITY

"Intensity" establishes whether the impact would be destructive or benign.

Rating	Description
ZERO TO VERY LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes are not affected.
LOW	Where the impact affects the environment in such a way that natural, cultural and social functions and processes continue, albeit in a slightly modified way.
MEDIUM	Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

4. SIGNIFICANCE

"Significance" attempts to evaluate the importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	Description
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***long term***[1]; OR of ***high intensity*** at a ***national level*** in the ***medium term***; OR of ***medium intensity*** at a ***national level*** in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term***; OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.***
INSIGNIFICANT	Impacts with: ***Zero to very low intensity*** with any combination of extent and duration.
UNKNOWN	In certain cases it may not be possible to determine the significance of an impact.

5. STATUS OF IMPACT

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

[1] For any impact that is considered to be "Permanent" apply the "Long-Term" rating.

6. PROBABILITY

"Probability" describes the likelihood of the impact occurring.

Rating	Description
IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience.
PROBABLE	Where there is a distinct possibility that the impact would occur.
HIGHLY PROBABLE	Where it is most likely that the impact would occur.
DEFINITE	Where the impact would occur regardless of any prevention measures.

7. DEGREE OF CONFIDENCE

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	Description
HIGH	Greater than 70% sure of impact prediction.
MEDIUM	Between 35% and 70% sure of impact prediction.
LOW	Less than 35% sure of impact prediction.

APPENDIX 2.2

FISHING INDUSTRY ASSESSMENT

PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN LICENCE BLOCK 2C SITUATED OFF THE WEST COAST OF SOUTH AFRICA

Specialist Assessment of the Impact on Fisheries

Compiled for:
CCA Environmental (Pty) Ltd

On behalf of:

Anadarko
Petroleum Corporation

by

S. Wilkinson & D.W. Japp
Capricorn Fisheries Monitoring cc
Cape Town

February 2013

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EXECUTIVE SUMMARY

Anadarko South Africa (Pty) Ltd ("Anadarko") is proposing to explore for oil and gas reserves in Block 2C off the West Coast of South Africa. Anadarko's proposed initial three-year exploration work programme may include undertaking seismic and seafloor geochemical surveys consisting of multi-beam bathymetry, seafloor sampling and seabed heatflow measurements. This report gives a description of the fisheries active off the West Coast, the distribution of fishing effort conducted in the vicinity of the proposed exploration area and an assessment of the likely impact of the proposed exploration activities on the fishing industry in terms of disruption to fishing activity and loss of access to fishing grounds. Furthermore, mitigation measures are proposed with a view to reducing potential negative effects between seismic and fishing operations.

The impact of the proposed exploration programme is considered to be of local extent and short-term duration. The status of the impact on all fishery sectors is assessed to be negative. The intensity of the impact on the tuna pole sector is assessed to be of MEDIUM intensity and of VERY LOW significance. The intensity of the impact on the demersal trawl, demersal long-line and large pelagic long-line fisheries is assessed to be of LOW intensity and of VERY LOW significance. There is no impact expected on the commercial and recreational line, small pelagic purse-seine and West Coast rock lobster fisheries. It is highly probable that the impact would occur on the demersal trawl, demersal long-line and pelagic long-line sectors and it is probable that the impact would occur on the tuna pole sector. The likelihood of the impact occurring on the commercial and recreational linefish, small pelagic purse-seine and West Coast rock lobster sectors is improbable. The degree of confidence in the impact predictions for the demersal trawl, demersal long-line, pelagic long-line, small pelagic purse-seine and West Coast rock lobster sectors is high, while that of the tuna pole and commercial and recreational linefish sectors is medium.

It is recommended that during the seismic survey the survey vessel is accompanied by a "chase vessel" with staff familiar with the fisheries expected in the survey area. Note that during the bathymetry multi-beam survey and seabed sampling phases, a chase vessel is not necessary. It is also recommended that an experienced on-board Independent Observer or Fisheries Liaison Officer (FLO) be present on board the survey vessels for the duration of each exploration activity in order to assist in the identification of fishing vessels and gear types, as well as communications with vessels when necessary. The FLO should be familiar with the various fisheries active in the area. In the case of the seismic and multi-beam surveys the FLO should also be able to act as the Marine Mammal Observer (MMO) and thus must also be familiar with environmental monitoring protocols relating specifically to marine mammals, birds and other fauna.

Communications should be established with the industrial fishing associations, vessel agents and vessel operators prior to the commencement of the exploration activities. Communications should be ongoing

throughout the duration of each exploration activity with the submission of daily reports indicating the vessel's location to interested and affected parties (I&APs).

Industrial bodies and I&APs should include: the Department of Agriculture, Forestry and Fisheries (DAFF), the Department of Environmental Affairs (DEA), the South African Tuna Association, the South African Tuna Long-Line Association, Fresh Tuna Exporters Association, the South African Deep-Sea Trawling Industry Association, the South African Hake Long-Line Association, the South African Pelagic Fishing Industry Association, the West Coast Rock Lobster Association, De Beer's Marine and Transnet National Ports Authority.

1. INTRODUCTION

This specialist study was commissioned by CCA Environmental (Pty) Ltd as part of the Environmental Management Programme (EMP) for the proposal by Anadarko South Africa (Pty) Ltd to undertake an exploration programme in offshore licence block 2C, located off the West Coast of South Africa between 30°S and 31°S. The licence block covers an area of approximately 6 223.74 km^2 and extends from roughly the 300 m contour to beyond the continental shelf with depths up to 1 500 m (see Figure 1).

Anadarko is proposing to explore for oil and gas using methodologies, which may include: (1) 3D/2D seismic surveys; and (2) seafloor geochemical surveying consisting of multi-beam bathymetry, seafloor sampling and heatflow measurements.

This report provides an assessment of the potential impacts of the proposed exploration programme on the fishing industry in terms of the likely disruption to fishing operations and loss of access to fishing grounds due to the safe operational limit that would be requested during the seismic survey. The commercial fishing sectors that operate in the vicinity of the proposed Exploration Right area are discussed and an impact assessment is made for each of these fisheries.

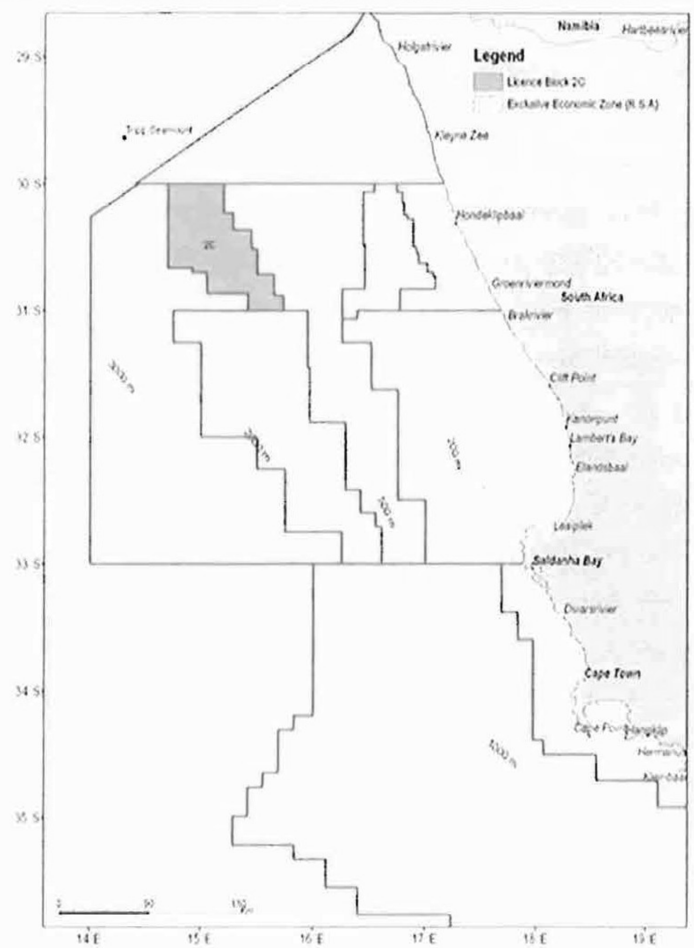

Figure 1 Location of the 2D and 3D seismic survey operations proposed to be undertaken by Anadarko (Pty) Ltd in Licence Block 2C.

South African fisheries data for the period 2000 to 2010 were sourced from the Department of Agriculture, Forestry and Fisheries (DAFF). Information on species distribution was taken from the Benguela Current Large Marine Ecosystem (BCLME) State of the Stocks Report 2007.

1.1 Seismic Surveys

During seismic surveys high-level, low frequency sounds are directed towards the seabed from near-surface sound sources towed by a vessel. Signals reflected from geological discontinuities below the sea floor are recorded by towed hydrophones. Analyses of the returned signals allow for interpretation of subsea geological formations. A 2D survey typically involves a towed airgun array and a single streamer, whereas 3D surveys use multiple streamers. A single array can be up to 10 000 m long. The airguns are commonly towed some 100 m behind the vessel at a depth of 5 to 10 m below the surface. A surface tail-buoy with radar reflectors is connected to the end of the streamer. A typical 3D seismic survey configuration is illustrated in Figure 2.

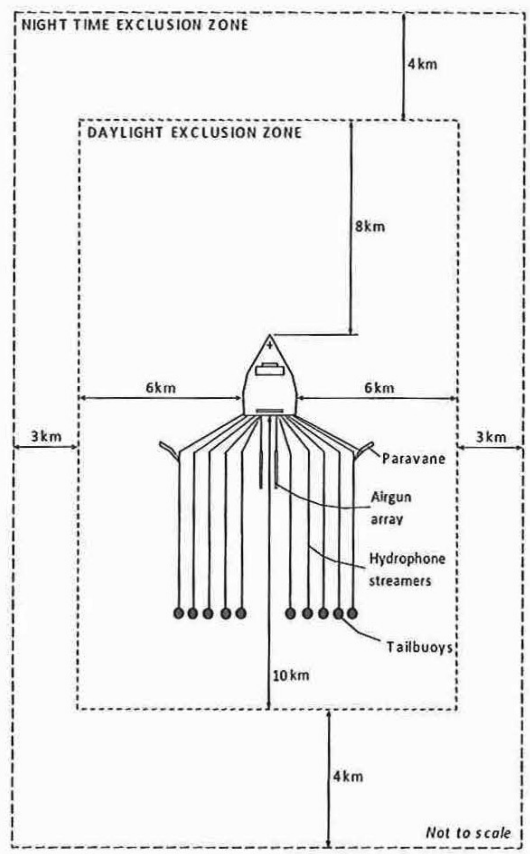

Figure 2. Typical configuration for a 3D seismic survey operation. Safe operational limits applicable to both 2D and 3D surveys are also shown.

A seismic vessel would travel along transects of a prescribed grid within the Block 2C licensed area, which is selected to cross any known or suspected geological structures in the area. Consequently the survey vessel would be restricted in maneuverability and would require a turning circle area which would increase the impact area beyond the survey acquisition area. A supply/chase vessel would assist in the operation of keeping other vessels at a safe distance from the survey vessel and towed gear. During surveying vessels would travel at a speed of 4 to 6 knots.

Anadarko is currently evaluating the existing 2D and 3D seismic data which cover portions of Block 2C. This evaluation and other factors will determine whether additional 2D seismic data are required prior to acquiring 3D seismic data or, if additional 2D seismic data is unnecessary, only additional 3D seismic data is necessary to evaluate the exploration potential of the block.

If additional 2D seismic data are required, it is anticipated that the proposed survey would comprise a number of low density spaced survey lines covering the majority of Block 2C. Although survey commencement would ultimately depend on a permit award date, availability of seismic contractors and other factors, it is anticipated that the 2D survey would be undertaken during the summer of 2013/2014 and would take in the order of one to two months to complete.

If additional 3D seismic data are required, it is anticipated that the proposed 3D seismic survey would cover a minimum area of 750 km2 and the maximum area could cover the entire block. As with the 2D survey, commencement would depend on the permit award data, availability of seismic contractors and other factors. It is anticipated that if a 3D seismic survey is deemed necessary it would be undertaken in the summer of 2013/2014 and would take on the order of two to three months to complete.

1.2 Seafloor geochemical surveying

Multi-beam bathymetry survey

The operator proposes to undertake a multi-beam bathymetry survey to produce a digital terrain model of the seafloor. The survey vessel would be equipped with a multi-beam echo sounder to obtain swath bathymetry and a sub-bottom profiler to image the seabed and the near surface geology. The multi-beam system provides depth sounding information on either side of the vessel's track across a swath width of approximately two times the water depth. Although this type of survey typically does not require the vessel to tow any cables, it is "restricted in its ability to manoeuvre" due to the operational nature of this work.

The multi-beam bathymetry survey, if deemed necessary, would likely be undertaken over the majority of Block 2C area. It is anticipated that data acquisition would take in the order of three to four weeks to complete at a vessel speed of 5 to 8 knots.

Seafloor sampling programme

The seafloor sampling programme would consist of collecting seafloor sediment (piston coring) samples for laboratory geochemical analyses in order to determine if there are any naturally occurring hydrocarbons present. The programme would likely utilise a core barrel capable of retrieving sediment samples that are up to 6 m in length and 6.7 cm in diameter. The recovered cores are visually examined at the surface for indications of hydrocarbons (gas hydrate, gas parting or oil staining) and sub-samples retained for further geochemical analysis in an onshore laboratory. The remaining sediment would be returned to the seafloor.

It is anticipated that up to 200 piston core samples would be collected across Block 2C. Each individual piston core would have a potential disturbance volume of 0.02 m^3, resulting in a total disturbance volume of approximately 4 m^3. The exact volume of an individual core is dependent on the recovery which is rarely 100%, i.e. the potential disturbance of an individual core would likely be <0.02 m^3. The exact number and location of core samples would be identified following the analysis of the 3D seismic and / or the multi-beam bathymetric survey results. It is anticipated that the seafloor sampling programme would take in the order of three to five weeks to complete.

Seafloor heatflow measurements

The heatflow measurements would be conducted using heatflow probes. The heatflow probe is normally 3 m in length and has 16 sensors. The measurement device or probe would be dropped from a vessel into the seafloor. The probe is allowed to equilibrate and then recovered to the surface after about 20 minutes. No material is removed from the sea bed, and the entire probe is retrieved at the end of the measurement.

It is anticipated that up to 50 separate heatflow measurements would be collected across Block 2C, which would take in the order of three to five weeks to complete, if undertaken together with the piston coring programme.

1.3 Exclusion zones

Under the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972, Part B, Rule 18), a survey vessels that is engaged in surveying or towing operations are defined as a "vessel restricted in its ability to manoeuvre" and requires that vessels engaged in fishing, so far as possible, keep out of the way of a vessel restricted in her ability to manoeuvre. It should also be noted that under the Marine Traffic Act (No. 2 of 1981), a survey vessel (and its array of airguns and hydrophones) used for the purpose of exploiting the seabed falls under the definition of an "offshore installation" and as such it is protected by a safety zone of 500 m. It is an offence for an unauthorised vessel to enter the safety zone. In addition to a statutory 500 m safety zone, a seismic contractor would request a safe operational limit (that is greater than the 500 m safety zone) that it would like other vessels to stay beyond. Typical safe operational limits for 2D and 3D surveys are illustrated in Figure 2. During seismic surveys, one or more "chase" boats are usually commissioned to patrol the area during the seismic survey to ensure that other vessels adhere to these safe operational limits.

2. SOUTH AFRICAN COMMERCIAL FISHERIES

South Africa's commercial fisheries are managed and monitored by DAFF (previously managed under the Department of Environmental Affairs and Tourism: Directorate: Marine and Coastal Management). Approximately 14 different commercial fisheries sectors currently operate within South African offshore regions (see Table 1). In addition to commercial sectors, recreational fishing is active along the coastline comprising shore angling and small, open craft boats generally less than 10 m in length.

The primary fisheries in terms of highest economic value and greatest landed tonnage are the demersal (bottom) trawl and long-line fisheries targeting the Cape hakes (*Merluccius paradoxus* and *M. capensis*) and the pelagic-directed purse-seine fishery targeting pilchard (*Sardinops sagax)*, anchovy (*Engraulis encrasicolus*) and red-eye round herring (*Etrumeus whitheadii*). Secondary species in these fisheries includes a large assemblage of demersal fish of which monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*) are the most commercially important.

Other fisheries include a mid-water trawl fishery targeting horse mackerel (*Trachurus trachurus capensis*) predominantly on the South Coast, a hand-jig fishery targeting chokka squid (*Loligo vulgaris reynaudii*) also based on the South Coast.

The pelagic long-line and pole fisheries target migratory stocks of tuna including albacore (*Thunnus alalunga*), bigeye tuna (*T. obesus*) and yellowfin tuna (*T. albacares*), as well as swordfish (*Xiphias gladius*) included in the catch taken by the long-line sector.

Traditional line fishery refers to a long-standing fishery based on a large assemblage of primarily 35 different species. The fishery extends both into warm-temperate and cool-temperate biogeographical regions; but operates relatively close to shore. Within the Western Cape the predominant catch species is snoek (*Thyrsites atun*), whereas towards the East Coast catch species increase in number and include resident reef fish (Sparidae and Serranidae), pelagic migrants (Carangidae and Scombridae) and demersal migrants (Sciaenidae and Sparidae).

Crustacean fisheries comprise a trap fishery targeting West Cost rock lobster (*Jasus Lalandii*), a line trap fishery targeting the South Coast rock lobster (*Palinurus gilchristi*) and a trawl fishery based solely on the East Coast targeting penaeid prawns, langoustines (*Metanephrops andamanicus* and *Nephropsis stewarti*), deep-water rock lobster (*Palinurus delagoae*) and red crab (*Chaceon macphersoni*).

Table 1. Summary of South African offshore commercial fishing sectors.

Sector	Gear Type	Areas of Operation	No. of Active Vessels (2011)	Landed Catch or TAC (2010)
Small pelagics	Purse-seine	West Coast, South Coast	101	422,927 t
Hake deep-sea trawl	Demersal trawl	West Coast, South Coast	45	150,030 t
Hake/ sole inshore trawl	Demersal trawl	South Coast	31	10,429 t

Sector	Gear Type	Areas of Operation	No. of Active Vessels (2011)	Landed Catch or TAC (2010)
Mid-water trawl	Mid-water trawl	South Coast	6	35,215 t (TAC)
Hake long-line	Demersal-set long-line	West Coast, South Coast	64	~8,000 t (TAC)
Hake hand-line	Hook and line	West Coast, South Coast	100	Currently not operational
Pelagic long-line	Drifting pelagic long-line	West Coast, South Coast, East Coast	31	1,759 t
Tuna pole	Pole and line	West Coast, South Coast	128	~6,000 t
Demersal shark long-line	Demersal-set long-line	South Coast	6	834 t
Traditional line fish	Hand line or rod-and-reel	West Coast, South Coast, East Coast	450	13,688 t
West coast rock lobster	Hoop-net Demersal-set trap	West Coast	105	3,368 t
South coast rock lobster	Demersal-set line with trap	South Coast	12	734 t
Kwazulu-Natal crustacean trawl	Demersal trawl	East Coast	5	117 t
Squid jig	Hand-jigs	South Coast	138	10,777 t

Only fisheries active in the vicinity of the proposed survey area will be addressed further in the current report, *viz;* the demersal offshore trawl, demersal long-line, pelagic long-line, tuna pole, traditional line fish, small pelagic purse-seine and West Coast rock lobster sectors. Each of these fishing sectors deploy one of four principal gear types namely trawl gear, purse-seine gear, longline gear (demersal or pelagic) and hoop net traps.

3. DEMERSAL TRAWL

The hake-directed trawl fishery is the most valuable sector of the South African fishing industry and is split into two sub-sectors: the offshore ("deep-sea") sector which is active off both the South and West Coasts, and the much smaller inshore trawl sector which is only active off the South Coast. A fleet of 45 trawlers operate within the offshore sector targeting the Cape hakes (*Merluccius capensis* and *M. paradoxus*). Main by-catch species include monkfish (*Lophius vomerinus*), kingklip (*Genypterus capensis*) and snoek (*Thyrsites atun*). The current annual hake Total Allowable Catch (TAC) of the offshore fishery is currently approximately 150 000 tons.

The offshore fleet is segregated into wetfish and freezer vessels which differ in terms of the capacity for the processing of fish at sea and in terms of vessel size and capacity. While freezer vessels may work in an area for up to a month at a time, wetfish vessels may only remain in an area for about a week before returning to port. Wetfish vessels range between 24 m and 56 m in length while freezer vessels are usually larger, ranging up to 90 m in length with a displacement of 2 000 metric tons and engine power of up to 2 000 kilowatts. Winch bollard pulls vary from 16 tons to 40 tons.

Trawl gear is deployed astern of the vessel, the gear configurations are similar for both freezer and wet fish vessels, the main elements of which are trawl warps, bridles and doors, a footrope, headrope, net and codend (see Figure 3). Generally, trawlers tow their gear at 3.5 knots for up to four hours per drag. When towing gear, the distance of the trawl net from the vessel is usually between two and three times the depth of the water. The horizontal net opening may be up to 50 m in width and 10 m in height and the swept area on the seabed between the doors may be up to 150 m.

A typical configuration of demersal trawling gear consists of the following components :

- Steel warps up to 32 mm diameter - in pairs up to 3 km long when towed;
- A pair of trawl doors (500 kg to 3 tons each);
- Net footropes which may have heavy steel bobbins attached (up to 24" diameter; maximum 200 kg) as well as large rubber rollers ("rock-hoppers"); and
- Net mesh (diamond or square shape) is normally wide at the net opening whereas the bottom end of the net (or cod-end) has a mesh size minimum limit of 110 mm

Trawl times differ between operators and fish availability, ranging from 60 minutes to four hours. Vessels tow at speeds of between three and four knots and typically make two to three trawls during the day. Monk is often caught in this area on the West Coast at night with slightly heavier trawl gear. During these trawls the vessel slows down to two to three knots and the duration of the trawl can be up to eight hours.

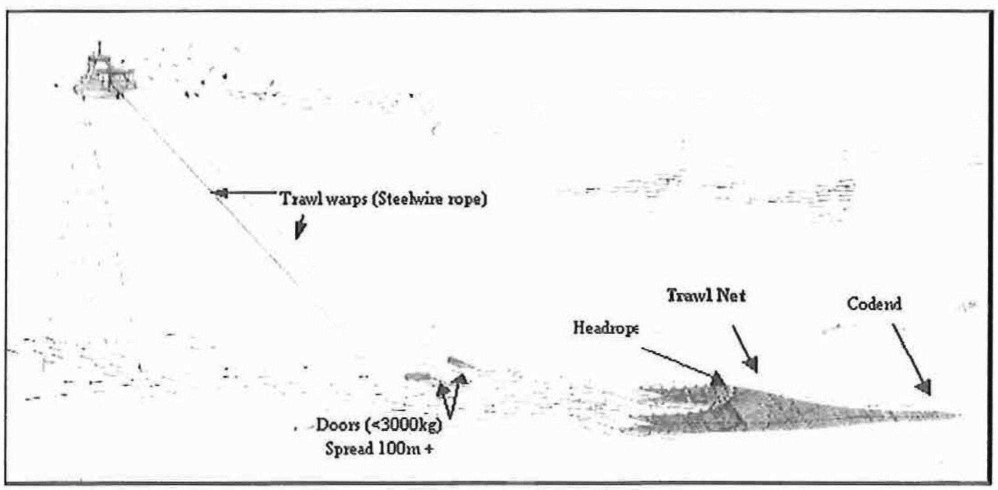

Figure 3. Typical gear configuration used by demersal trawlers (offshore) targeting hake

Figure 4 shows the distribution of trawl fishing grounds in relation to Block 2C. Trawls are usually conducted along specific trawling lanes on "trawl friendly" substrate (flat, soft ground). Within South African waters, these grounds extend in a continuous band on the West Coast along the shelf edge between the 300 m and 1 000 m bathymetric contours[1]. Trawl nets are generally towed along depth contours (thereby maintaining a relatively constant depth) running parallel to the depth contours in a north-westerly or south-easterly direction. Trawlers also target fish aggregations around bathymetric features, in particular seamounts and canyons (i.e. Cape Columbine, Cape Canyon and Child's Bank), where there is an increase in seafloor slope and in these cases the direction of trawls follow the depth contours. Trawlers are prohibited from operating within five nautical miles of the coastline.

During the period 2005 to 2010 an average of 650 trawls per year took place within the Licence Block 2C, which is approximately 1 % of the total effort. During the period 2004 to 2010 the average annual catch in Block 2C was 2 350 tons, is approximately 1.6 % of the total catch. The impact of the proposed exploration activities on the offshore demersal trawl sector is therefore considered to be of LOW intensity. The impact of the survey is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high. The demersal trawl fishery is active year-round and it is highly probable that trawl activity would be affected by survey operations within a depth range of 300 m to 1000 m.

Environmental Impact Assessment of Fisheries: Demersal Trawl		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High

[1] Trawling to these depths is a recent development (since 2002) due to declining availability of hake in shallower water.

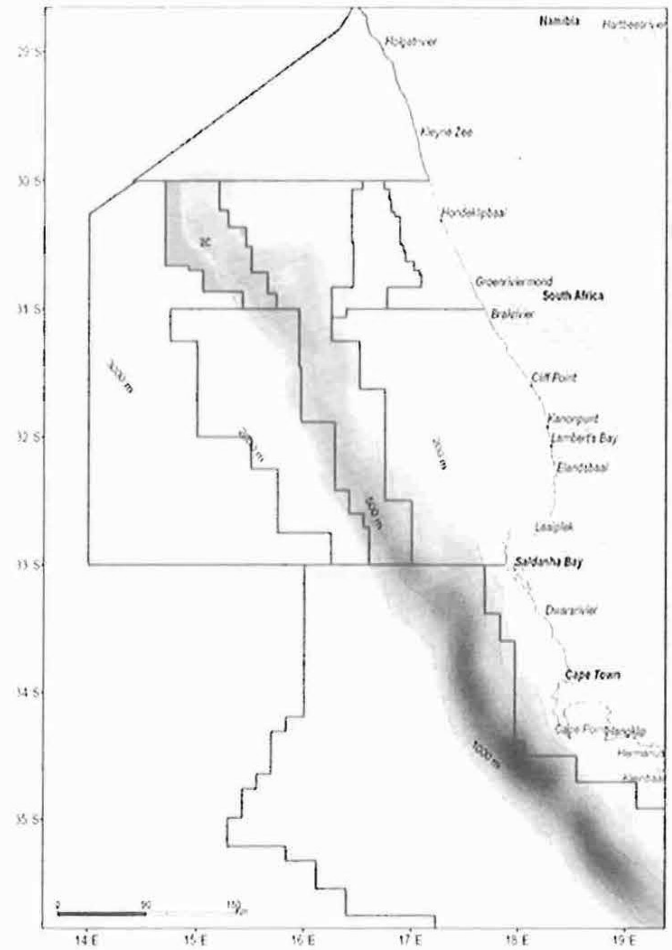

Figure 4. Effort expended by the demersal trawl fishing sector targeting hake in the vicinity of the survey area proposed by Anadarko

4. DEMERSAL LONG-LINE

Similar to the demersal trawl fishery the target species of the long-line fishery are the Cape hakes, with a small non-targeted commercial by-catch that includes kingklip. The catch is landed predominantly prime quality hake for export to Europe and is packed unfrozen on ice therefore the value is approximately 50% higher than that of trawled hake. Operations are *ad hoc* and intermittent, subject to market demand. Currently 64 vessels are operational within the South African fishery, most of which are based at the harbours of Cape Town and Hout Bay and approximately 8 000 tons of hake are landed annually (2011).

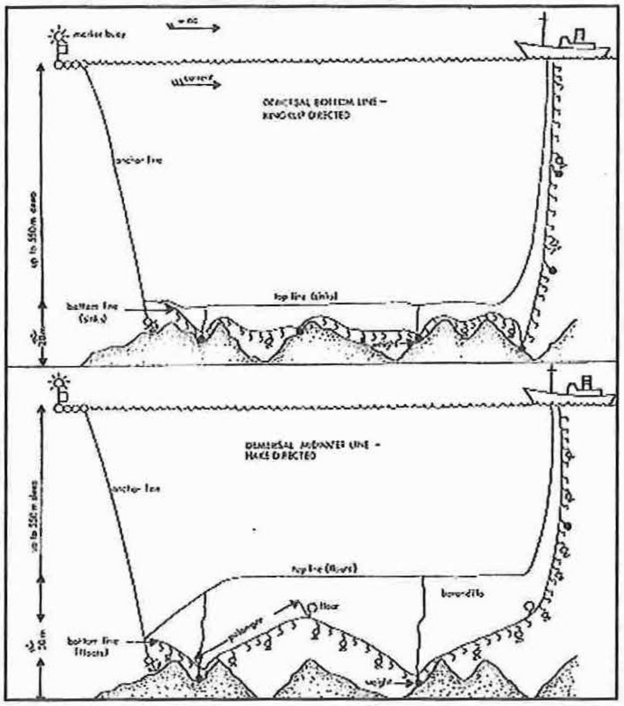

Figure 5 Typical configuration of demersal (bottom-set) hake long-line gear used in South African waters.

A demersal long-line vessel may deploy either a double or single line which is weighted along it's length to keep it close to the seafloor (see Figure 5). Steel anchors, of 40 to 60 kg are placed at the ends of each line to anchor it, and are marked with an array of seven or eight floats. This GPS position is recorded by the vessel on setting and no radar reflectors are used to mark the gear position. Floats may be marked with the call sign/registration number of the vessel. If a double line system is used, top and bottom lines are connected by means of dropper lines. Since the top-line (polyethylene, 10 – 16 mm diameter) is more buoyant than the bottom line, it is raised off the seafloor and minimizes the risk of snagging or fouling. The purpose of the top-line is to aid in gear retrieval if the bottom line breaks at any point along the length of the line. Lines are typically between 10 km and 20 km in length, carrying between 6 900 and 15 600 hooks each. Baited hooks are attached to the bottom line at regular intervals (1 to 1.5 m) by means of a snood. Gear is usually set at night at a speed of between five and nine knots. Once deployed the line is left to soak for up to eight hours before it is retrieved. A line hauler is used to retrieve gear (at a speed of approximately one knot) and can take six to ten hours to complete. Long-line vessels vary in length from 18 m to 50 m and remain at sea for four to seven days at a time.

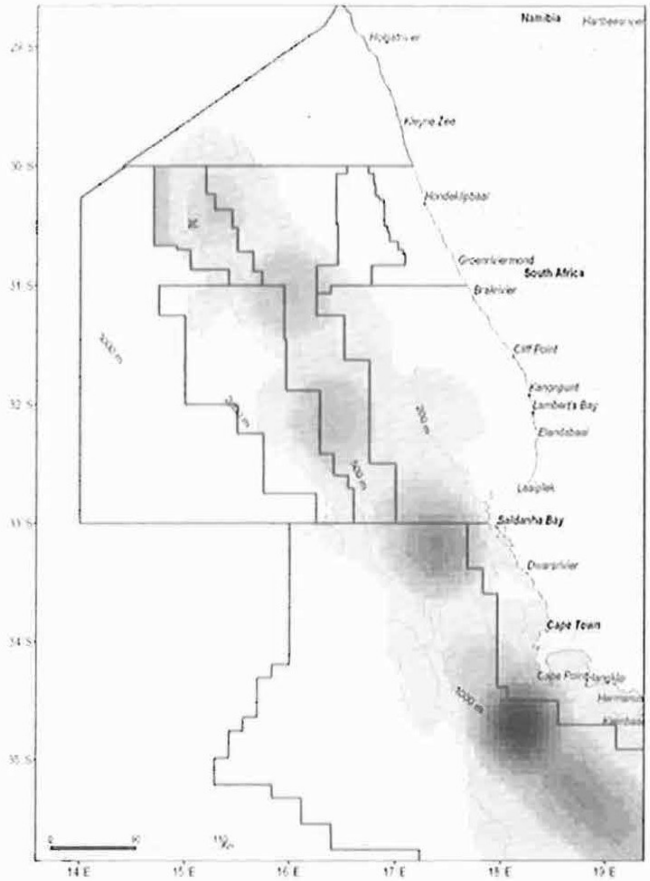

Figure 6. Effort expended by the demersal long-line fishing sector targeting hake in relation to the area of the survey proposed by Anadarko.

Refer to Figure 6 above for an overview of the spatial extent of demersal long-line grounds in the vicinity of Licence Block 2C. On the West Coast, long-line vessels fish in similar areas to those targeted by the hake-directed trawling fleet, extending along the shelf edge to the 1 000 m contour in places. Lines are set along the bathymetric contours. An average of 50 lines were set in Block 2C each year (2002 – 2008) up to a maximum depth of 1000 m. This is equivalent to approximately 1 % of the total national effort.

The impact of the proposed survey operations on the demersal long-line sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of LOW intensity and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

During hauling operations a demersal long-line vessel would be severely restricted in manoeuvrability, therefore direct communication from the survey vessels would be required in order to keep demersal long-line vessels clear of the survey vessels.

Environmental Impact Assessment of Fisheries: Demersal Long-Line		
	Without Mitigation	Assuming Mitigation
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High

5. LARGE PELAGIC LONG-LINE

The large pelagic long-line fishery operates extensively within the South African Exclusive Economic Zone (EEZ) targeting primarily tuna and swordfish. Tuna, tuna-like species and billfishes are migratory stocks and are therefore managed as a "shared resource" amongst various countries. There are currently 50 commercial large pelagic fishing rights issued for South African waters and 31 vessels active in the fishery. Many rights holders employ Asian vessels fishing under joint ventures with South African companies.

Vessels range from 30 m to 54 m in length. Gear consists of monofilament mainlines of between 25 km and 100 km in length which are suspended from surface buoys and marked at each end (Figures 7 & 8). The main fishing line is normally suspended 20 m below the water surface via droppers connecting it to surface buoys at regular intervals. Baited hooks are attached to the mainline via 20 m long trace lines, thereby targeting fish at a depth of 40 m below the surface. Up to 3 500 hooks may be set per line. Lines are usually set at night, with hauling commencing the next morning. Various types of buoys are used in combinations to keep the mainline near the surface and locate it should the line be cut or break for any reason. Each end of the line is marked by a Dahn Buoy and radar reflector, which marks the line position for later retrieval. A line may be left drifting for a considerable length of time before retrieval by means of a powered hauler at a speed of approximately one knot. During hauling, vessel manoeuvrability is severely restricted and, in the event of an emergency, the line may be dropped and hauled in at a later stage.

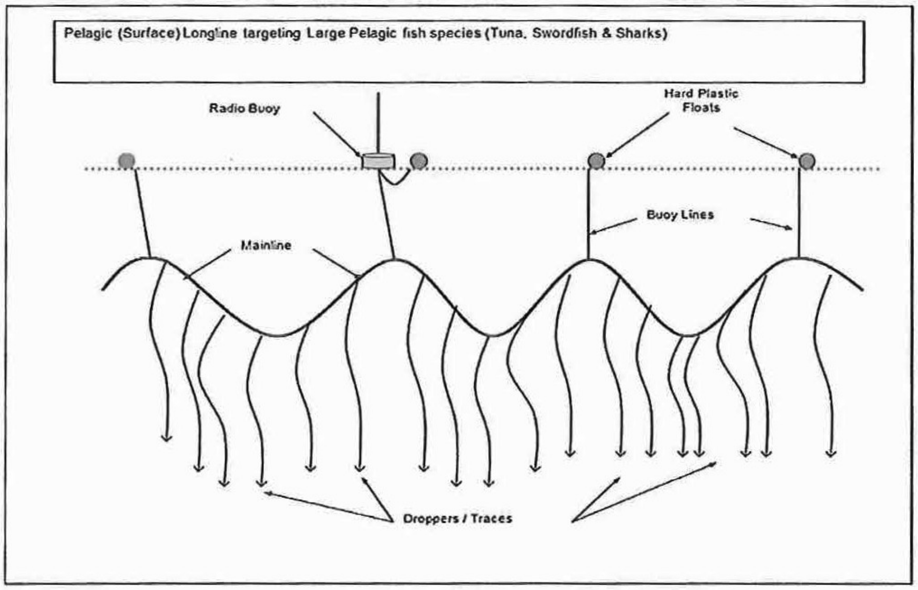

Figure 7. Typical pelagic long-line gear configuration targeting tuna, swordfish and shark species. Note: gear floats close to the surface of the sea and would present a potential obstruction to surface navigation

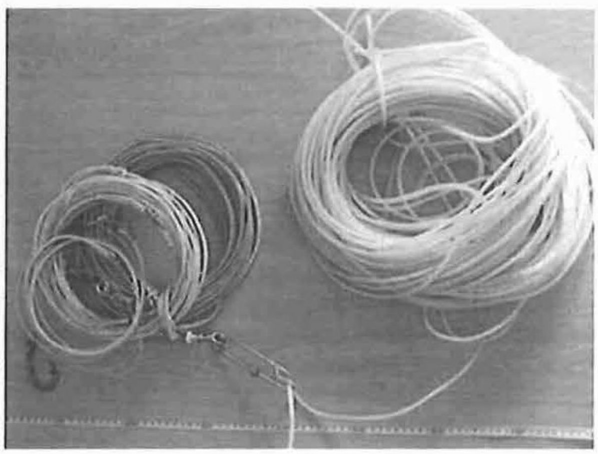

Figure 8. Photograph of a mainline (braided monofilament) with a dropper line and trace typically used by the pelagic long-line fishery

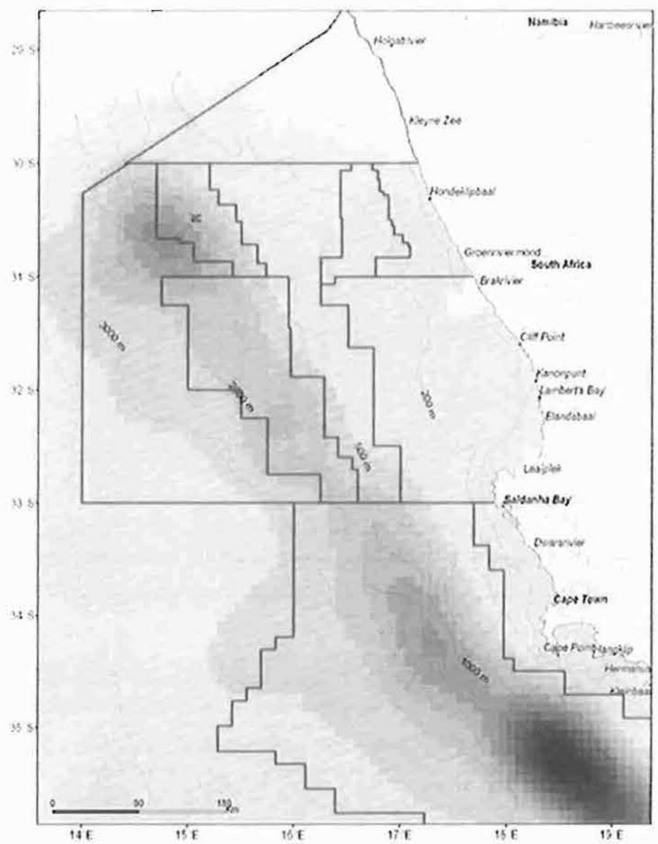

Figure 9. Effort expended by the large pelagic long-line fishery in South African waters and the high seas in relation to the proposed Anadarko survey area.

The fishery operates extensively from the continental shelf break into deeper waters, year-round. Pelagic long-line vessels are primarily concentrated seawards of the 500 m depth contour where the continental slope is steepest but some fishing does occur in shallower water inshore. Figure 9 shows the distribution of effort expended by the fishery within South African waters and on the high seas. Within the South African fishery, an average annual of approximately 10 lines were set within Licence Block 2C between 1998 and 2008. Approximately 1.7% of the total national effort was undertaken within the Licence Block and 1.9 % (12.6 tons) of the overall catch of targeted species was recorded in the area.

The impact of the proposed exploration activities on the offshore pelagic long-line sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of LOW intensity and of overall VERY LOW significance. It is highly probable that the impact would occur and the degree of confidence of the assessment for this fishery is high.

The presence of long-lines would present a potential threat to the proposed seismic survey operation in terms of entanglements with towed seismic gear. Extreme vigilance would be needed to avoid any drifting lines and regular communications with vessels in the area would be essential.

Environmental Impact Assessment of Fisheries: Pelagic Long-Line		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Highly Probable	Highly Probable
Confidence	High	High

6. TUNA POLE

Poling for tuna is predominantly based on the southern Atlantic longfin tuna stock (*T. alalunga*) and a very small amount of skipjack tuna (*Katsumonus pelamis*), yellowfin tuna and bigeye tuna. The available records (provided by the International Commission for the Conservation of Atlantic Tunas – ICCAT) are reported for the whole EEZ and no detailed spatial catch and effort data is therefore available. The fishery is seasonal with vessel activity mostly between December and May and peak catches in February and March. The South African fleet consists of approximately 128 pole-and-line vessels which are based at the ports of Cape Town, Hout Bay and Saldanha Bay. The sector lands approximately 3 000 tons per annum.

Vessels operating within the fishery are typically small (< 25 m in length). Catch is stored on ice, chilled sea water or frozen and the storage method often determines the range of the vessel. Trip durations average between four and five days, depending on the distance of the fishing grounds from port. Vessels drift whilst attracting and catching pelagic tuna species. Whilst at sea, the majority of time is spent searching for fish with actual fishing events taking place over a relatively short period of time. Sonars and echo sounders are used to locate schools of tuna. At the start of fishing, water is sprayed outwards from high-pressure nozzles to simulate small baitfish aggregating near the water surface, thereby attracting tuna to the surface. Live bait is flung out to entice the tuna to the surface (chumming). Tuna swimming near the surface are caught with hand-held fishing poles. The ends of these poles are fitted with a short length of fishing line leading to a hook. Hooked fish are pulled from the water and many tons can be landed in a short period of time. In order to land heavier fish, lines may be strung from the ends of the poles to overhead blocks to increase lifting power (see Figure 10).

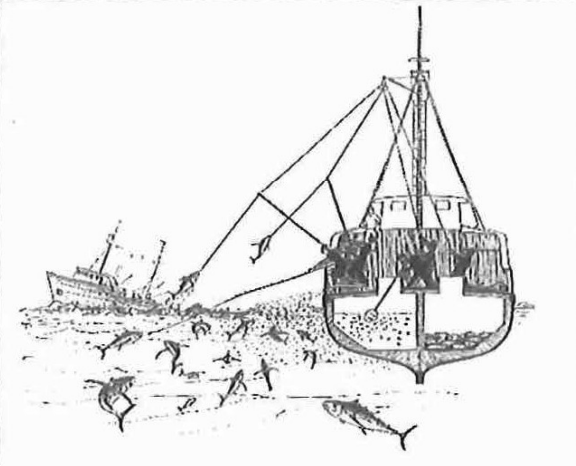

Figure 10. Schematic diagram of pole and line operation (www.fao.org/fishery).

The nature of the fishery and communication between vessels often results in a large number of these vessels operating in close proximity to each other at a time. The vessels fish predominantly during daylight hours and as they do not anchor or have any fixed gear in the water, these vessels remain highly manoeuvrable and could take avoiding action at any time. However, at night in fair weather conditions the fleet of vessels may drift or deploy drogues to remain within an area and would be less responsive during these periods. Effort fluctuates according to the availability of fish in the area, but once a shoal of tuna is located a number of vessels will move into the area and target a single shoal which may remain in the area for days at a time. As such the fishery is dependent on window periods of favourable conditions relating to catch availability. Although fishing activity is highly variable during the fishing season, peak catches are usually experienced between February and March, with relatively lower levels of activity between December and January.

Fishing activity occurs along the entire West Coast beyond the 200 m bathymetric contour (Figure 11). The tuna pole fleet would be expected to operate in the vicinity of Licence Block 2C, particularly around Child's Bank.

The impact of the proposed exploration activities on the tuna pole sector is considered to be of local extent and short-term duration. The status of the impact is assessed to be negative, of MEDIUM intensity and of overall VERY LOW significance. It is probable that the impact would occur and the degree of confidence of the assessment for this fishery is medium. It is recommended that sufficient notice be given to the tuna pole fishery of the location of the proposed exploration activities and advance notice prior to the commencement of these activities. In the event of the tuna pole fleet moving into a specific location within the exploration area to target a shoal of fish, the possibility exists to co-ordinate exploration operations to avoid that particular area for a limited duration.

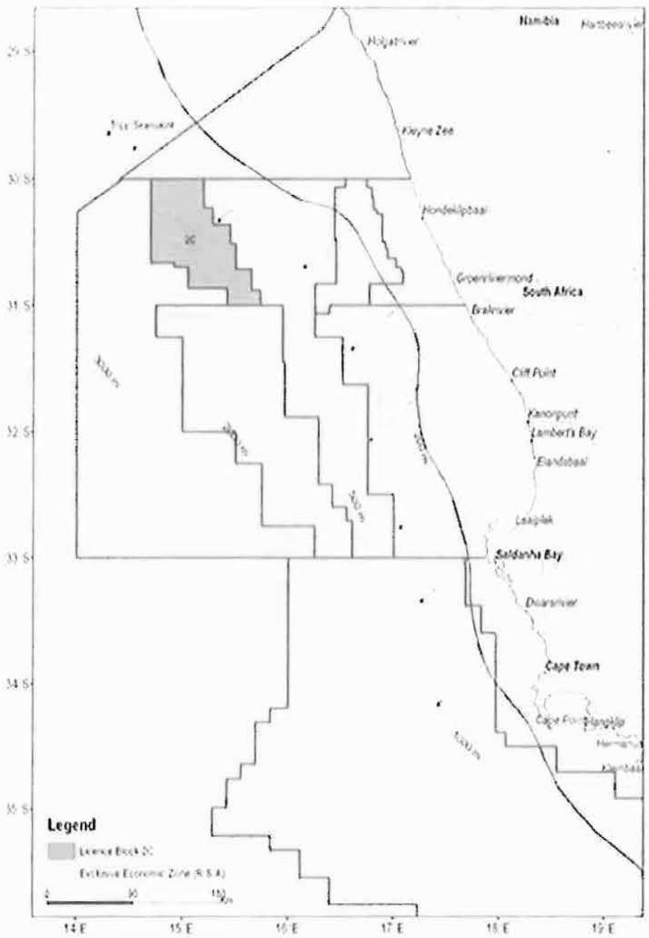

Figure 11. Spatial extent of fishing activity of the tuna pole fishery in relation to the proposed Anadarko survey area.

Environmental Impact Assessment of Fisheries: Tuna Pole		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium	Medium
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

7. COMMERCIAL AND RECREATIONAL LINE-FISH

The South African commercial line fishery is the country's third most important fishery in terms of total tons landed and economic value. The bulk of the fishery catch is made up of about 35 different species of reef fish as well as pelagic and demersal species which are mostly marketed locally as "fresh fish". The fishery is widespread across the country's shoreline from Port Nolloth on the west coast to Cape Vidal on the east coast. Effort is managed geographically with the spatial effort of the fishery divided into three zones. The majority of the catch (up to 95%) is landed by the Cape commercial fishery, which operates on the continental shelf up to a maximum depth of 200 m from the Namibian border on the West Coast to the Kei River in the Eastern Cape. Fishing vessels range up to a maximum of 20 nm offshore, although fishing at the outer limit of this range would be sporadic (C. Wilke, pers. comm.).

Line fishing techniques consist of hook and line deployments (up to 10 hooks per line), and differ from the pelagic long-line fishing technique in that the use of set long-lines is not permitted. The fishery includes commercial, subsistence and recreational sectors. Up to 3 000 boats are involved in the fishery on the national level, 450 of which are involved in the commercial fishery, and range in size from 3 m beach-launched dinghies to 20 m harbour-based vessels that may remain at sea for up to 30 days (Mann, 2000).

Linefish catches are reported inshore of the 200 m bathymetric contour (mostly October to March) and Block 2C is not targeted by the fishery. There is no expected impact of the proposed exploration activities on the fishery.

8. SMALL PELAGIC PURSE-SEINE

The South African small pelagic fishery is the largest local fishery by volume and the second most important in terms of value. Small pelagic species abundance and distribution fluctuates considerably in accordance with the upwelling ecosystem in which they exist. Annual landings have fluctuated between 300 000 and 600 000 tons over the last decade[2], with landings of 312 000 tons recorded for 2009. The two main targeted species are sardine and anchovy, with associated by-catch of round herring (red-eye) and juvenile horse mackerel. Fishing grounds occur primarily along the West and South coasts of the Western Cape and the Eastern Cape coast up to a distance of 50 nautical miles offshore, but usually closer inshore than this. The majority of the fleet of 101 vessels operate from St Helena Bay, Laaiplek, Saldanha Bay and Hout Bay (all in the vicinity of the survey area) with fewer vessels operating on the South Coast from the harbours of Gansbaai, Mossel Bay and

[2] Acoustic surveys are conducted to assess the pre- and post-spawning biomass of small pelagic species and the TAC is set and adjusted accordingly each year.

Port Elizabeth. Ports of deployment correspond to the location of canning factories and fish reduction plants along the coast.

The purse seine fleet consists of approximately 100 wooden, glass-reinforced plastic and steel-hulled vessels ranging in length from 11 m to 48 m. Targeted species are surface-shoaling and once a shoal has been located the vessel will steam around it and encircle it with a large net, extending to a depth of 60 to 90 m (see Figure 12). Netting walls surround aggregated fish, preventing them from escaping by diving downwards. These are surface nets framed by lines: a float line on top and lead line at the bottom. Once the shoal has been encircled the net is pursed, hauled in and the fish pumped onboard into the hold of the vessel. It is important to note that after the net is deployed the vessel has no ability to manoeuvre until the net has been fully recovered onboard and this may take up to 1.5 hours. Therefore, direct communication from the survey vessels would be required to ensure purse-seine vessels stay clear of the survey vessels. Vessels usually operate overnight and return to offload their catch the following day.

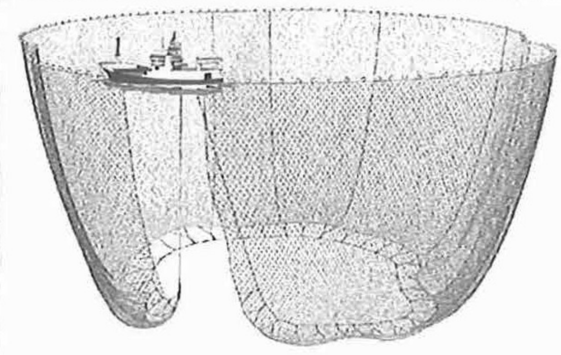

Figure 12. Typical gear configuration of a pelagic purse-seine vessel targeting small pelagic species

The small pelagic sector operates throughout the year with a short break over the Christmas and New Year period. The geographical distribution and intensity of the fishery is largely dependent on the seasonal fluctuation and geographical distribution of the targeted species. Within South Africa, the sardine-directed fleet consists of larger vessels that tend to concentrate effort in a broad area extending from St Helena Bay, southwards past Cape Town towards Cape Point and then eastwards along the coast to Mossel Bay and Port Elizabeth. The anchovy-directed fishery takes place predominantly on the South-West Coast from St Helena Bay to Cape Point and similarly the intensity of this fishery is dependent on fish availability and is most active in the period from March to September. Round herring (non-quota species) is targeted when available and specifically in the early part of the year (January to March) and is distributed South of Cape Point to St Helena Bay.

The fishing grounds of the small pelagic purse-seine fishery do not extend into Licence Block 2C (Figure 13) and there is therefore no impact expected by the proposed survey operations on the fishery.

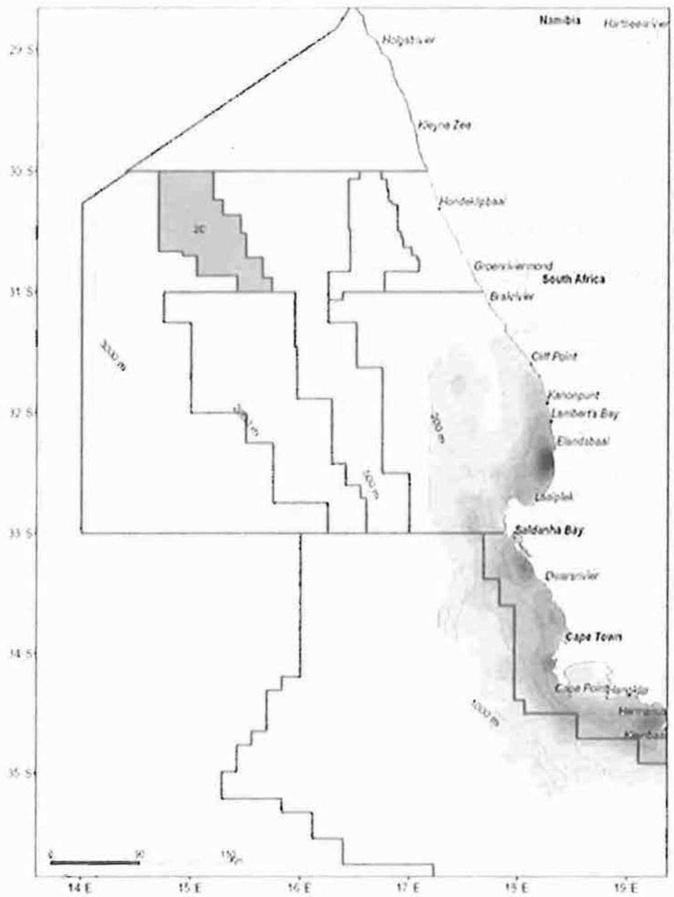

Figure 13. Spatial distribution of the catch of small pelagic species by the purse-seine fishery in South African waters in relation to the proposed survey area.

9. WEST COAST ROCK LOBSTER TRAP

The South African West Coast rock lobster fishery is based on *J. lalandii*, a slow-growing, long-lived species which occurs inside the 200 m depth contour along the entire West Coast to East London on the East Coast. The fishery is divided into the offshore fishery and the near-shore fishery, both directed inshore of the 100 m bathymetric contour. Effort is seasonal with boats operating from the shore and coastal harbours. Catch is landed whole and is managed using a TAC, 80% and 20% of which is allocated to the offshore and inshore fisheries respectively. A total national landing of approximately 3 300 tons (whole weight) was recorded for 2011.

Fishing grounds are divided for management purposes into Zones (and further subdivided into Areas) stretching from the Orange River mouth to east of Cape Hangklip in the South-Eastern Cape and TACs are allocated by area. Rock lobster factories were constructed in Port Nolloth and Hondeklipbaai to process comparatively large catches in the past. In the last decade however, the TAC allocated to the Northern Cape has only been fully landed twice and there has been very little commercial effort recorded in this area for the last five seasons.

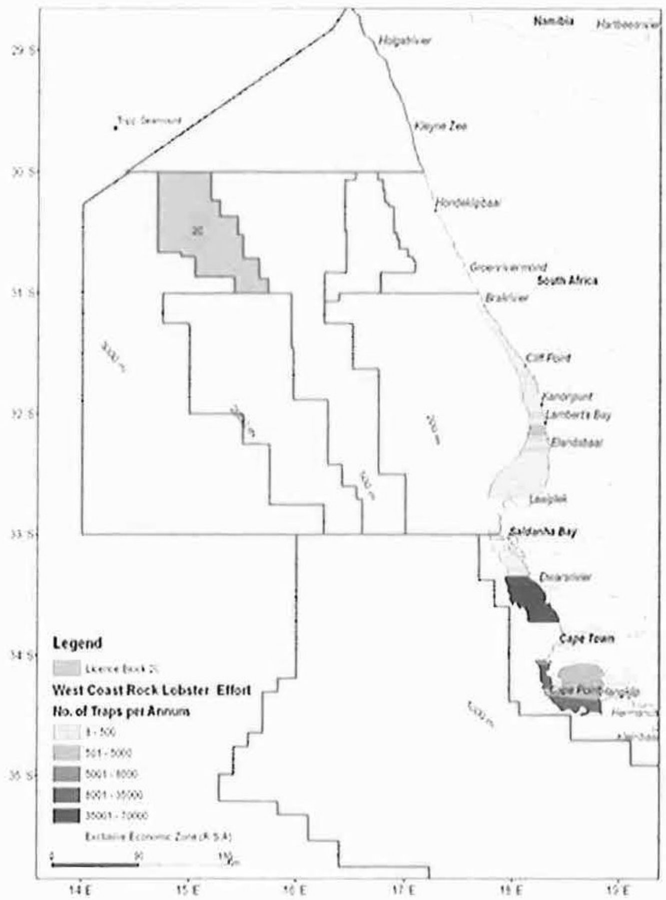

Figure 14. Location of the proposed development area in relation to the South African inshore West Coast rock lobster fishery

The offshore sector operates in a water depth range of 30 m to 100 m whilst the inshore fishery is restricted by the type of gear used to waters shallower than 30 m in depth. The offshore sector makes use of traps consisting of rectangular metal frames covered by netting, which are deployed from trap boats (otherwise known as "deck boats") whilst the inshore fishery makes use of hoopnets deployed from small dingies. The West Coast rock lobster offshore fishing fleet consists of vessels that range in length from 6 m to 14 m. Traps are set at dusk and retrieved during the early morning using a powerful winch for hauling. Vessels using traps will leave up to 30 traps per vessel in the fishing grounds overnight during the week, Monday to Friday. As a requirement of permit conditions for this sector, all traps must be removed over the weekend.

Baited traps consisting of rectangular metal frames covered by netting, are deployed from small dinghy's and delivered to larger catcher reefers to take to shore for processing. The rock lobster fishing fleet consists of vessels that range in length from 7 m to 21 m. Traps are set at dusk and retrieved during the early morning using a powerful winch for hauling.

The fishing grounds of the West Coast rock lobster fishery do not coincide with Licence Block 2C (Figure 14) and there is therefore no impact expected by the proposed survey operations on the fishery.

10. CONCLUSIONS AND RECOMMENDATIONS

The impact of the proposed exploration programme is considered to be of local extent and short-term duration. The status of the impact on all fishery sectors is assessed to be negative. The intensity of the impact on the tuna pole sector is assessed to be of MEDIUM intensity and of VERY LOW significance. The intensity of the impact on the demersal trawl, demersal long-line and large pelagic long-line fisheries is assessed to be of LOW intensity and of VERY LOW significance. There is no impact expected on the commercial and recreational line, small pelagic purse-seine and West Coast rock lobster fisheries. It is highly probable that the impact would occur on the demersal trawl, demersal long-line and pelagic long-line sectors and it is probable that the impact would occur on the tuna pole sector. The likelihood of the impact occurring on the commercial and recreational linefish, small pelagic purse-seine and West Coast rock lobster sectors is improbable. The degree of confidence in the impact predictions for the demersal trawl, demersal long-line, pelagic long-line, small pelagic purse-seine and West Coast rock lobster sectors is high, while that of the tuna pole and commercial and recreational linefish sectors is medium.

The following is noted;

- During hauling operations a demersal long-line vessel is severely restricted in manoeuvrability, and would be required to cut their line in cases of emergency. Direct communication from the survey vessels would be required in order to keep demersal long-line vessels clear of the survey vessels; and
- The presence of drifting pelagic long-line gear within the survey area would pose a potential threat to seismic survey operations in terms of entanglement with towed survey gear, and it is highly likely that gear would be encountered within the survey area offshore of the 500 m bathymetric contour. Regular communications with vessels in the vicinity are therefore essential in avoiding the risk of gear entanglements.

In order to minimize disruption to survey time and fishing operations, the following mitigation measures are recommended:

- At least one chase vessel should accompany the seismic vessel for the duration of the project;
- Communications should be established with the industrial fishing associations, vessel agents and vessel operators prior to the commencement of the exploration activities. Communications should be ongoing throughout the duration of each exploration activity with the submission of daily reports indicating the vessel's location to I&APs;
- Industrial bodies and I&APs should include: the Department of Agriculture, Forestry and Fisheries (DAFF), the Department of Environmental Affairs (DEA), the South African Tuna Association, the South African Tuna Long-Line Association, Fresh Tuna Exporters Association, the South African Deep-Sea Trawling Industry Association, the South African Hake Long-Line Association, the South African Pelagic Fishing Industry Association, De Beer's Marine and Transnet National Ports Authority;
- An experienced Independent Observer/ Fisheries Liaison Officer (FLO) should be present on-board survey vessels to report on vessel activity on a daily basis, and advise on action to be taken in the event of encountering fishing operations or gear. The FLO should be familiar with the various fisheries active in the area. In the case of the seismic and multi-beam surveys the FLO should also be able to act as the Marine Mammal Observer (MMO) and thus must also be familiar with environmental monitoring protocols relating specifically to marine mammals, birds and other fauna; and
- In the event of the tuna pole fleet moving into a specific location within the exploration area to target a shoal of fish, the possibility of co-ordinating exploration operations to avoid that particular area for a limited duration should be investigated.

Table 3. Summary table showing impact ratings of the proposed offshore seismic survey on the fishing industry both with and without mitigation measures.

	Extent	Duration	Intensity	Significance	Probability	Confidence
Environmental Impact Assessment of Fisheries: Safety zone during the proposed offshore seismic survey						
Demersal Trawl						
Without mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
With mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
Demersal Long-Line						
Without mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
With mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
Large Pelagic Long-Line						
Without mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
With mitigation	Local	Short-term	Low	Very Low	Highly Probable	High
Tuna Pole						
Without mitigation	Local	Short-term	Medium	Very Low	Probable	Medium
With mitigation	Local	Short-term	Medium	Very Low	Probable	Medium

11. REFERENCES

Atkinson, L. and K. Sink. User profiles for the South African offshore environment. South African National Biodiversity Institute. Biodiversity Series 10 (2008).

Fishing Industry Handbook 2011; South Africa, Namibia and Moçambique 39th Edition. George Warman Publications

Mann, B.Q. 2000. Southern African Marine Linefish Status Reports. Oceanographic Research Institute Special Publication, Durban.

Sauer, W.H.H., Hecht, T., Britz, P.J. and Mather, D. 2003. An economic and sectoral study of the South African Fishing Industry, vol. 2: fishery profiles. Report prepared for Marine and Coastal Management by Rhodes University.

APPENDIX 1: CONVENTION FOR ASSIGNING SIGNIFICANCE RATINGS TO IMPACTS

Specialists will consider seven rating scales when assessing potential impacts. These include:

1 Extent;
2 Duration;
3 Intensity;
4 Significance;
5 Status of impact;
6 Probability; and
7 Degree of confidence.

In assigning significance ratings to potential impacts before and after mitigation specialists are instructed to follow the approach presented below:

1. The core criteria for determining significance ratings are "extent" (Section 1), "duration" (Section 2) and "intensity" (Section 3). The preliminary significance ratings for combinations of these three criteria are given in Section 4.

2. The status of an impact is used to describe whether the impact would have a negative, positive or zero effect of the surrounding environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

3. Describe the impact in terms of the probability of the impact occurring (Section 5) and the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge (Section 6).

4. Additional criteria to be considered, which could "increase" the significance rating if deemed justified by the specialist, with motivation, are the following:

    - **Permanent / irreversible impacts (as distinct from long-term, reversible impacts);**
    - **Potentially substantial cumulative effects; and**
    - **High level of risk or uncertainty, with potentially substantial negative consequences.**

5. Additional criteria to be considered, which could "decrease" the significance rating if deemed justified by the specialist, with motivation, are the following:

    - Improbable impact, where confidence level in prediction is high.

6. When assigning significance ratings to impacts *after mitigation*, the specialist needs to:

    - **First, consider probable changes in intensity, extent and duration of the impact after mitigation, assuming effective implementation of mitigation measures, leading to a revised significance rating; and**

- **Then moderate the significance rating after taking into account the likelihood of proposed mitigation measures being effectively implemented. Consider:**
  - **Any potentially significant risks or uncertainties associated with the effectiveness of mitigation measures;**
  - **The technical and financial ability of the proponent to implement the measure; and**
  - **The commitment of the proponent to implementing the measure, or guarantee over time that the measures would be implemented.**

The significance ratings are based on largely objective criteria and inform decision-making at a project level as opposed to a local community level. In some instances, therefore, whilst the significance rating of potential impacts might be "low" or "very low", the importance of these impacts to local communities or individuals might be extremely high. The importance which I&APs attach to impacts must be taken into consideration, and recommendations should be made as to ways of avoiding or minimising these negative impacts through project design, selection of appropriate alternatives and / or management.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance rating	Effect on decision-making
Very Low; Low	**Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.**
Medium	**Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.**
High; Very High	**Would strongly influence the decision to proceed with the proposed project.**

1. Extent

"Extent" defines the physical extent or spatial scale of the impact.

Rating	Description
LOCAL	Extending only as far as the activity, limited to the site and its immediate surroundings. Specialist studies to specify extent.
REGIONAL	West Coast
NATIONAL	South Africa
INTERNATIONAL	

2. Duration

"Duration" gives an indication of how long the impact would occur.

Rating	Description
SHORT TERM	0 - 5 years
MEDIUM TERM	6 - 15 years
LONG TERM	Where the impact would cease after the operational life of the activity, either because of natural processes or by human intervention.
PERMANENT	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient.

3. Intensity

"Intensity" establishes whether the impact would be destructive or benign.

Rating	Description
Zero – Very Low	Where natural environmental functions and processes are not affected
LOW	Where the affected environment is altered, but natural functions and processes continue, albeit in a slightly modified way.
MEDIUM	Where the affected environment is altered, but natural, cultural and social functions and processes continue, albeit in a modified way.
HIGH	Where natural, cultural and social functions or processes are altered to the extent that it will temporarily or permanently cease.

4. Significance

"Significance" attempts to evaluatethe importance of a particular impact, and in doing so incorporates the above three scales (i.e. extent, duration and intensity).

Rating	Description
VERY HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level***and endure in the ***long term***; OR of ***high intensity*** at a ***national level*** in the ***medium term***; OR of ***medium intensity*** at a ***national level***in the ***long term.***
HIGH	Impacts could be EITHER: of ***high intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***high intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***medium term;*** OR of ***low intensity*** at a ***national level*** in the ***long term;*** OR of ***high intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***regional level*** in the ***long term.***
MEDIUM	Impacts could be EITHER: of ***high intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***medium intensity*** at a ***regional level*** in the ***medium term***; OR of ***high intensity*** at a ***regional level*** in the ***short term***; OR of ***medium intensity*** at a ***national level*** in the ***short term***; OR of ***medium intensity*** at a ***local level*** in the ***long term***; OR of ***low intensity*** at a ***national level*** in the ***medium term;***

Rating	Description
	OR of ***low intensity*** at a ***regional level*** in the ***long term.***
LOW	Impacts could be EITHER of ***low intensity*** at a ***regional level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***national level*** in the ***short term***; OR of ***high intensity*** at a ***local level*** and endure in the ***short term***; OR of ***medium intensity*** at a ***regional level*** in the ***short term***; OR of ***low intensity*** at a ***local level*** in the ***long term***; OR of ***medium intensity*** at a ***local level*** and endure in the ***medium term.***
VERY LOW	Impacts could be EITHER of ***low intensity*** at a ***local level*** and endure in the ***medium term***; OR of ***low intensity*** at a ***regional level*** and endure in the ***short term***; OR of ***low to medium intensity*** at a ***local level*** and endure in the ***short term.***
INSIGNIFICANT	Impacts with: Zero to Very Low intensity with any combination of extent and duration.
UNKNOWN	In certain cases it may not be possible to determine the significance of an impact.

5. Status of impact

The status of an impact is used to describe whether the impact would have a negative, positive or zero effect on the affected environment. An impact may therefore be negative, positive (or referred to as a benefit) or neutral.

6. Probability

"Probability" describes the likelihood of the impact occurring.

Rating	Description
IMPROBABLE	Where the possibility of the impact to materialise is very low either because of design or historic experience.
PROBABLE	Where there is a distinct possibility that the impact would occur.
HIGHLY PROBABLE	Where it is most likely that the impact would occur.
DEFINITE	Where the impact would occur regardless of any prevention measures.

7. Degree of confidence

This indicates the degree of confidence in the impact predictions, based on the availability of information and specialist knowledge.

Rating	Description
HIGH	Greater than 70% sure of impact prediction.
MEDIUM	Between 35% and 70% sure of impact prediction.
LOW	Less than 35% sure of impact prediction.

APPENDIX 2.3

MARINE FAUNAL ASSESSMENT

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN LICENCE BLOCK 2C, WEST COAST, SOUTH AFRICA

Marine Faunal Assessment

Prepared for:

cca ENVIRONMENTAL

On behalf of:

Anadarko Petroleum Corporation

ENVIRONMENTAL MANAGEMENT PROGRAMME FOR PROPOSED OIL AND GAS EXPLORATION ACTIVITIES IN LICENCE BLOCK 2C, WEST COAST, SOUTH AFRICA

MARINE FAUNAL ASSESSMENT

Prepared for

CCA Environmental (Pty) Ltd

On behalf of:

Anadarko South Africa (Pty) Ltd

Prepared by

Andrea Pulfrich
Pisces Environmental Services (Pty) Ltd

February 2013

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ABBREVIATIONS and UNITS

CCA	CCA Environmental (Pty) Ltd
cm	centimetres
CMS	Centre for Marine Studies
CSIR	Council for Scientific and Industrial Research
dB	decibells
EMP	Environmental Management Programme
h	hour
Hz	Herz
IUCN	International Union for the Conservation of Nature
kHz	kiloHerz
km	kilometre
km^2	square kilometre
MMO	Marine Mammal Observer
m	metres
m/sec	metres per second
N	north
NW	north-west
PAM	Passive Acoustic Monitoring
PTS	permanent threshold shifts
S	south
SW	south-west
TTS	temporary threshold shifts
UPC	Universal Power Corp
2D	two-dimensional
3D	three-dimensional
µg/l	micrograms per litre
µPa	micro Pascal
°C	degrees Centigrade
%	percent
‰	parts per thousand
~	approximately
<	less than
>	greater than

EXPERTISE AND DECLARATION OF INDEPENDENCE

This report was prepared by Dr Andrea Pulfrich of Pisces Environmental Services (Pty) Ltd. Andrea has a PhD in Fisheries Biology from the Institute for Marine Science at the Christian-Albrechts University, Kiel, Germany.

As Director of Pisces since 1998, Andrea has considerable experience in undertaking specialist environmental impact assessments, baseline and monitoring studies, and Environmental Management Programmes relating to marine diamond mining and dredging, hydrocarbon exploration and thermal/hypersaline effluents. She is a registered Environmental Assessment Practitioner and member of the South African Council for Natural Scientific Professions, South African Institute of Ecologists and Environmental Scientists, and International Association of Impact Assessment (South Africa).

This specialist report was compiled for CCA Environmental (Pty) Ltd on behalf of Anadarko South Africa (Pty) Ltd ("Anadarko") for their use in preparing an Environmental Management Programme for proposed exploration for oil and gas in Block 2C on the South African West Coast. I do hereby declare that Pisces Environmental Services (Pty) Ltd is financially and otherwise independent of the Applicants and CCA Environmental.

Andrea Pulfrich

Dr Andrea Pulfrich

1. GENERAL INTRODUCTION

For this investigation Anadarko South Africa (Pty) Ltd ("Anadarko") is proposing to undertake a three-year exploration programme in Block 2C, on the South African West Coast (Figure 1), comprising:

- Two-dimentional (2D) and three-dimentional (3D) seismic surveys;
- Multi-beam bathymetry survey;
- Seafloor heatflow measurements; and
- Seabed sampling programme.

In terms of the of Section 79(4)(b) of the Mineral and Petroleum Resources Development Act (No. 28 of 2002) (MPRDA), a requirement for obtaining an Exploration Right is that an Environmental Management Programme (EMP) must be compiled in terms of Section 39 and submitted to the Petroleum Agency of South Africa (PASA) for consideration and for approval by the Minister of Mineral Resources. CCA Environmental (Pty) Ltd (CCA) has been appointed to compile the EMP for the proposed exploration programme. CCA in turn has approached Pisces Environmental Services (Pty) Ltd for a specialist report on potential impacts of the proposed operations on marine fauna in the area.

Hydrocarbon deposits occur in reservoirs in sedimentary rock layers. Being lighter than water they accumulate in traps where the sedimentary layers are arched or tilted by folding or faulting of the geological layers. Marine seismic surveys are the primary tool for locating such deposits and are thus an indispensable component of offshore oil or gas exploration.

The nature of the sound impulses utilised during seismic surveys have resulted in concern over their potential impact on marine fauna, particularly marine mammals, fish, and turtles (McCauley *et al.* 2000). Consequently, it has been proposed that environmental management already be applied at the exploration stage of the a life cycle of a hydrocarbon field project (Duff *et al.* 1997, in Salter & Ford 2001).

1.1. Scope of Work

This specialist report was compiled as a desktop study on behalf of CCA, for their use in compiling an EMP for the proposed exploration programme in Block 2C off the South African West Coast.

The terms of reference for this study, as specified by CCA, are:

- Provide a general description of the local marine fauna in and around the proposed Exploration Right area;
- Identify, describe and assess the significance of potential impacts of the proposed exploration programme on the local marine fauna, focussing particularly on marine mammals and turtles, but including generic effects on fish and pelagic and benthic invertebrates; and
- Identify practicable mitigation measures to reduce any negative impacts and indicate how these could be implemented in the implementation and management of the proposed project.

1.2. Approach to the Study

As determined by the terms of reference, this study has adopted a 'desktop' approach. Consequently, the description of the natural baseline environment in the study area is based on a review and collation of existing information and data from the scientific literature, internal reports and the Generic Environmental Management Programme Report (EMPR) compiled for oil and gas exploration in South Africa (CCA & CMS 2001). The sections on whales and dolphins and the impacts of seismics on these, were compiled with contributions made by Dr Simon Elwen and Dr Tess Gridley of the Namibian Dolphin Project and the Mammal Research Institute (University of Pretoria) to a previous Marine Faunal Assessment undertaken for Block 1 (Pulfrich *et al.* 2012) The information for the identification of potential impacts was drawn from various scientific publications, the Generic EMPR, information sourced from the Internet as well as Marine Mammal Observer Close-out Reports prepared for previous seismic surveys undertaken off the South African coast. The sources consulted are listed in the Reference chapter.

All identified marine impacts are summarised, categorised and ranked in appropriate impact assessment tables, to be incorporated in the overall EMP Addendum.

2. DESCRIPTION OF THE PROPOSED PROJECT

Anadarko is proposing to undertake a 2D and 3D survey over Block 2C in combination with seafloor geochemical surveying (e.g. multibeam bathymetry, seafloor sampling, and heatflow measurements). Block 2C covers an area of ~6,224 km^2, extending from roughly the 300 m depth contour to beyond the continental shelf with depths up to 1,500 m. (Figure 1).

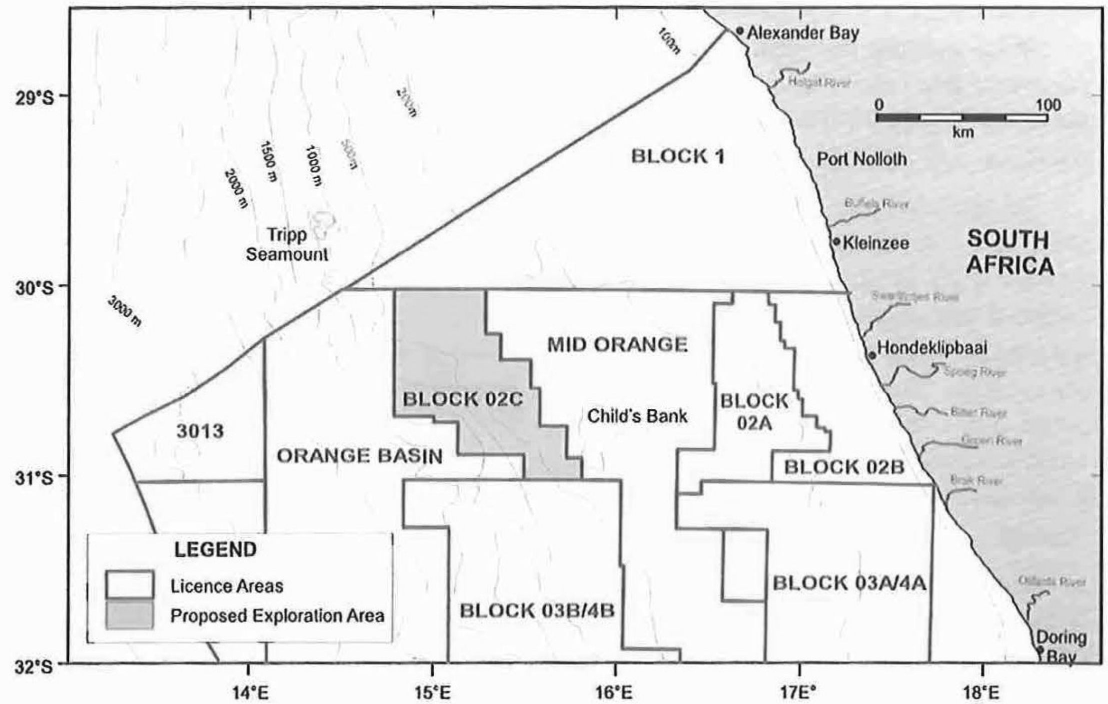

Figure 1: Map indicating location of petroleum licence Block 2C in relation to neighbouring licence blocks. Places mentioned in the text are also indicated.

2.1. Seismic Surveys

Seismic survey programmes comprise data acquisition in either 2D and/or 3D scales, depending on information requirements. 2D surveys are typically applied to obtain regional data from widely spaced survey grids and provide a vertical slice through the seafloor geology along the survey track-line. Infill surveys on closer grids subsequently provide more detail over specific areas of interest. In contrast, 3D seismic surveys are conducted on a very tight survey grid in specific target areas identified during 2D applications, and provide a cube image of the seafloor geology along each survey track-line.

During seismic surveys high-level, low frequency sound impulses are generated by an array of acoustic instrumentation towed behind a survey vessel, just below the sea surface. The sounds are directed towards the seabed and the seismic signal is reflected by the geological interfaces below the seafloor. The reflected signals are received by receivers or sets of hydrophones towed behind the vessel in a single streamer (2D) or in multiple streamers (3D) and are fed back to the recording instruments on board. The spacing between the hydrophone groups is commonly 25 m or shorter, depending on the purpose of the seismic survey. Each group contains many hydrophones, spaced less than 1 m apart. The hydrophone streamers must be towed at constant depth (5 - 30 m), with flotation usually achieved by filling the cables with kerosene, so that they are neutrally buoyant. To compensate for minor adjustments, Automatic Cable Levellers, or "birds" are used. The ends of the hydrophone streamers are marked with tail buoys, to warn shipping about the presence of the cable in the water. The tail buoys also act as a platform for surface positioning systems so that the cable locations can be accurately monitored.

While aquiring the seismic data, the survey vessel would travel along transects of a prescribed grid within the survey area that have been chosen to cross any known or suspected geological structure in the area. The vessel typically travels at a speed of between four and six knots (i.e. 2 to 3 metres per second) while surveying.

The seismic survey would involve a seismic sound source (airgun array) and a hydrophone streamer. The configuration of the airgun and hydrophone array would be dependent on whether a 2D or 3D seismic survey is undertaken. Typically the streamer(s) can be up to 12,000 m long and towed at variable depths between 5 - 30 m depth below the surface. The streamer(s) would therefore not be visible, except for the tail-buoy(s) at the terminal end(s) of the cable(s). The airgun array would be towed ~some 100 m behind the vessel at a depth of between 5 - 10 m below the surface. As the survey vessel would be restricted in manoeuvrability (a turn radius of 4.5 km is expected), other vessels should remain clear of it. A supply/chase vessel usually assists in the operation of keeping other vessels at a safe distance.

Each triggering of a sound pulse is termed a seismic shot, and these are fired at intervals of 10 - 20 seconds and at an operating pressure of between 2,000 to 2,500 psi and a volume of 3,000 to 5,000 cubic inches. Each seismic shot is usually only between 5 and 30 milliseconds in duration, and despite peak levels within each shot being high, the total energy delivered into the water is low.

Airguns have most of their energy in the 5-300 Hz frequency range, with the optimal frequency required for deep penetration seismic work being 50-80 Hz. The maximum sound pressure levels at the source of airgun arrays in use today in the seismic industry are in the range 230-255 dB re 1μPa at 1 m, with the majority of their produced energy being low frequency of 10-100 Hz (McCauley 1994; NRC 2003). The location where this level of sound is attained is directly beneath the airgun array, generally near its centre, but the exact location and depth beneath the array are dependent on the detailed makeup of the array, the water depth, and the physical properties of the seafloor (Dragoset 2000). However, based on analogue sound sources, sound levels for the seismic survey can notionally be expected to attenuate below 160 dB less than 1,325 m from the source array.

It is anticipated that the proposed 2D seismic survey would comprise a number of low density spaced survey lines covering the majority of Block 2C. Once the initial 2D survey has been undertaken the data will be analysed. After data analysis further possible target areas may be identified for further 3D surveying. It is anticipated that the minimum 3D seismic survey size would be in the order 750 km^2, but it could cover the entire block. Although survey commencement would ultimately depend on a permit award date, availability of seismic contractors and other factors, it is anticipated that the survey would be undertaken during the summer of 2013/2014 and would take on the order of 2 - 3 months to complete.

2.2. Multi-beam Bathymetry Survey

The multi-beam bathymetry survey would be undertaken over the majority of the Exploration Right area, in order to produce a digital terrain model of the seafloor (Figure 2).

The survey vessel would be equipped with a multi-beam echo sounder to obtain swath bathymetry, and a sub-bottom profiler to image the seabed and the near-surface geology. Multi-beam technology is a complex sonar array that allows surveying of the seafloor at a resolution and accuracy sufficient to image the typical scale of active seafloor seeps. The multi-beam system provides depth-sounding information on either side of the vessel's track across a swath width of approximately two times the water depth, thereby allowing for highly accurate imaging and mapping of seafloor topography in the form of digital terrain models.

The multi-beam echo sounder emits a fan of acoustic beams from a transducer at frequencies ranging from 90 - 100 kHz and typically produces sound levels up to 235 db re 1 μPa at 1 m. Multi-beam surveys have a footprint on the seabed of up to 7.4 times the water depth and to a width of 1.5°. When mapping in 1,000 m of water, such a system would ensonify a moving area 7.4 km by 50 m. Multi-beam surveys are typically conducted at speeds of up to 12 knots, working in parallel tracks with some overlap between swaths. At this speed, a point 1,000 m away from the ship would experience sound levels >50% beam strength for <10 seconds (O'Brien *et al.* 2005).

Figure 2: Schematic of a vessel using multi-beam depth/echo sounders (http://www.gns.cri.nz/).

The sub-bottom profiler emits an acoustic pulse from a transducer at frequencies ranging from 0.4 - 40 kHz and typically produces sound levels in the order of 200-230 db re 1 μPa at 1 m. The operating frequencies of the acoustic equipment used in sonar surveys typically fall into the high frequency kHz range, and are thus well beyond the hearing abilities of most marine fauna.

These bathymetric data alone are not sufficient to identify all possible hydrocarbon seeps, as many seeps have no bathymetric expression. Backscatter data is typically collected concurrently by multi-beam echosounders as it can measure several properties of the seafloor associated with hydrocarbon seeps including; hardness; roughness; and volumetric heterogeneity. One or more of these three properties can result in an increase in backscatter intensity recorded by the multi-beam system and aid in the identification of potential natural hydrocarbon seeps on the seafloor in the survey area.

Chirp seismic systems in contrast are powerful echo-sounders, where the sound source penetrates the seabed up to 60 m beneath the seafloor thereby providing a profiles of the deeper sediment layers.

It is anticipated that data acquisition would take in the order of 28 - 35 productive days to complete at a vessel speed of 4 knots.

The data acquired by these sonar techniques would be used to identify, prioritize, and target potential piston coring and heat-flow measurement locations. Selected sites will then be sampled with navigated piston cores. The number of cores sampled and their exact location within the licence area can only be evaluated once the multi-beam bathymetric survey results are available.

2.3. Seafloor Heatflow Measurements

The heatflow measurements would be conducted using heatflow probes, which would measure both the temperature and thermal conductivity of sediments in situ up to 12 m below the seabed. The probe typically consists of a 6-cm diameter solid alloy steel bar, which extends from the the wire termination at the top through the 500 kg lead-fill weight stand, down to the tip of the heatflow probe. The out-rigged thermistor string is attached parallel to the steel bar (Figure 3). The heatflow probe is normally 3 m in length and has 16 sensors. The first eleven sensors measure temperature within the probe at 30 cm intervals down into the sediment. The remaining sensors measure the water temperature, internal temperature of the probe, the tilt of the probe from vertical, water pressure, as well as a reference resistor. Acquisition of these data would be used to determine the thermal regime and calibrate thermal models to understand hydrocarbon system potential.

The measurement device would be lowered from a vessel to near the seabed. It is then allowed to drop under its own weight, being driven into the sediments by gravity. The instrument is allowed to equilibrate for a minimum of 20 minutes and is then recovered to the surface. No samples or other materials would be recovered with the heatflow probe. It is anticipated that up to 50 measurements would be collected across the Exploration Right area, which would take in the order of 21 - 35 productive days to complete.

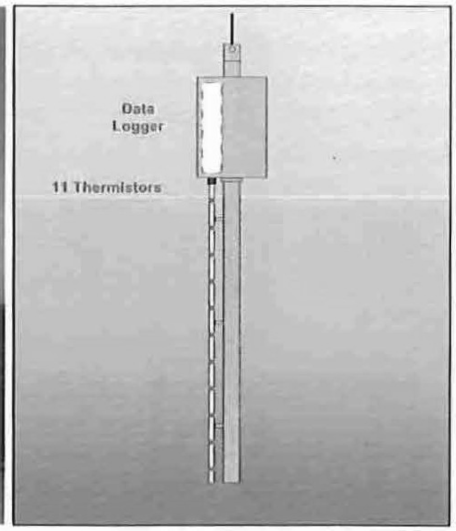

Figure 3: Heatflow probe being lowered over the side of a survey vessel (Source: www.geo.uni-bremen.de), and schematic of a heatflow probe (Source: TDI-Brookes).

2.4. Seabed Sampling Programme

Having identified possible locations of natural hydrocarbon on the seafloor using multi-beam bathymetry, backscatter and sub-bottom profiles, targeted piston coring would be undertaken. Piston coring is one of the more common methods used to collect seabed geochemical samples, with the sequence of operation illustrated in Figure 4. The piston coring operation is carried out by winching the tool over the side of the vessel and lowering the corer to just above the seabed (A). As the trigger weight hits the bottom (B), it releases the weight on the trigger arm and the trigger arm begins to rise. Once the trigger arm has risen through its full 1.2 m of travel (C), the corer is released to "free-fall" the 3 m distance to the bottom, forcing the core barrel to travel down over the piston into the sediment. When the corer hits the end of its 3 m slack loop, the piston starts up the core barrel (D) creating suction below the piston, and expelling the water out the top of the corer. When forward momentum of the core has stopped, a slow pullout on the winch is begun. The suction created by the core sample in the liner prevents movement of the piston to the top of the core barrel in response to tension on the core wire. This suction triggers the separation of the top and bottom sections of the piston (E). The bottom half of the piston remains in place over the sediment to maintain integrity of the sample, while the top half (attached to the coring wire) "fetches up" against the stop in the core head, allowing the corer to be pulled out of the sediment and the sample to be hauled onboard. The recovered cores are visually examine at the surface for indications of hydrocarbons (gas hydrate, gas parting, or oil staining) and three sets of sub-samples retained for further geochemical analysis. Any material having geologic or environmental interest would be preserved for further study. The remaining sediment would be returned to the seabed.

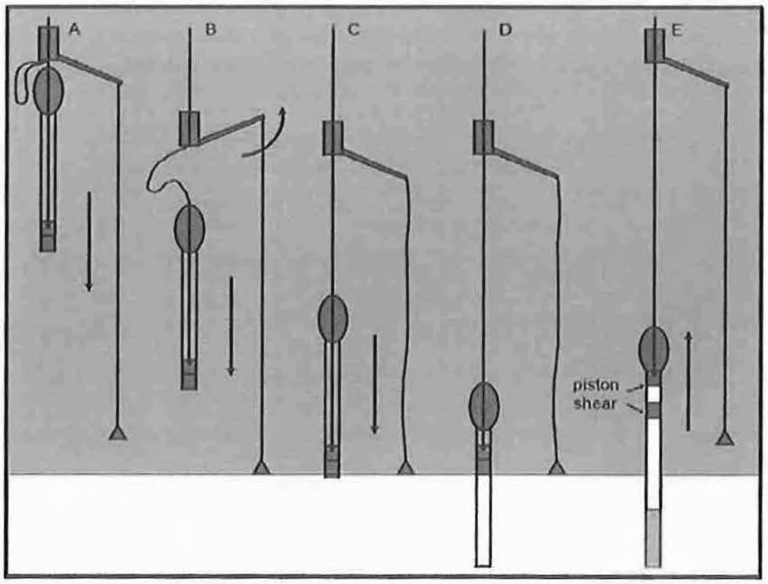

Figure 4: Schematic of the piston core operation at the seabed (Source: TDI-Brooks).

Typically core barrels are 6 m in length, with a diameter of 67 mm. It is proposed to take in the order of 200 cores collected across the Exploration Right area, although the exact number and their location would be identified following analysis of the multi-beam bathymetric survey results. Each individual core would have a disturbance area and volume of 0.003 m^2 and 0.02 m^3, respectively, resulting in a total disturbance area and volume of approximately 0.6 m^2 and 4 m^3, respectively. It is anticipated that the initial seabed sampling programme would take on the order of 21 to 35 productive days to complete.

3. DESCRIPTION OF THE BASELINE MARINE ENVIRONMENT

The descriptions of the physical and biological environments along the South African West Coast focus primarily on the study area between the Orange River mouth and Hondeklipbaai. The purpose of this environmental description is to provide the marine baseline environmental context within which the proposed seismic surveys will take place. The summaries presented below are based on information gleaned from Lane & Carter (1999), Morant (2006), and Penney *et al.* (2007).

3.1. Geophysical Characteristics

3.1.1 Bathymetry

The continental shelf along the West Coast is generally wide and deep, although large variations in both depth and width occur. The shelf maintains a general NNW trend, widening north of Cape Columbine and reaching its widest off the Orange River (180 km) (Figure 1). The nature of the shelf break varies off the South African West Coast. Between Cape Columbine and the Orange River, there is usually a double shelf break, with the distinct inner and outer slopes, separated by a gently sloping ledge. The immediate nearshore area consists mainly of a narrow (about 8 km wide) rugged rocky zone and slopes steeply seawards to a depth of around 80 m. The middle and outer shelf normally lacks relief and slopes gently seawards reaching the shelf break at a depth of ~300 m.

Banks on the continental shelf include the Orange Bank (Shelf or Cone), a shallow (160 - 190 m) zone that reaches maximal widths (180 km) offshore of the Orange River, and Child's Bank, situated ~150 km offshore at about 31°S. Tripp Seamount is a geological feature to the northwest of Block 2C, which rises from the seabed at ~1,000 m to a depth of 150 m.

3.1.2 Coastal and Inner-shelf Geology and Seabed Geomorphology

Figure 5 illustrates the distribution of seabed surface sediment types off the South African north-western coast. The inner shelf is underlain by Precambrian bedrock (also referred to as Pre-Mesozoic basement), whilst the middle and outer shelf areas are composed of Cretaceous and Tertiary sediments (Dingle 1973; Birch *et al.* 1976; Rogers 1977; Rogers & Bremner 1991). As a result of erosion on the continental shelf, the unconsolidated sediment cover is generally thin, often less than 1 m. Sediments are finer seawards, changing from sand on the inner and outer shelves to muddy sand and sandy mud in deeper water. However, this general pattern has been modified considerably by biological deposition (large areas of shelf sediments contain high levels of calcium carbonate) and localised river input. An ~500-km long mud belt (up to 40 km wide, and of 15 m average thickness) is situated over the outer edge of the middle shelf between the Orange River and St Helena Bay (Birch *et al.* 1976). Further offshore, sediment is dominated by muddy sands, sandy muds, mud and some sand. The continental slope, seaward of the shelf break, has a smooth seafloor, underlain by calcareous ooze.

Present day sedimentation is limited to input from the Orange River. This sediment is generally transported northward. Most of the sediment in the area is therefore considered to be relict deposits by now ephemeral rivers active during wetter climates in the past. The Orange River, when in flood, still contributes largely to the mud belt as suspended sediment is carried southward by poleward flow. In this context, the absence of large sediment bodies on the inner shelf reflects on the paucity of terrigenous sediment being introduced by the few rivers that presently drain the South African West Coast coastal plain.

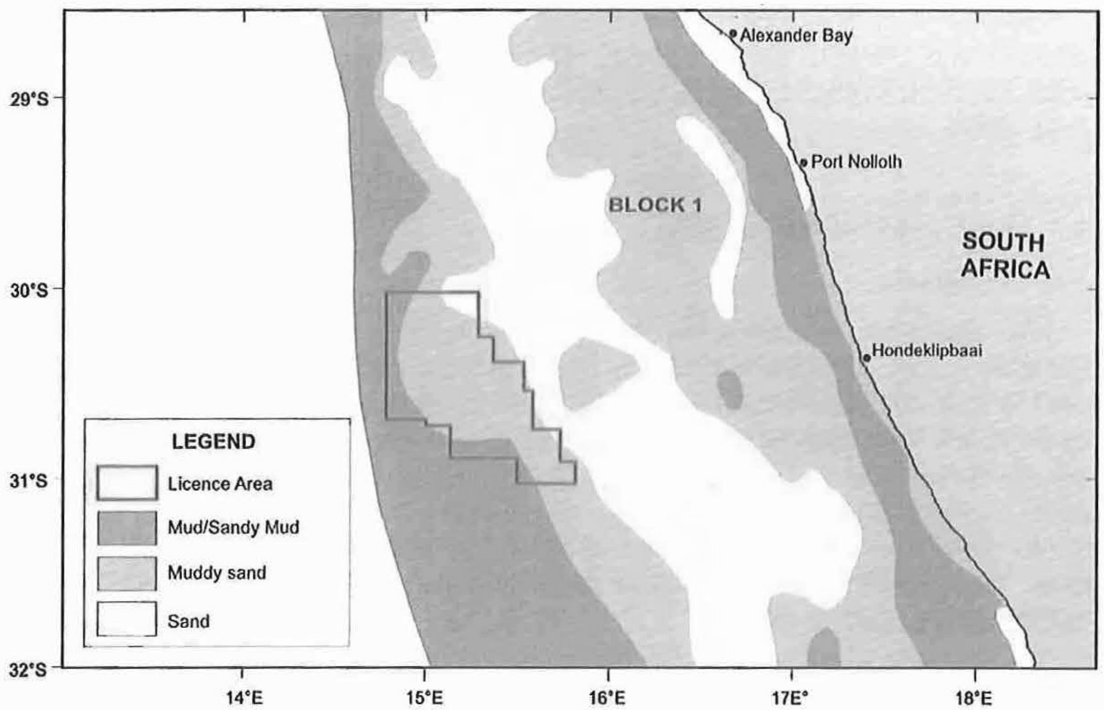

Figure 5: Sediment distribution on the continental shelf of the South African West Coast (Adapted from Rogers 1977).

3.2. Biophysical Characteristics

3.2.1 Wind Patterns

Winds are one of the main physical drivers of the nearshore Benguela region, both on an oceanic scale, generating the heavy and consistent south-westerly swells that impact this coast, and locally, contributing to the northward-flowing longshore currents, and being the prime mover of sediments in the terrestrial environment. Consequently, physical processes are characterised by the average seasonal wind patterns, and substantial episodic changes in these wind patterns have strong effects on the entire Benguela region.

The prevailing winds in the Benguela region are controlled by the South Atlantic subtropical anticyclone, the eastward moving mid-latitude cyclones south of southern Africa, and the seasonal atmospheric pressure field over the subcontinent. The south Atlantic anticyclone is a perennial feature that forms part of a discontinuous belt of high-pressure systems which encircle the subtropical southern hemisphere. This undergoes seasonal variations, being strongest in the austral summer, when it also attains its southernmost extension, lying south west and south of the subcontinent. In winter, the south Atlantic anticyclone weakens and migrates north-westwards.

These seasonal changes result in substantial differences between the typical summer and winter wind patterns in the region, as the southern hemisphere anti-cyclonic high-pressures system, and the associated series of cold fronts, moves northwards in winter, and southwards in summer. The strongest winds occur in summer, during which winds blow 99% of the time, with a total of 226 gales (winds exceeding 18 m/s or 35 kts) being recorded over the period (Figure 6; supplied by CSIR). Virtually all winds in summer come from the south-east to south-west, strongly dominated by southerlies which occur over 40% of the time, averaging 20 - 30 kts and reaching speeds in excess of 100 km/h (60 kts). South-easterlies are almost as common, blowing about one-third of the time, and also averaging 20 - 30 kts. The combination of these southerly/south-easterly winds drives the massive offshore movements of surface water, and the resultant strong upwelling of nutrient-rich bottom waters, which characterise this region in summer.

Winter remains dominated by southerly to south-easterly winds, but the closer proximity of the winter cold-front systems results in a significant south-westerly to north-westerly component (Figure 6). This 'reversal' from the summer condition results in cessation of upwelling, movement of warmer mid-Atlantic water shorewards and breakdown of the strong thermoclines which typically develop in summer. There are also more calms in winter, occurring about 3% of the time, and wind speeds generally do not reach the maximum speeds of summer. However, the westerlies winds blow in synchrony with the prevailing south-westerly swell direction, resulting in heavier swell conditions in winter.

3.2.2 Large-Scale Circulation and Coastal Currents

The southern African West Coast is strongly influenced by the Benguela Current. Current velocities in continental shelf areas generally range between 10 - 30 cm/s (Boyd & Oberholster 1994). On its western side, flow is more transient and characterised by large eddies shed from the retroflection of the Agulhas Current. In the south the Benguela current has a width of 200 km, widening rapidly northwards to 750 km. The flows are predominantly wind-forced, barotropic and fluctuate between poleward and equatorward flow (Shillington *et al.* 1990; Nelson & Hutchings 1983) (Figure 7). Fluctuation periods of these flows are 3 - 10 days, although the long-term mean current residual is in an approximate northwest (alongshore) direction. Near bottom shelf flow is mainly poleward (Nelson 1989) with low velocities of typically 5 cm/s. The poleward flow becomes more consistent in the southern Benguela.

The major feature of the Benguela Current Coastal is upwelling and the consequent high nutrient supply to surface waters leads to high biological production and large fish stocks. The prevailing longshore, equatorward winds move nearshore surface water northwards and offshore. To balance the displaced water, cold, deeper water wells up inshore. Although the rate and intensity of upwelling fluctuates with seasonal variations in wind patterns, the most intense upwelling tends to occur where the shelf is narrowest and the wind strongest. There are three upwelling centres in the southern Benguela, namely the Namaqua (30°S), Cape Columbine (33°S) and Cape Point (34°S) upwelling cells (Taunton-Clark 1985) (Figure 8; bottom left). Upwelling in these cells is seasonal, with maximum upwelling occurring between September and March. An example of one such strong upwelling event in December 1996, followed by relaxation of upwelling and intrusion of warm Agulhas waters from the south, is shown in the satellite images in Figure 8.

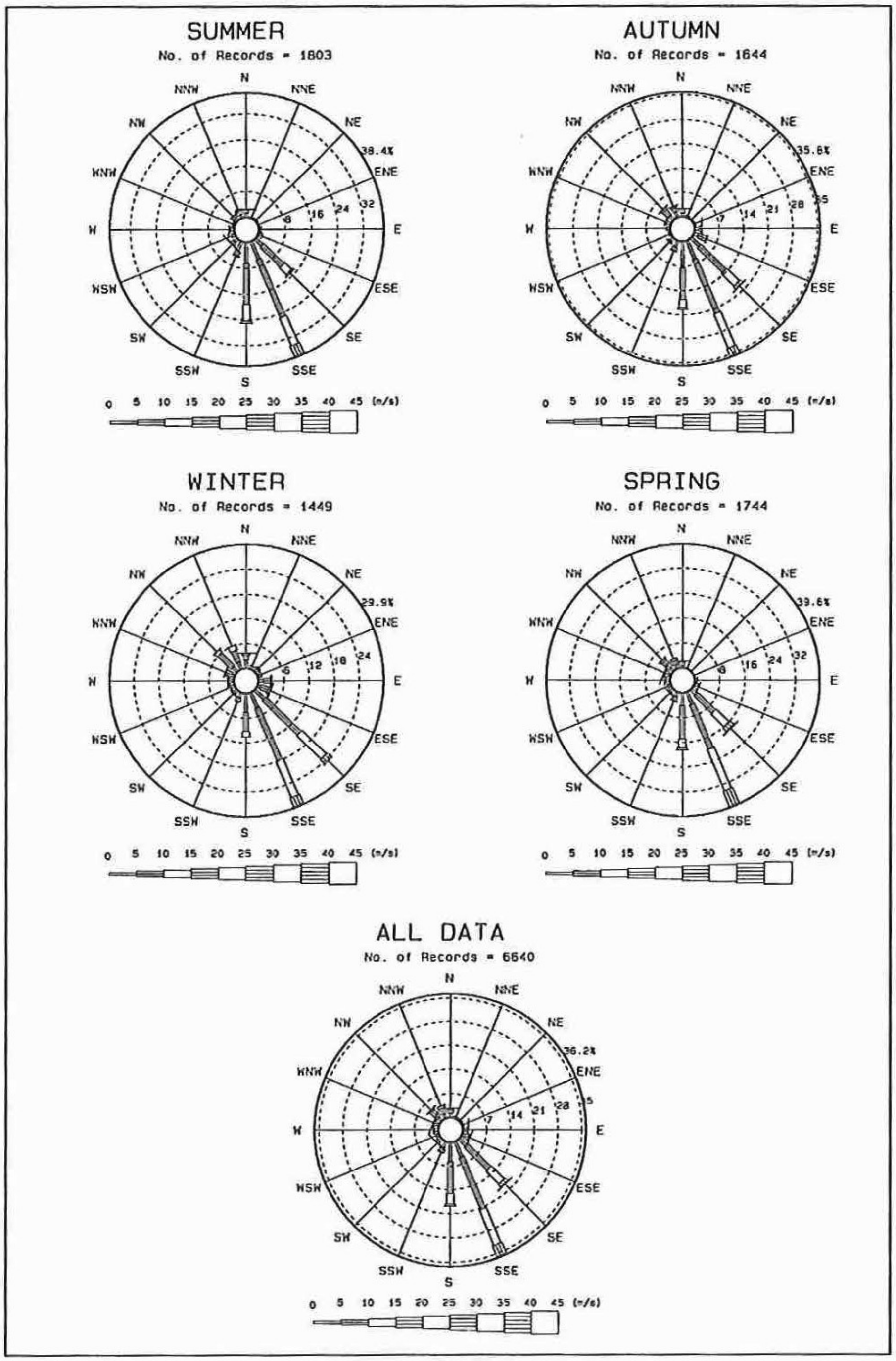

Figure 6: VOS Wind Speed vs Wind Direction data for the offshore area 28°-29°S; 15°-16°E (Oranjemund) (Source: Voluntary Observing Ship (VOS) data from the Southern Africa Data Centre for Oceanography (SADCO)).

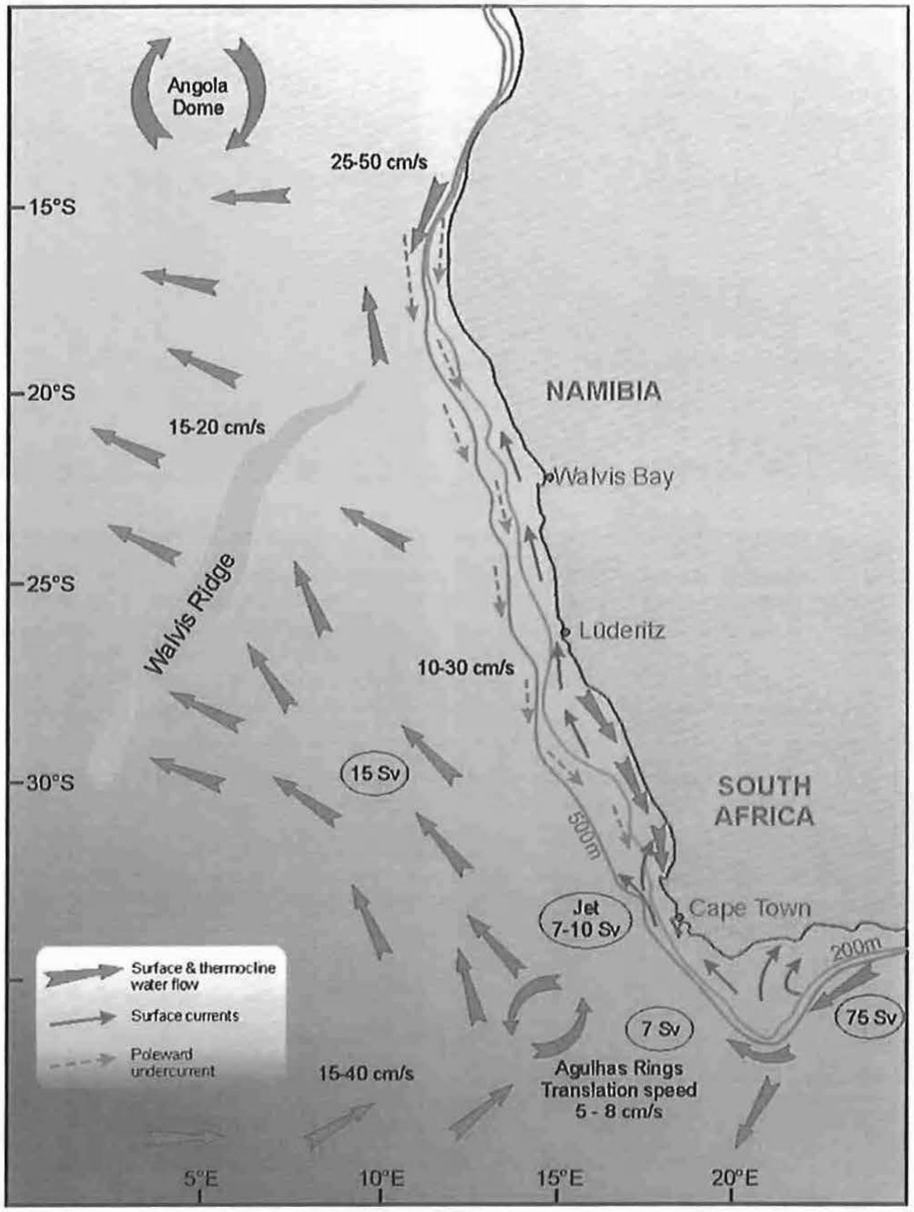

Figure 7: Major features of the predominant circulation patterns and volume flows in the Benguela System, along the southern Namibian and South African west coasts (re-drawn from Shannon & Nelson 1996).

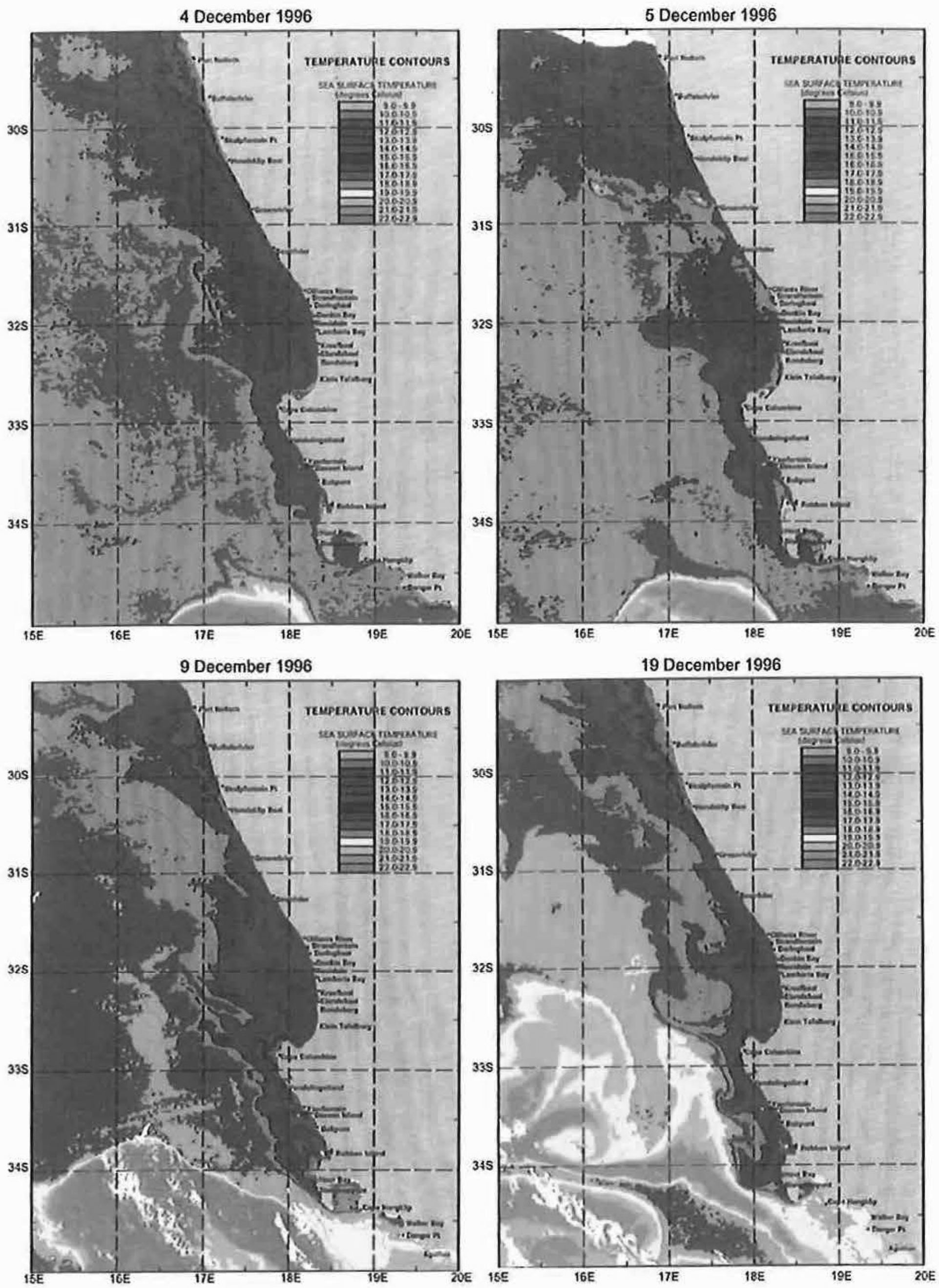

Figure 8: Satellite sea-surface temperature images showing upwelling intensity along the South African west coast on four days in December 1996 (from Lane & Carter 1999).

Where the Agulhas Current passes the southern tip of the Agulhas Bank (Agulhas Retroflection area), it may shed a filament of warm surface water that moves north-westward along the shelf edge towards Cape Point, and Agulhas Rings, which similarly move north-westwards into the South Atlantic Ocean. These rings may extend to the seafloor and west of Cape Town may split, disperse or join with other rings. During the process of ring formation, intrusions of cold subantractic water moves into the South Atlantic. The contrast in warm (nutrient-poor) and cold (nutrient-rich) water is thought to be reflected in the presence of cetaceans and large migratory pelgic fish species (Best 2007).

3.2.3 Waves and Tides

Most of the west coast of southern Africa is classified as exposed, experiencing strong wave action, rating between 13 - 17 on the 20 point exposure scale (McLachlan 1980). Much of the coastline is therefore impacted by heavy south-westerly swells generated in the roaring forties, as well as significant sea waves generated locally by the prevailing moderate to strong southerly winds characteristic of the region. The peak wave energy periods fall in the range 9.7 - 15.5 seconds.

Typical seasonal swell-height rose-plots, compiled from Voluntary Observing Ship (VOS) data off Oranjemund, are shown in Figure 9 (supplied by CSIR). The wave regime along the southern African west coast shows only moderate seasonal variation in direction, with virtually all swells throughout the year coming from the SW - S direction. Winter swells, however, are strongly dominated by those from the SW - SSW, which occur almost 80% of the time, and typically exceed 2 m in height, averaging about 3 m, and often attaining over 5 m. With wind speeds capable of reaching 100 km/h during heavy winter south-westerly storms, winter swell heights can exceed 10 m.

In comparison, summer swells tend to be smaller on average, typically around 2 m, not reaching the maximum swell heights of winter. There is also a more pronounced southerly swell component in summer. These southerly swells tend to be wind-induced, with shorter wave periods (~8 seconds), and are generally steeper than swell waves (CSIR 1996). These wind-induced southerly waves are relatively local and, although less powerful, tend to work together with the strong southerly winds of summer to cause the northward-flowing nearshore surface currents, and result in substantial nearshore sediment mobilisation, and northwards transport, by the combined action of currents, wind and waves.

In common with the rest of the southern African coast, tides are semi-diurnal, with a total range of some 1.5 m at spring tide, but only 0.6 m during neap tide periods.

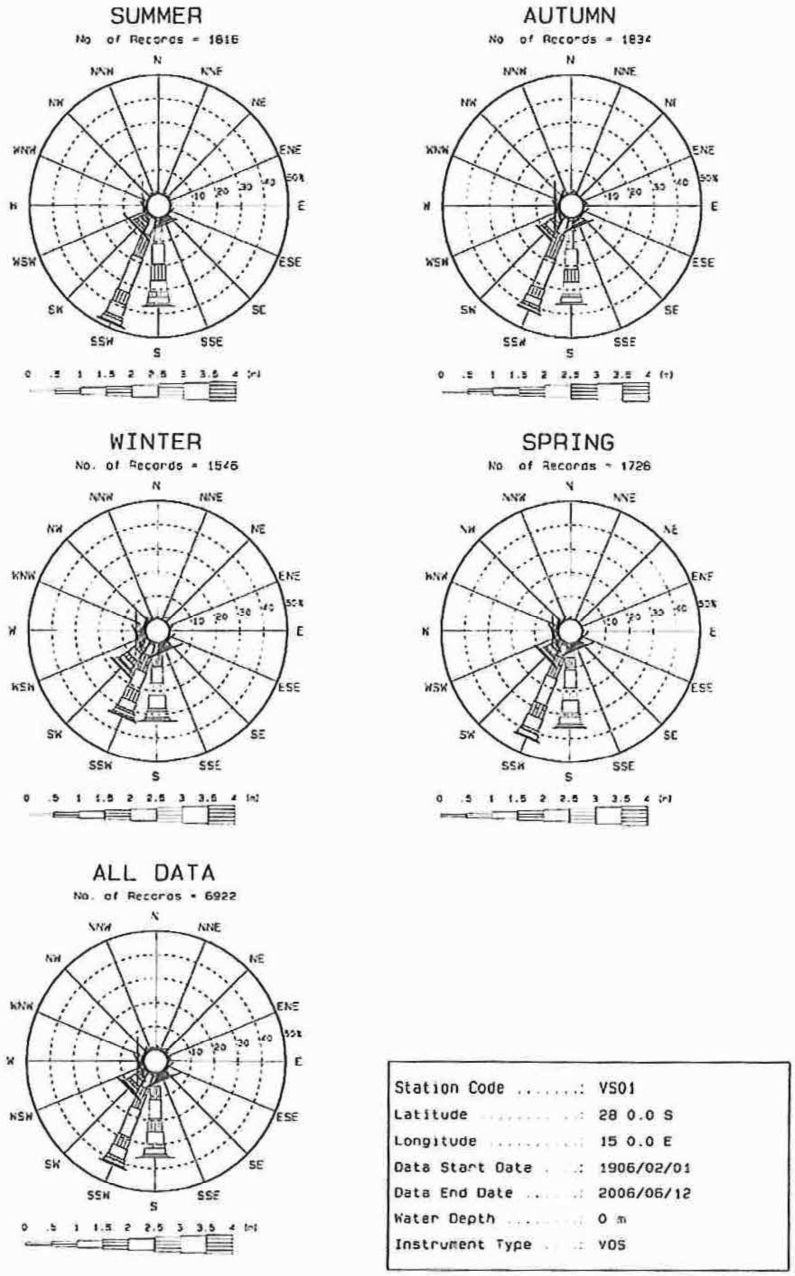

Figure 9: VOS Wave Height vs Wave Direction data for the offshore area (28°-29°S; 15°-16°E recorded during the period 1 February 1906 and 12 June 2006)) (Source: Voluntary Observing Ship (VOS) data from the Southern African Data Centre for Oceanography (SADCO)).

3.2.4 Water

South Atlantic Central Water (SACW) comprises the bulk of the seawater in the study area, either in its pure form in the deeper regions, or mixed with previously upwelled water of the same origin on the continental shelf (Nelson & Hutchings 1983). Salinities range between 34.5‰ and 35.5‰ (Shannon 1985).

Seawater temperatures on the continental shelf of the southern Benguela typically vary between 6°C and 16°C. Well-developed thermal fronts exist, demarcating the seaward boundary of the upwelled water. Upwelling filaments are characteristic of these offshore thermal fronts, occurring as surface streamers of cold water, typically 50 km wide and extending beyond the normal offshore extent of the upwelling cell. Such fronts typically have a lifespan of a few days to a few weeks, with the filamentous mixing area extending up to 625 km offshore. South and east of Cape Agulhas, the Agulhas retroflection area is a global "hot spot" in terms of temperature variability and water movements.

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations, especially on the bottom. SACW itself has depressed oxygen concentrations (~80% saturation value), but lower oxygen concentrations (<40% saturation) frequently occur (Bailey *et al.* 1985; Chapman & Shannon 1985).

Nutrient concentrations of upwelled water of the Benguela system attain 20 µm nitrate-nitrogen, 1.5 µm phosphate and 15-20 µm silicate, indicating nutrient enrichment (Chapman & Shannon 1985). This is mediated by nutrient regeneration from biogenic material in the sediments (Bailey *et al.* 1985). Modification of these peak concentrations depends upon phytoplankton uptake which varies according to phytoplankton biomass and production rate. The range of nutrient concentrations can thus be large but, in general, concentrations are high.

3.2.5 Upwelling & Plankton Production

The cold, upwelled water is rich in inorganic nutrients, the major contributors being various forms of nitrates, phosphates and silicates (Chapman & Shannon 1985). During upwelling the comparatively nutrient-poor surface waters are displaced by enriched deep water, supporting substantial seasonal primary phytoplankton production. This, in turn, serves as the basis for a rich food chain up through zooplankton, pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (hake and snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). High phytoplankton productivity in the upper layers again depletes the nutrients in these surface waters. This results in a wind-related cycle of plankton production, mortality, sinking of plankton detritus and eventual nutrient re-enrichment occurring below the thermocline as the phytoplankton decays.

3.2.6 Organic Inputs

The Benguela upwelling region is an area of particularly high natural productivity, with extremely high seasonal production of phytoplankton and zooplankton. These plankton blooms in turn serve as the basis for a rich food chain up through pelagic baitfish (anchovy, pilchard, round-herring and others), to predatory fish (snoek), mammals (primarily seals and dolphins) and seabirds (jackass penguins, cormorants, pelicans, terns and others). All of these species are subject to natural mortality, and a proportion of the annual production of all these trophic levels, particularly the plankton communities, die naturally and sink to the seabed.

Balanced multispecies ecosystem models have estimated that during the 1990s the Benguela region supported biomasses of 76.9 tons/km^2 of phytoplankton and 31.5 tons/km^2 of zooplankton alone (Shannon *et al.* 2003). Thirty six percent of the phytoplankton and 5% of the zooplankton are estimated to be lost to the seabed annually. This natural annual input of millions of tons of organic material onto the seabed off the southern African West Coast has a substantial effect on the ecosystems of the Benguela region. It provides most of the food requirements of the particulate and filter-feeding benthic communities that inhabit the sandy-muds of this area, and results in the high organic content of the muds in the region. As most of the organic detritus is not directly consumed, it enters the seabed decomposition cycle, resulting in subsequent depletion of oxygen in deeper waters.

An associated phenomenon ubiquitous to the Benguela system are red tides (dinoflagellate and/or ciliate blooms) (see Shannon & Pillar 1985; Pitcher 1998). Also referred to as Harmful Algal Blooms (HABs), these red tides can reach very large proportions. Toxic dinoflagellate species can cause extensive mortalities of fish and shellfish through direct poisoning, while degradation of organic-rich material derived from both toxic and non-toxic blooms results in oxygen depletion of subsurface water.

3.2.7 Low Oxygen Events

The continental shelf waters of the Benguela system are characterised by low oxygen concentrations with <40% saturation occurring frequently (e.g. Visser 1969; Bailey *et al.* 1985). The low oxygen concentrations are attributed to nutrient remineralisation in the bottom waters of the system (Chapman & Shannon 1985). The absolute rate of this is dependent upon the net organic material build-up in the sediments, with the carbon rich mud deposits playing an important role. As the mud on the shelf is distributed in discrete patches (see Figure 5), there are corresponding preferential areas for the formation of oxygen-poor water. The two main areas of low-oxygen water formation in the southern Benguela region are in the Orange River Bight and St Helena Bay (Chapman & Shannon 1985; Bailey 1991; Shannon & O'Toole 1998; Bailey 1999; Fossing *et al.* 2000). The spatial distribution of oxygen-poor water in each of the areas is subject to short- and medium-term variability in the volume of hypoxic water that develops. De Decker (1970) showed that the occurrence of low oxygen water off Lambert's Bay is seasonal, with highest development in summer/autumn. Bailey & Chapman (1991), on the other hand, demonstrated that in the St Helena Bay area daily variability exists as a result of downward flux of oxygen through thermoclines and short-term variations in upwelling intensity. Subsequent upwelling processes can move this low-oxygen water up onto the inner shelf, and into nearshore waters, often with devastating effects on marine communities.

Periodic low oxygen events in the nearshore region can have catastrophic effects on the marine communities leading to large-scale stranding of rock lobsters, and mass mortalities of marine biota and fish (Newman & Pollock 1974; Matthews & Pitcher 1996; Pitcher 1998; Cockcroft *et al.* 2000). The development of anoxic conditions as a result of the decomposition of huge amounts of organic matter generated by algal blooms is the main cause for these mortalities and walkouts. The blooms develop over a period of unusually calm wind conditions when sea surface temperatures where high. Algal blooms usually occur during summer-autumn (February to April) but can also develop in winter during the 'berg' wind periods, when similar warm windless conditions occur for extended periods.

3.2.8 Turbidity

Turbidity is a measure of the degree to which the water loses its transparency due to the presence of suspended particulate matter. Total Suspended Particulate Matter (TSPM) can be divided into Particulate Organic Matter (POM) and Particulate Inorganic Matter (PIM), the ratios between them varying considerably. The POM usually consists of detritus, bacteria, phytoplankton and zooplankton, and serves as a source of food for filter-feeders. Seasonal microphyte production associated with upwelling events will play an important role in determining the concentrations of POM in coastal waters. PIM, on the other hand, is primarily of geological origin consisting of fine sands, silts and clays. Off the southern African West Coast, the PIM loading in nearshore waters is strongly related to natural riverine inputs. 'Berg' wind events can potentially contribute the same order of magnitude of sediment input as the annual estimated input of sediment by the Orange River (Shannon & Anderson 1982; Zoutendyk 1992, 1995; Shannon & O'Toole 1998; Lane & Carter 1999).

Concentrations of suspended particulate matter in shallow coastal waters can vary both spatially and temporally, typically ranging from a few mg/l to several tens of mg/l (Bricelj & Malouf 1984; Berg & Newell 1986; Fegley *et al.* 1992). Field measurements of TSPM and PIM concentrations in the Benguela current system have indicated that outside of major flood events, background concentrations of coastal and continental shelf suspended sediments are generally <12 mg/l, showing significant long-shore variation (Zoutendyk 1995). Considerably higher concentrations of PIM have, however, been reported from southern African West Coast waters under stronger wave conditions associated with high tides and storms, or under flood conditions.

The major source of turbidity in the swell-influenced nearshore areas off the West Coast is the redistribution of fine inner shelf sediments by long-period Southern Ocean swells. The current velocities typical of the Benguela (10-30 cm/s) are capable of resuspending and transporting considerable quantities of sediment equatorwards. Under relatively calm wind conditions, however, much of the suspended fraction (silt and clay) that remains in suspension for longer periods becomes entrained in the slow poleward undercurrent (Shillington *et al.* 1990; Rogers & Bremner 1991).

Superimposed on the suspended fine fraction, is the northward littoral drift of coarser bedload sediments, parallel to the coastline. This northward, nearshore transport is generated by the predominantly south-westerly swell and wind-induced waves. Longshore sediment transport varies considerably in the shore-perpendicular dimension, being substantially higher in the surf-zone than at depth, due to high turbulence and convective flows associated with breaking waves, which suspend and mobilise sediment (Smith & Mocke 2002).

On the inner and middle continental shelf, the ambient currents are insufficient to transport coarse sediments, and resuspension and shoreward movement of these by wave-induced currents occur primarily under storm conditions (see also Drake *et al.* 1985; Ward 1985).

3.3. The Biological Environment

Biogeographically, the study area falls into the cold temperate Namaqua Bioregion, which extend from Sylvia Hill, north of Lüderitz in Namibia to Cape Columbine (Emanuel *et al.* 1992; Lombard *et al.* 2004). The portion of the proposed Exploration Right area that extends beyond the shelf break onto the continental slope and into abyssal depths fall into the Atlantic Offshore Bioregion (Lombard *et al.* 2004). The coastal, wind-induced upwelling characterising the western Cape coastline, is the principle physical process which shapes the marine ecology of the southern Benguela region. The Benguela system is characterised by the presence of cold surface water, high biological productivity, and highly variable physical, chemical and biological conditions.

Communities within marine habitats are largely ubiquitous throughout the southern African West Coast region, being particular only to substrate type or depth zone. These biological communities consist of many hundreds of species, often displaying considerable temporal and spatial variability (even at small scales). The majority of the proposed Exploration Right area is located beyond the 300 m depth contour, the closest points to shore being ~200 km off the coast in the area off the Groen River, and ~220 km off the coast in the north of the Exploration Right area off Kleinzee. The near- and offshore marine ecosystems comprise a limited range of habitats, namely unconsolidated seabed sediments and the water column. The biological communities 'typical' of these habitats are described briefly below, focussing both on dominant, commercially important and conspicuous species, as well as potentially threatened or sensitive species, which may be affected by the proposed seismic survey.

3.3.1 Demersal Communities

3.3.1.1 Benthic Invertebrate Macrofauna

The benthic biota of soft-bottom substrates constitutes invertebrates that live on (epifauna), or burrow within (infauna), the sediments, and are generally divided into macrofauna (animals >1 mm) and meiofauna (<1 mm). The structure and composition of benthic soft bottom communities is primarily a function of water depth and sediment grain size, but other factors such as current velocity, organic content, and food abundance also play a role (Snelgrove & Butman 1994; Flach & Thomsen 1998; Ellingsen 2002).

Numerous studies have been conducted on southern African West Coast continental shelf benthos, mostly focused on mining, pollution or demersal trawling impacts (Christie & Moldan 1977; Moldan 1978; Jackson & McGibbon 1991; Environmental Evaluation Unit 1996; Parkins & Field 1997; 1998; Pulfrich & Penney 1999; Goosen *et al.* 2000; Savage *et al.* 2001; Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b; Atkinson 2009). The description below is drawn from the various baseline and monitoring surveys conducted by diamond mining companies (Bickerton & Carter 1995; Steffani & Pulfrich 2007; Steffani 2007a; 2007b), supplemented by the work of Christie (1974), who undertook a systematic study investigating macrobenthic community distributions across the continental shelf off Lamberts Bay.

In general, species diversity, abundance and biomass increase from the shore to 80 m depth, with communities being characterised equally by polychaetes, crustaceans and molluscs. Further offshore to 120 m depth, the midshelf is a particularly rich benthic habitat where biomass can attain 60 g/m^2 dry weight (Christie 1974; see also Steffani 2007b). The comparatively high benthic biomass in this midshelf region represents an important food source to carnivores such as the mantis shrimp, cephalopods and demersal fish species (Lane & Carter 1999). Outside of this rich zone biomass declines to 4.9 g/m^2 at 200 m depth and then is consistently low (<3 g/m^2) on the outer shelf (Christie 1974). Offshore communities are dominated by polychaetes (e.g. *Diopatra dubia, D. monroi, D. cuprea cuprea, Lumbrineris albidentata, Laonice cirrata*), echinoderms (e.g. *Amphiura* sp., *Ophiura* sp.) and crustaceans (e.g. *Ampelisca brevicornis, Hippomedon onconotus, Tanais philetaerus*) (Atkinson 2009). The benthic fauna of the continental shelf and continental slope beyond ~450 m depth are poorly known, largely due to limited opportunities for sampling, and to date very few areas of the continental slope off the West Coast have been biologically surveyed. With little sea floor topography and hard substrate, such areas are likely to offer minimal habitat diversity or niches for animals to occupy. Detritus-feeding crustaceans, holothurians and echinoderms tend to be the dominant epi-benthic organisms of such habitats.

An array of environmental factors and their complex interplay is responsible for the structure of benthic communities, however, the relative importance of each of these factors is difficult to determine as they interact and combine to define a distinct habitat in which the animals occur. Nonetheless, water depth and sediment composition are two of the major components of the physical environment determining the macrofauna community structure (Steffani & Pulfrich 2004a, 2004b; 2007; Steffani 2007a; 2007b). Whilst many empirical studies related community structure to sediment composition (e.g. Christie 1974; Warwick *et al.* 1991; Yates *et al.* 1993; Desprez 2000; van Dalfsen *et al.* 2000), other studies have illustrated the high natural variability of soft-bottom communities, both in space and time, on scales of hundreds of metres to metres (e.g. Kenny *et al.* 1998; Kendall & Widdicombe 1999; van Dalfsen *et al.* 2000; Zajac *et al.* 2000; Parry *et al.* 2003).

Also associated with soft-bottom substrates are demersal communities that comprise bottom-dwelling invertebrate and vertebrate species, many of which are dependent on the invertebrate benthic macrofauna as a food source. Atkinson (2009) reported numerous species of urchins and burrowing anemones beyond 300 m depth off the West Coast. Common commercial demersal species found mostly on the continental shelf but also extending beyond 500 m water depth include both the shallow-water hake, *Merluccuis capensis* and the deep-water hake (*Merluccius paradoxus*), monkfish (*Lophius vomerinus*), and kingklip (*Genypterus capensis*). There are also many other demersal "bycatch" species that include jacopever (*Helicolenus dactylopterus*), angelfish/pomfret (*Brama brama*), kingklip (*Genypterus capensis*) and gurnard (*Chelidonichtyes* sp), as well as several cephalopod species (such as squid and cuttlefishes) and many elasmobranch (sharks and rays) species. The distribution of the shelf community varies seasonally (Lane & Carter 1999; Hampton *et al.* 1999).

3.3.1.2 Deep-water coral communities

There has been increasing interest in deep-water corals in recent years because of their likely sensitivity to disturbance and their long generation times. These benthic filter-feeders generally occur at depths exceeding 150 m. Some species form reefs while others are smaller and remain solitary. Corals add structural complexity to otherwise uniform seabed habitats thereby creating areas of high biological diversity (Breeze *et al.* 1997; MacIssac *et al.* 2001). Deep water corals establish themselves below the thermocline where there is a continuous and regular supply of concentrated particulate organic matter, caused by the flow of a relatively strong current over special topographical formations which cause eddies to form. Nutrient seepage from the substratum might also promote a location for settlement (Hovland *et al.* 2002). Substantial shelf areas in the productive Benguela region should thus potentially be capable of supporting rich, cold water, benthic, filter-feeding communities.

3.3.1.3 Demersal Fish Species

As many as 110 species of bony and cartilaginous fish have been identified in the demersal communities on the continental shelf of the West Coast (Roel 1987). Changes in fish communities occur with increasing depth (Roel 1987; Smale *et al.* 1993; Macpherson & Gordoa 1992; Bianchi *et al.* 2001; Atkinson 2009), with the the most substantial change in species composition occurring in the shelf break region between 300 m and 400 m depth (Roel 1987; Atkinson 2009). The shelf community (<380 m) is dominated by the Cape hake *M. capensis*, and includes jacopever *Helicolenus dactylopterus*, Izak catshark *Holohalaelurus regain*, soupfin shark *Galeorhinus galeus* and whitespotted houndshark *Mustelus palumbes*. The more diverse deeper water community is dominated by the deepwater hake *Merluccius paradoxus*, monkfish *Lophius vomerinus*, kingklip *Genypterus capensis*, bronze whiptail *Lucigadus ori* and hairy conger *Bassanago albescens* and various squalid shark species. There is some degree of species overlap between the depth zones.

Roel (1987) showed seasonal variations in the distribution ranges shelf communities, with species such as the pelagic goby *Sufflogobius bibarbatus*, and West Coast sole *Austroglossus microlepis* occurring in shallow water north of Cape Point during summer only. The deep-sea community was found to be homogenous both spatially and temporally. In a more recent stdy, however, Atkinson (2009) identified two long-term community shifts in demersal fish communities; the first (early to mid-1990s) being associated with an overall increase in density of many species, whilst many species decreased in density during the second shift (mid-2000s). These community shifts correspond temporally with regime shifts detected in environmental forcing variables (Sea Surface Temperatures and upwelling anomalies) (Howard *et al.* 2007) and with the eastward shifts observed in small pelagic fish species and rock lobster populations (Coetzee *et al.* 2008, Cockcroft *et al.* 2008).

The diversity and distribution of demersal cartilagenous fishes on the West Coast is discussed by Compagno *et al.* (1991). The species likely to occur in the proposed Exploration Right area, and their approximate depth range, are listed in Table 2.

Table 2: Demersal cartilaginous species found on the continental shelf along the West Coast, with approximate depth range at which the species occurs (Compagno *et al.* 1991).

Common Name	Scientific name	Depth Range
Frilled shark	*Chlamydoselachus anguineus*	200-1,000
Six gill cowshark	*Hexanchus griseus*	150-600
Gulper shark	*Centrophorus granulosus*	480
Leafscale gulper shark	*Centrophorus squamosus*	370-800
Bramble shark	*Echinorhinus brucus*	55-285
Black dogfish	*Centroscyllium fabricii*	>700
Portuguese shark	*Centroscymnus coelolepis*	>700
Longnose velvet dogfish	*Centroscymnus crepidater*	400-700
Birdbeak dogfish	*Deania calcea*	400-800
Arrowhead dogfish	*Deania profundorum*	200-500
Longsnout dogfish	*Deania quadrispinosum*	200-650
Sculpted lanternshark	*Etmopterus brachyurus*	450-900
Brown lanternshark	*Etmopterus compagnoi*	450-925
Giant lanternshark	*Etmopterus granulosus*	>700
Smooth lanternshark	*Etmopterus pusillus*	400-500
Spotted spiny dogfish	*Squalus acanthias*	100-400
Shortnose spiny dogfish	*Squalus megalops*	75-460
Shortspine spiny dogfish	*Squalus mitsukurii*	150-600
Sixgill sawshark	*Pliotrema warreni*	60-500
Goblin shark	*Mitsukurina owstoni*	270-960
Smalleye catshark	*Apristurus microps*	700-1,000
Saldanha catshark	*Apristurus saldanha*	450-765
"grey/black wonder" catsharks	*Apristurus* spp.	670-1,005
Tigar catshark	*Halaelurus natalensis*	50-100
Izak catshark	*Holohalaelurus regani*	100-500
Yellowspotted catshark	*Scyliorhinus capensis*	150-500
Soupfin shark/Vaalhaai	*Galeorhinus galeus*	<10-300
Houndshark	*Mustelus mustelus*	<100
Whitespotted houndshark	*Mustelus palumbes*	>350
Little guitarfish	*Rhinobatos annulatus*	>100
Atlantic electric ray	*Torpedo nobiliana*	120-450
African softnose skate	*Bathyraja smithii*	400-1,020
Smoothnose legskate	*Cruriraja durbanensis*	>1,000
Roughnose legskate	*Crurirajaparcomaculata*	150-620
African dwarf skate	*Neoraja stehmanni*	290-1,025
Thorny skate	*Raja radiata*	50-600
Bigmouth skate	*Raja robertsi*	>1,000
Slime skate	*Raja pullopunctatus*	15-460
Rough-belly skate	*Raja springeri*	85-500
Yellowspot skate	*Raja wallacei*	70-500
Roughskin skate	*Raja spinacidermis*	1,000-1,350

Common Name	Scientific name	Depth Range
Biscuit skate	*Raja clavata*	25-500
Munchkin skate	*Raja caudaspinosa*	300-520
Bigthorn skate	*Raja confundens*	100-800
Ghost skate	*Raja dissimilis*	420-1,005
Leopard skate	*Raja leopardus*	300-1,000
Smoothback skate	*Raja ravidula*	500-1,000
Spearnose skate	*Raja alba*	75-260
St Joseph	*Callorhinchus capensis*	30-380
Cape chimaera	*Chimaera* sp.	680-1,000
Brown chimaera	*Hydrolagus* sp.	420-850
Spearnose chimaera	Rhinochimaera atlantica	650-960

3.3.2 Seamount Communities

Two geological features of note in the vicinity of the proposed Exploration Right area are Child's Bank, situated ~150 km offshore at about 31°S, and Tripp Seamount situated ~250 km offshore at about 29°40'S. Features such as banks, knolls and seamounts (referred to collectively here as "seamounts"), which protrude into the water column, are subject to, and interact with, the water currents surrounding them. The effects of such seabed features on the surrounding water masses can include the up-welling of relatively cool, nutrient-rich water into nutrient-poor surface water thereby resulting in higher productivity (Clark *et al.* 1999), which can in turn strongly influences the distribution of organisms on and around seamounts. Evidence of enrichment of bottom-associated communities and high abundances of demersal fishes has been regularly reported over such seabed features.

The enhanced fluxes of detritus and plankton that develop in response to the complex current regimes lead to the development of detritivore-based food-webs, which in turn lead to the presence of seamount scavengers and predators. Seamounts provide an important habitat for commercial deepwater fish stocks such as orange roughy, oreos, alfonsino and Patagonian toothfish, which aggregate around these features for either spawning or feeding (Koslow 1996).

Such complex benthic ecosystems in turn enhance foraging opportunities for many other predators, serving as mid-ocean focal points for a variety of pelagic species with large ranges (turtles, tunas and billfish, pelagic sharks, cetaceans and pelagic seabirds) that may migrate large distances in search of food or may only congregate on seamounts at certain times (Hui 1985; Haney *et al.* 1995). Seamounts thus serve as feeding grounds, spawning and nursery grounds and possibly navigational markers for a large number of species (SPRFMA 2007).

Enhanced currents, steep slopes and volcanic rocky substrata, in combination with locally generated detritus, favour the development of suspension feeders in the benthic communities characterising seamounts (Rogers 1994). Deep- and cold-water corals (including stony corals, black corals and soft corals) (Figure 10, left) are a prominent component of the suspension-feeding fauna of many seamounts, accompanied by barnacles, bryozoans, polychaetes, molluscs, sponges, sea squirts, basket stars, brittle stars and crinoids (reviewed in Rogers 2004). There is also associated mobile benthic fauna that includes echinoderms (sea urchins and sea cucumbers) and crustaceans (crabs and lobsters) (reviewed by Rogers 1994).

Some of the smaller cnidarians species remain solitary while others form reefs thereby adding structural complexity to otherwise uniform seabed habitats. The coral frameworks offer refugia for a great variety of invertebrates and fish (including commercially important species) within, or in association with, the living and dead coral framework (Figure 10, right) thereby creating spatially fragmented areas of high biological diversity. Compared to the surrounding deep-sea environment, seamounts typically form biological hotspots with a distinct, abundant and diverse fauna, many species of which remain unidentified. Consequently, the fauna of seamounts is usually highly unique and may have a limited distribution restricted to a single geographic region, a seamount chain or even a single seamount location (Rogers *et al.* 2008). Levels of endemism on seamounts are also relatively high compared to the deep sea. As a result of conservative life histories (*i.e.* very slow growing, slow to mature, high longevity, low levels of recruitment) and sensitivity to changes in environmental conditions, such biological communities have been identified as Vulnerable Marine Ecosystems (VMEs). They are recognised as being particularly sensitive to anthropogenic disturbance (primarily deep-water trawl fisheries and mining), and once damaged are very slow to recover, or may never recover (FAO 2008).

It is not always the case that seamount habitats are VMEs, as some seamounts may not host communities of fragile animals or be associated with high levels of endemism. South Africa's seamounts and their associated benthic communities have not been sampled by either geologists or biologists (Sink & Samaai 2009) and the same is most likely true for Tripp Seamount. There is reference to decapods crustaceans from Tripp Seamount (Kensley 1980, 1981) and exploratory deep-water trawl fishing (Hampton 2003), but otherwise knowledge of benthic communities characterising southern African seamounts is lacking. Evidence from video footage taken on hard-substrate habitats in 100 - 120 m depth off southern Namibia and to the south-east of the submarine knoll known as Child's Bank off the Namaqualand coast (De Beers Marine, unpublished data) (Figure 11) suggest that vulnerable communities including gorgonians, octocorals and reef-building sponges occur on the continental shelf, and similar communities may thus be expected on the seamount.

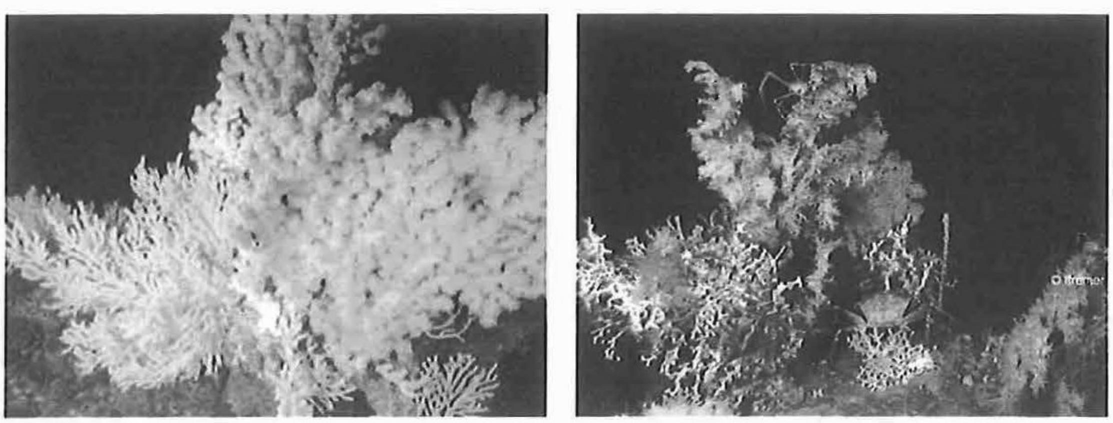

Figure 10: Seamounts are characterised by a diversity of deep-water corals that add structural complexity to seabed habitats and offer refugia for a variety of invertebrates and fish (Photos: www.dfo-mpo.gc.ca/science/Publications/article/2007/21-05-2007-eng.htm, Ifremer & AWI 2003).

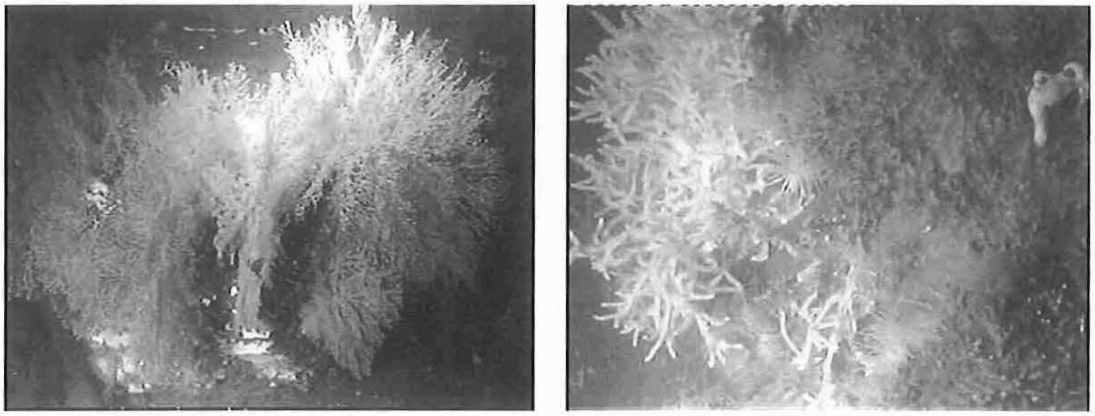

Figure 11: Gorgonians and bryozoans communities recorded on deep-water reefs (100-120 m) off the southern African West Coast (Photos: De Beers Marine).

3.3.3 Pelagic Communities

The pelagic communities are typically divided into plankton and fish, and their main predators, marine mammals (seals, dolphins and whales), seabirds and turtles.

3.3.3.1 Plankton

Plankton is particularly abundant in the shelf waters off the West Coast, being associated with the upwelling characteristic of the area. Plankton range from single-celled bacteria to jellyfish of 2-m diameter, and include bacterio-plankton, phytoplankton, zooplankton, and ichthyoplankton (Figure 12).

Phytoplankton are the principle primary producers with mean productivity ranging from 2.5 - 3.5 g C/m^2/day for the midshelf region and decreasing to 1 g C/m^2/day inshore of 130 m (Shannon & Field 1985; Mitchell-Innes & Walker 1991; Walker & Peterson 1991). The phytoplankton is dominated by large-celled organisms, which are adapted to the turbulent sea conditions. The most common diatom genera are *Chaetoceros, Nitschia, Thalassiosira, Skeletonema, Rhizosolenia, Coscinodiscus* and *Asterionella* (Shannon & Pillar 1985). Diatom blooms occur after upwelling events, whereas dinoflagellates (e.g. *Prorocentrum, Ceratium* and *Peridinium*) are more common in blooms that occur during quiescent periods, since they can grow rapidly at low nutrient concentrations. In the surf zone, diatoms and dinoflagellates are nearly equally important members of the phytoplankton, and some silicoflagellates are also present.

Red-tides are ubiquitous features of the Benguela system (see Shannon & Pillar, 1986). The most common species associated with red tides (dinoflagellate and/or ciliate blooms) are *Noctiluca scintillans, Gonyaulax tamarensis, G. polygramma* and the ciliate *Mesodinium rubrum*. *Gonyaulax* and *Mesodinium* have been linked with toxic red tides. Most of these red-tide events occur quite close inshore although Hutchings *et al.* (1983) have recorded red-tides 30 km offshore. They are unlikley to occur in the offshore regions of the proposed Exploration Right area.

The mesozooplankton (≥200 µm) is dominated by copepods, which are overall the most dominant and diverse group in southern African zooplankton. Important species are

Centropages brachiatus, Calanoides carinatus, Metridia lucens, Nannocalanus minor, Clausocalanus arcuicornis, Paracalanus parvus, P. crassirostris and *Ctenocalanus vanus*. All of the above species typically occur in the phytoplankton rich upper mixed layer of the water column, with the exception of *M. lucens* which undertakes considerable vertical migration.

The macrozooplankton (≥1,600 µm) are dominated by euphausiids of which 18 species occur in the area. The dominant species occurring in the nearshore are *Euphausia lucens* and *Nyctiphanes capensis*, although neither species appears to survive well in waters seaward of oceanic fronts over the continental shelf (Pillar *et al.* 1991).

Standing stock estimates of mesozooplankton for the southern Benguela area range from 0.2 - 2.0 g C/m^2, with maximum values recorded during upwelling periods. Macrozooplankton biomass ranges from 0.1-1.0 g C/m^2, with production increasing north of Cape Columbine (Pillar 1986). Although it shows no appreciable onshore-offshore gradients, standing stock is highest over the shelf, with accumulation of some mobile zooplanktors (euphausiids) known to occur at oceanographic fronts. Beyond the continental slope biomass decreases markedly.

Zooplankton biomass varies with phytoplankton abundance and, accordingly, seasonal minima will exist during non-upwelling periods when primary production is lower (Brown 1984; Brown & Henry 1985), and during winter when predation by recruiting anchovy is high. More intense variation will occur in relation to the upwelling cycle; newly upwelled water supporting low zooplankton biomass due to paucity of food, whilst high biomasses develop in aged upwelled water subsequent to significant development of phytoplankton. Irregular pulsing of the upwelling system, combined with seasonal recruitment of pelagic fish species into West Coast shelf waters during winter, thus results in a highly variable and dynamic balance between plankton replenishment and food availability for pelagic fish species.

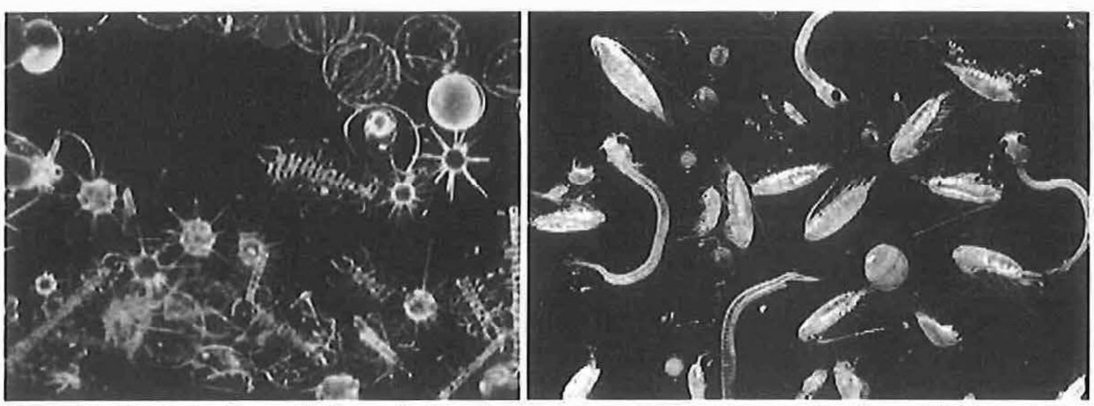

Figure 12: Phytoplankton (left, photo: hymagazine.com) and zooplankton (right, photo: mysciencebox.org) is associated with upwelling cells.

Although ichthyoplankton (fish eggs and larvae) comprise a minor component of the overall plankton, it remains significant due to the commercial importance of the overall fishery in the region. Various pelagic and demersal fish species are known to spawn in the inshore regions of the southern Benguela, (including pilchard, round herring, chub mackerel lanternfish and hakes (Crawford *et al.* 1987) (see Figure 13), and their eggs and larvae form an important contribution to the ichthyoplankton in the region. Ichthyoplankton abundance in the offshore oceanic waters of the proposed Exploration Right area are, however, expected to be low.

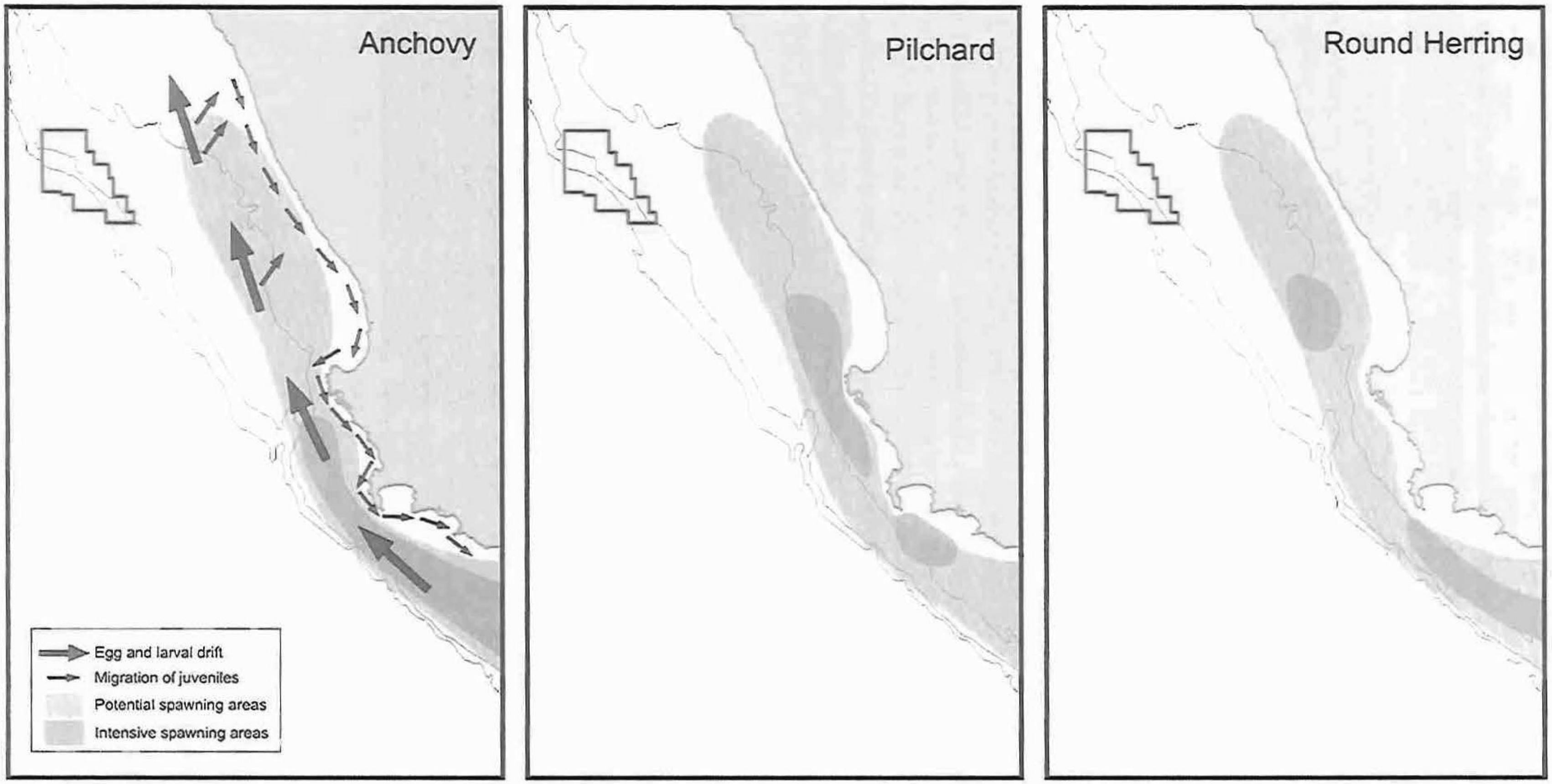

Figure 13: Major spawning areas in the southern Benguela region in relation to the licence block (red polygon) (adapted from Cruikshank 1990).

3.3.3.2 Cephalopods

The major cephalopod resource in the southern Benguela are sepiods/cuttlefish (Lipinski 1992; Augustyn *et al.* 1995) (Table 3). Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60 - 190 m, whereas *S. hieronis* densities were higher at depths between 110 - 250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. Biomass of these species was generally higher in the summer than in winter.

Cuttlefish are largely epi-benthic and occur on mud and fine sediments in association with their major prey item; mantis shrimps (Augustyn *et al.* 1995). They form an important food item for demersal fish.

Table 3: The cephalopod species occurring in the Benguela system (Lipinski 1992).

Species
Loligo vulgaris reynaudii
Todarodes angolensis
Todarodes filippovae
Todaropsis eblanae
Lycoteuthis ?diadema
Sepia australis
Sepia hieronis
Octopus spp.
Argonauta spp.
Rossia enigmatica
Ommastrephes bartramii
Abraliopsis gilchristi
Lolliguncula mercatoris
Histioteuthis miranda

3.3.3.3 Fish

Small pelagic species include the sardine/pilchard (*Sadinops ocellatus*) (Figure 14, left), anchovy (*Engraulis capensis*), chub mackerel (*Scomber japonicus*), horse mackerel (*Trachurus capensis*) (Figure 14, right) and round herring (*Etrumeus whiteheadi*). These species typically occur in mixed shoals of various sizes (Crawford *et al.* 1987), and generally occur within the 200 m contour and thus unlikely to be encountered in the proposed Exploration Right area. Most of the pelagic species exhibit similar life history patterns involving seasonal migrations between the west and south coasts. Apart from round herring which spawn offshore of the shelf break on the West Coast (see Figure 13), the spawning areas of the major pelagic species are distributed on the continental shelf extending from south of St Helena Bay to Mossel Bay on the South Coast (Shannon & Pillar 1986). They spawn downstream of major upwelling centres in spring and summer, and their eggs and larvae are subsequently carried around Cape Point and up the coast in northward flowing surface waters.

Figure 14: Cape fur seal preying on a shoal of pilchards (left). School of horse mackerel (right) (photos: www.underwatervideo.co.za; www.delivery.superstock.com).

At the start of winter every year, juveniles of most small pelagic shoaling species recruit into coastal waters in large numbers between the Orange River and Cape Columbine. They recruit in the pelagic stage, across broad stretches of the shelf, to utilise the shallow shelf region as nursery grounds before gradually moving southwards in the inshore southerly flowing surface current, towards the major spawning grounds east of Cape Point. Recruitment success relies on the interaction of oceanographic events, and is thus subject to spatial and temporal variability. Consequently, the abundance of adults and juveniles of these small, short-lived (1-3 years) pelagic fish is highly variable both within and between species.

Two species that migrate along the West Coast following the shoals of anchovy and pilchards are snoek *Thyrsites atun* and chub mackerel *Scomber japonicas*. Their appearance along the West and South-West coasts are highly seasonal. Snoek migrating along the southern African West Coast reach the area between St Helena Bay and the Cape Peninsula between May and August. They spawn in these waters between July and October before moving offshore and commencing their return northward migration (Payne & Crawford 1989). They are voracious predators occurring throughout the water column, feeding on both demersal and pelagic invertebrates and fish. Chub mackerel similarly migrate along the southern African West Coast reaching South-Western Cape waters between April and August. They move inshore in June and July to spawn before starting the return northwards offshore migration later in the year. Their abundance and seasonal migrations are thought to be related to the availability of their shoaling prey species (Payne & Crawford 1989).

Large pelagic species include tunas, billfish and pelagic sharks, which migrate throughout the southern oceans, between surface and deep waters (>300 m) and have a highly seasonal abundance in the Benguela. Species occurring off western southern Africa include the albacore/longfin tuna *Thunnus alalunga* (Figure 15, right), yellowfin *T. albacares*, bigeye *T. obesus*, and skipjack *Katsuwonus pelamis tunas*, as well as the Atlantic blue marlin *Makaira nigricans* (Figure 15, left), the white marlin *Tetrapturus albidus* and the broadbill swordfish *Xiphias gladius* (Payne & Crawford 1989). The distributions of these species is dependent on food availability in the mixed boundary layer between the Benguela and warm central Atlantic waters. Concentrations of large pelagic species are also known to occur associated with underwater feature such as canyons and seamounts as well as meteorologically induced oceanic fronts (Penney *et al.* 1992).

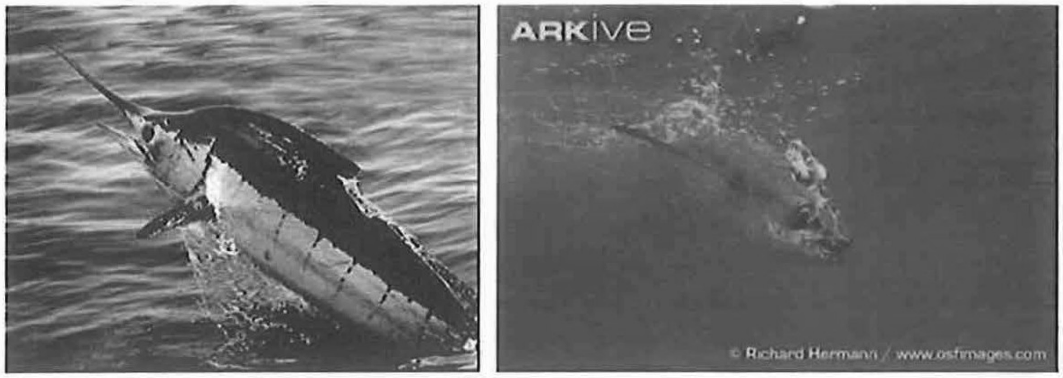

Figure 15: Large migratory pelagic fish such as blue marlin (left) and longfin tuna (right) occur in offshore waters (photos: www.samathatours.com; www.osfimages.com).

A number of species of pelagic sharks are also known to occur on the West and South-West Coast, including blue *Prionace glauca*, short-fin mako *Isurus oxyrinchus* and oceanic whitetip sharks *Carcharhinus longimanus*. Occurring throughout the world in warm temperate waters, these species are usually found further offshore on the West Coast. Great whites *Carcharodon carcharias* and whale sharks *Rhincodon typus* may also be encountered in coastal and offshore areas, although the latter occurs more frequently along the South and East coasts. Of these the blue shark is listed as "Near threatened", and the short-fin mako, whitetip, great white and whale sharks as "Vulnerable" on the International Union for Conservation of Nature (IUCN).

3.3.3.4 Turtles

Three species of turtle occur along the West Coast, namely the Leatherback (*Dermochelys coriacea*) (Figure 16, left), and occasionally the Loggerhead (*Caretta caretta*) (Figure 16, right) and the Green (*Chelonia mydas*) turtle. Loggerhead and Green turtles are expected to occur only as occasional visitors along the West Coast.

The Leatherback is the only turtle likely to be encountered in the offshore waters of west South Africa. The Benguela ecosystem, especially the northern Benguela where jelly fish numbers are high, is increasingly being recognized as a potentially important feeding area for leatherback turtles from several globally significant nesting populations in the south Atlantic (Gabon, Brazil) and south east Indian Ocean (South Africa) (Lambardi *et al.* 2008, Elwen & Leeney 2011; SASTN 2011[1]). Leatherback turtles from the east South Africa population have been satellite tracked swimming around the west coast of South Africa and remaining in the warmer waters west of the Benguela ecosystem (Lambardi *et al.* 2008).

Leatherback turtles inhabit deeper waters and are considered a pelagic species, travelling the ocean currents in search of their prey (primarily jellyfish). While hunting they may dive to over 600 m and remain submerged for up to 54 minutes (Hays *et al.* 2004), thus making them difficult to observe from the surface and susceptible to seismic operations. Their

[1] *SASTN Meeting - Second meeting of the South Atlantic Sea Turtle Network, Swakopmund, Namibia, 24-30 July 2011.*

abundance in the study area is unknown but expected to be low. Breeding areas for Leatherback turtles occur over 2,000 km to north-west of the survey area in the Republic of Congo and Gabon.

Leatherbacks feed on jellyfish and are known to have mistaken plastic marine debris for their natural food. Ingesting this can obstruct the gut, lead to absorption of toxins and reduce the absorption of nutrients from their real food. Leatherback Turtles are listed as "Critically Endangered" worldwide by the IUCN and are in the highest categories in terms of need for conservation in CITES (Convention on International Trade in Endangered Species), and CMS (Convention on Migratory Species). Loggerhead and green turtles are listed as "Endangered". As a signatory of CMS, South Africa has endorsed and signed a CMS International Memorandum of Understanding specific to the conservation of marine turtles. South Africa is thus committed to conserve these species at an international level.

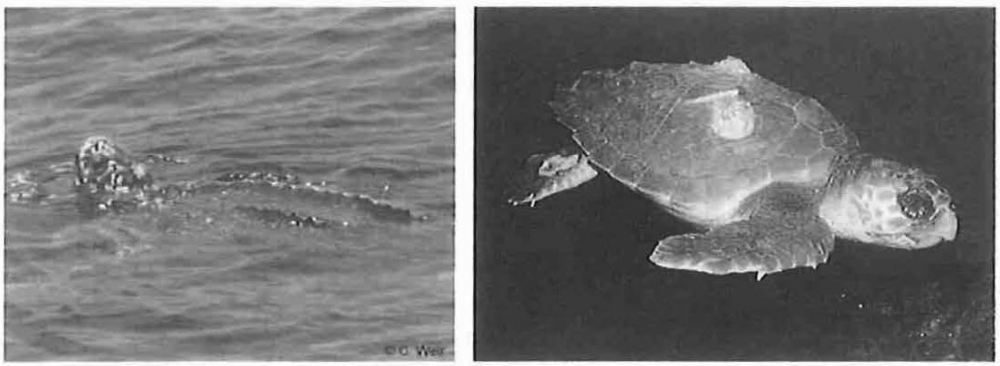

Figure 16: Leatherback (left) and loggerhead turtles (right) occur along the West Coast of Southern Africa (Photos: Ketos Ecology 2009; www.aquaworld-crete.com).

3.3.3.5 Seabirds

Large numbers of pelagic seabirds exploit the pelagic fish stocks of the Benguela system. Of the 49 species of seabirds that occur in the Benguela region, 14 are defined as resident, 10 are visitors from the northern hemisphere and 25 are migrants from the southern Ocean. The 18 species classified as being common in the southern Benguela are listed in Table 4. The area between Cape Point and the Orange River supports 38% and 33% of the overall population of pelagic seabirds in winter and summer, respectively. Most of the species in the region reach highest densities offshore of the shelf break (200 - 500 m depth) with highest population levels during their non-breeding season (winter). Pintado petrels and Prion spp. show the most marked variation here.

14 species of seabirds breed in southern Africa; Cape Gannet (Figure 17, left), African Penguin (Figure 17, right), four species of Cormorant, White Pelican, three Gull and four Tern species (Table 5). The breeding areas are distributed around the coast with islands being especially important. The number of successfully breeding birds at the particular breeding sites varies with food abundance. Most of the breeding seabird species forage at sea with most birds being found relatively close inshore (10-30 km). Cape Gannets, however, are known to forage up to 140 km offshore (Dundee 2003; Ludynia 2007), and African Penguins have also been recorded as far as 60 km offshore.

Figure 17: Cape Gannets *Morus capensis* (left) (Photo: NACOMA) and African Penguins *Spheniscus demersus* (right) (Photo: Klaus Jost) breed primarily on the offshore Islands.

3.3.3.6 Marine Mammals

The marine mammal fauna occurring off the west coast of South Africa, north of Cape Columbine, include whales, dolphins and seals. South of Cape Columbine, some cetacean species more commonly associated with warmer Agulhas current waters are known to occur. The description below focusses on those species associated with the Benguela ecosystem proper and the waters offshore of this.

The cetacean fauna of the West Coast comprises **28 species** of whales and dolphins known (historic sightings or strandings) or likely (habitat projections based on known species parameters) to occur here (Table 6). The offshore areas have been particularly poorly studied with almost all available information from deeper waters (>200 m) arising from historic whaling records. Information on smaller cetaceans in deeper waters is particularly poor.

The distribution of whales and dolphins on the West Coast can largely be split into those associated with the continental shelf and those that occur in deep, oceanic waters. Species from both environments may, however, be found associated with the shelf (200 - 1,000 m), making this the most species-rich area for cetaceans. Cetacean density on the continental shelf is usually higher than in pelagic waters as species associated with the pelagic environment tend to be wide-ranging across 1,000s of kilometres. The most common species within the proposed Exploration Right area (in terms of likely encounter rate not total population sizes) are likely to be the dusky dolphin, long finned pilot whale, southern right whale and humpback whale.

Cetaceans comprised two basic taxonomic groups: the mysticetes (filter-feeding baleen whales) and the odontocetes (toothed predatory whales and dolphins). Due to large differences in their size, sociality, communication abilities, ranging behaviour and acoustic behaviour, these two groups are considered separately.

The majority of baleen whales fall into the family Balaenidae. Those occurring in the proposed Exploration Right area include the blue, fin, sei, minke, dwarf minke and two populations of Bryde's whale. Most of these species occur in pelagic waters, with only occasional visits into shelf waters. All of these species show some degree of migration either to, or through, the proposed Exploration Right area when *en route* between higher-latitude feeding grounds (Antarctic or Subantarctic) and lower-latitude breeding grounds.

Table 4: Pelagic seabirds common in the southern Benguela region (Crawford *et al.* 1991).

Common Name	Species name	Global IUCN
Shy albatross	*Thalassarche cauta*	Near Threatened
Black browed albatross	*Thalassarche melanophrys*	Endangered[1]
Yellow nosed albatross	*Thalassarche chlororhynchos*	Endangered
Giant petrel sp.	*Macronectes halli/giganteus*	Near Threatened
Pintado petrel	*Daption capense*	Least concern
Greatwinged petrel	*Pterodroma macroptera*	Least concern
Soft plumaged petrel	*Pterodroma mollis*	Least concern
Prion spp	*Pachyptila* spp.	Least concern
White chinned petrel	*Procellaria aequinoctialis*	Vulnerable
Cory's shearwater	*Calonectris diomedea*	Least concern
Great shearwater	*Puffinus gravis*	Least concern
Sooty shearwater	*Puffinus griseus*	Near Threatened
European Storm petrel	*Hydrobates pelagicus*	Least concern
Leach's storm petrel	*Oceanodroma leucorhoa*	Least concern
Wilson's storm petrel	*Oceanites oceanicus*	Least concern
Blackbellied storm petrel	*Fregetta tropica*	Least concern
Skua spp.	*Catharacta/Stercorarius* spp.	Least concern
Sabine's gull	*Larus sabini*	Least concern

[1]. May move to Critically Endangered if mortality from long-lining does not decrease.

Table 5: Breeding resident seabirds present along the West Coast (CCA & CMS 2001).

Common name	Species name	Global IUCN Status
African Penguin	*Spheniscus demersus*	Vulnerable
Great Cormorant	*Phalacrocorax carbo*	Least Concern
Cape Cormorant	*Phalacrocorax capensis*	Near Threatened
Bank Cormorant	*Phalacrocorax neglectus*	Endangered
Crowned Cormorant	*Phalacrocorax coronatus*	Least Concern
White Pelican	*Pelecanus onocrotalus*	Least Concern
Cape Gannet	*Morus capensis*	Vulnerable
Kelp Gull	*Larus dominicanus*	Least Concern
Greyheaded Gull	*Larus cirrocephalus*	Least Concern
Hartlaub's Gull	*Larus hartlaubii*	Least Concern
Caspian Tern	*Hydroprogne caspia*	Vulnerable
Swift Tern	*Sterna bergii*	Least Concern
Roseate Tern	*Sterna dougallii*	Least Concern
Damara Tern	*Sterna balaenarum*	Near Threatened

Depending on the ultimate location of these feeding and breeding grounds, seasonality off South Africa can be either unimodal (usually in June-August, e.g. minke and blue whales) or bimodal (usually May-July and October-November, e.g. fin whales), reflecting a northward and southward migration through the area. As whales follow geographic or oceanographic features, the northward and southward migrations may take place at difference distances from the coast, thereby influencing the seasonality of occurrence at different locations. Due to the complexities of the migration patterns, each species is discussed in further detail below.

Two types of Bryde's whales are recorded from South African waters - a larger pelagic form described as *Balaenoptera brydei* and a smaller neritic form (of which the taxonomic status is uncertain) but included by Best (2008) with *B. brydei* for the subregion. The migration patterns of Bryde's whales differ from those of all other baleen whales in the region. The inshore population is unique in that it is resident year round on the Agulhas Bank, south and east of Lambert's Bay, and does not migrate at all. Although some movement up the west coast in winter has been reported, sightings over the last two decades suggest that the distribution of this population has shifted eastwards, with sightings on the West Coast very rare compared to pre-1980s whaling records (Best 2007, 2001; Best *et al.* 1984). Although this is a very small population, which is possibly decreasing in size (Penry 2010), its current distribution implies that it is unlikely to be encountered in the proposed Exploration Right area.

The offshore population of Bryde's whale lives off the continental shelf (>200 m depth), and migrates between wintering grounds off equatorial West Africa (Gabon) and summering grounds off the South African West Coast (Best 2001). Its seasonality within South African waters is thus opposite to the majority of the balaenopterids, with abundance in the proposed Exploration Right area likely to be highest in January-February. Information on the number of animals in this population is lacking.

Sei whales migrate through South African waters, where they were historically hunted in relatively high numbers, to unknown breeding grounds further north. Their migration pattern thus shows a bimodal peak with numbers west of Cape Columbine highest in May and June, and again in August, September and October. All whales were caught in waters deeper than 200 m with most deeper than 1,000 m (Best & Lockyer 2002). Almost all information is based on whaling records 1958-1963 and there is no current information on abundance or distribution patterns in the region.

Fin whales were historically caught off the West Coast of South Africa, with a bimodal peak in the catch data suggesting animals were migrating further north during May-June to breed, before returning during August-October *en route* to Antarctic feeding grounds. Some juvenile animals may feed year round in deeper waters off the shelf (Best 2007). There are no recent data on abundance or distribution of fin whales off western South Africa.

Although blue whales were historically caught in high numbers off the South African West Coast, there have been only two confirmed sightings of the species in the area since 1973 (Branch *et al.* 2007), suggesting that the population using the area may have been extirpated by whaling. However, scientific search effort (and thus information) in pelagic waters is very low. The chance of encountering the species in the proposed Exploration Right area is considered low.

Table 6: Cetaceans occurrence off the West Coast of South Africa, their seasonality and likely encounter frequency within the proposed Exploration Right area.

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.
Delphinids					
Dusky dolphin	*Lagenorhynchus obscurus*	Yes (0- 800 m)	No	Year round	Daily
Heaviside's dolphin	*Cephalorhynchus heavisidii*	Yes (0-200 m)	No	Year round	Daily
Common bottlenose dolphin	*Tursiops truncatus*	No	Yes	Year round	Monthly
Common (short beaked) dolphin	*Delphinus delphis*	Yes	Yes	Year round	Monthly
Long-finned pilot whale	*Globicephala melas*		Yes	Year round	<Weekly
Killer whale	*Orcinus orca*	Occasional	Yes	Year round	Occasional
False killer whale	*Pseudorca crassidens*	Occasional	Yes	Year round	Monthly
Risso's dolphin	*Grampus griseus*	Yes (edge)	Yes	Year round	Occasional
Pygmy killer whale	*Feresa attenuata*		Yes	Year round	Occasional
Sperm whales					
Pygmy sperm whale	*Kogia breviceps*		Yes	Year round	Occasional
Sperm whale	*Physeter macrocephalus*		Yes	Year round	Occasional
Beaked whales					
Cuvier's	*Ziphius cavirostris*		Yes	Year round	Occasional
Arnoux's	*Beradius arnouxii*		Yes	Year round	Occasional
Southern bottlenose	*Hyperoodon planifrons*		Yes	Year round	Occasional
Layard's	*Mesoplodon layardii*		Yes	Year round	Occasional
True's	*M. mirus*		Yes	Year round	
Gray's	*M. grayi*		Yes	Year round	Occasional
Blainville's	*M. densirostris*		Yes	Year round	

Common Name	Species	Shelf	Offshore	Seasonality	Likely encounter freq.
Baleen whales					
Minke	*Balaenoptera bonaerensis*	Yes	Yes	>Winter	Monthly
Dwarf minke	*B. acutorostrata*	Yes		Year round	Occasional
Fin whale	*B. physalus*		Yes	MJJ & ON, rarely in summer	Occasional
Blue whale	*B. musculus*		Yes	MJJ	Occasional
Sei whale	*B. borealis*		Yes	MJ & ASO	Occasional
Bryde's (offshore)	*B. brydei*	Yes		Summer (JF)	Occasional
Bryde's (inshore)	*B brydei (subspp)*		Yes	Year round	Occasional
Pygmy right	*Caperea marginata*	Yes		Year round	Occasional
Humpback	*Megaptera novaeangliae*	Yes	Yes	SONDJF	Daily*
Southern right	*Eubalaena australis*	Yes		SONDJF	Daily*

* Barendse *et al.* (2010, 2011) and Mate *et al.* (2011) reported sightings of both individuals and groups on a daily basis in the nearshore feeding areas off Cape Columbine during the summer months.

The most abundant baleen whales off the coast of South Africa are southern right and humpback whales (Figure 18). Southern rights migrate to the southern Africa subcontinent to breed and calve, where they tend to have an extremely coastal distribution mainly in sheltered bays (90% <2 km from shore; Best 1990, Elwen & Best 2004). They typically arrive in coastal waters off the West Coast in June, building up to a maximum in September/October, with most departing again in December (although animals may be sighted as early as April and as late as February). On the South African West Coast they are most common south of Lambert's Bay (CCA & CMS 2001), although a number of the bays between Chameis Bay (27°56'S) and Conception Bay (23°55'S) in Namibia have in recent years become popular calving sites (Currie *et al.* 2009), with sightings reported as far north as the Kunene and Möwe Bay (Roux *et al.* 2001). The Southern Right calving season extends from late June to late October, peaking in August (Best 1994; Roux *et al.* 2001), with cow-calf pairs remaining in sheltered bays for up to two months before starting their southern migration.

The majority of humpback whales on the west coast of South Africa are migrating past the southern African continent to breeding grounds off Angola, Republic of Congo and Gabon (Rosenbaum *et al.* 2009, Barendse *et al.* 2010). On the West Coast it is thought that only a small proportion of the main migration comes close inshore, the majority choosing the shortest route to the central West African breeding grounds by following the edge of the continental shelf (Best 2007; Best & Allison 2010). Most Humpbacks reach southern African waters around April, continuing through to September/October when the southern migration begins and continues through to December. The calving season for Humpbacks extends from July to October, peaking in early August (Best 2007). Cow-calf pairs are typically the last to leave southern African waters on the return southward migration, although considerable variation in the departure time from breeding areas has been recorded (Barendse *et al.* 2010).

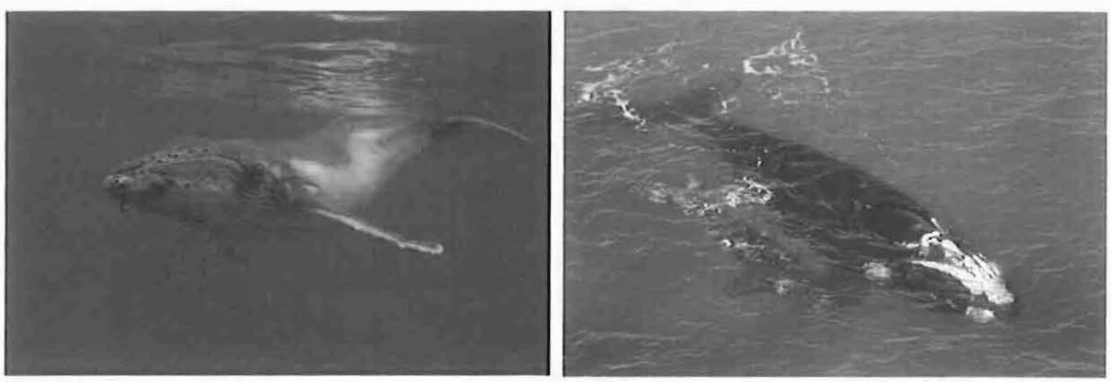

Figure 18: The Humpback whale *Megaptera novaeangliae* (left) and the Southern Right whale *Eubalaena australis* (right) are the most abundant large cetaceans occurring along the southern African West Coast (Photos: www.divephotoguide.com; www.aad.gov.au).

In the last decade, deviations from the predictable and seasonal migration patterns of these two species have been reported from the Cape Columbine - Yzerfontein area (Best 2007; Barendse *et al.* 2010). High abundances of both Southern Right and Humpback whales in this area during spring and summer (September-February), indicates that the upwelling zones off Saldanha and St Helena Bay may serve as an important summer feeding area (Barendse *et al.*

2011, Mate *et al.* 2011). It was previously thought that whales feed only rarely while migrating (Best *et al.* 1995), but these localised summer concentrations suggest that these whales may in fact have more flexible foraging habits.

Best (2000) estimated that southern right population was increasing at approximately 7% per annum. The most recent abundance estimate for the South African Southern right whale population (2008) puts the population at approximately 4,600 individuals of all age and sex classes, which is thought to be at least 23% of the original population size (Brandão *et al.* 2011). At least one third of the total South African population (between 1,033-1,577 individuals) has been estimated to use the west coast feeding ground (Peters *et al.* 2011), showing the potential importance of this area for the population as a whole. Unlike the very coastal distribution of southern rights on the south coast breeding grounds, the West Coast whales are predominantly distributed further offshore (up to at least 200 m) when feeding in St Helena Bay (Mate *et al.* 2011). Individual whales have been recorded using the area for up to 90 consecutive days (Mate *et al.* 2011), but also make exploratory trips northwards along the west coast, with regular sightings in southern Namibia as late as February (S. Elwen unpublished data).

Humpback whales off the west coast of South Africa fall into two main groups; those passing through the area on their northward and southward migrations to equatorial breeding grounds, and those showing temporary residence on the feeding ground in the Cape Columbine area. There is considerable overlap between migrating and non-migrating animals in nearshore waters and uncertainty exists about the relationship between animals (population structure) using the South African west coast and other aggregation sites further north off West Africa (Barendse *et al.* 2010). Genetic evidence shows some level of population separation between animals off southern Africa and Gabon (Rosenbaum *et al.* 2009), however, photographic and genetic matches of individual animals have been made between these two sites showing that at least some animals use both sites, either for feeding or as a migration corridor. Humpback whales from all west African populations are thus considered likely to pass through the proposed Exploration Right area. Recent abundance estimates put the number of animals using the west coast feeding area, over the period 2001-2007, at around 500 animals (Barendse *et al.* 2011). In contrast, in 2005 those on the Gabon breeding ground were estimated at between 5,000-6,000 animals (Collins *et al.* 2008). Both populations are likely to have increased in size since these estimates were undertaken. Furthermore, the estimates were made from geographically restricted areas, and should thus be considered as minimal. Humpback whales migrate at various distances from the coast including pelagic waters (Barendse *et al.* 2002), and as they are likely to regularly cross the proposed Exploration Right area, will probably be the most abundant large whale encountered. As in the case of southern right whales, of humpback seasonality off the West Coast is highest in spring and summer (September-February), and not during the traditional winter 'whale season'. The range of the summer resident humpbacks extends offshore to the 200 m contour in the Cape Columbine - Yzerfontein area with exploratory trips northwards along the coast keeping further inshore.

All information about sperm whales in the southern African subregion results from data collected during commercial whaling activities priot to 1985 (Best 2007). Sperm whales are the largest of the toothed whales and have a complex, well-structured social system with adult males behaving differently from younger males and female groups. They live in deep ocean waters, occasionally coming into depths of 200-500 m on the shelf (Best 2007). Seasonality of catches off the West Coast suggest that medium- and large-sized males are more abundant during winter, while female groups are more abundant in autumn (March-April), although animals occur year round (Best 2007). Although considered relatively abundant worldwide (Whitehead 2002), no current data are available on density or abundance of sperm whales in African waters. Sperm whales feed at great depth, during dives in excess of 30 minutes, making them difficult to detect visually. The regular echolocation clicks made by the species when diving, however, make them relatively easy to detect acoustically using Passive Acoustic Monitoring (PAM).

There are almost no data available on the abundance, distribution or seasonality of the smaller odontocetes (including the beaked whales and dolphins) known to occur in oceanic waters off the shelf of west South Africa. Beaked whales are all considered to be true deep water species usually being seen in waters in excess of 1,000-2,000 m depth (see various species accounts in Best 2007). Their presence in the area may fluctuate seasonally, but insufficient data exist to define this clearly.

Of the smaller odontocetes known to occur offshore, the long-finned pilot whale is likely to be the most commonly encountered in the proposed Exploration Right area, as it is usually associated with the shelf edge and is regularly reported by Marine Mammal Observers, fishermen and other observers (S. Elwen pers commn). False killer whales, killer whales, and the offshore form of the bottlenose dolphin are also likely to be encountered with some regularity in deeper waters (Findlay *et al.* 1992, Best 2007).

Inshore of the 500 m isobath, dusky dolphins (Figure 19, right) are likely to be the most frequently encountered small cetacean. This species is resident year round throughout the Benguela ecosystem coastal waters to depths of at least 500 m (Findlay *et al.* 1992). Although no information is available on the size of the population, they are regularly encountered in nearshore waters (Elwen *et al.* 2010) suggesting a relatively large population of several thousand at least. The species is very boat-friendly and will often approach vessels to bowride.

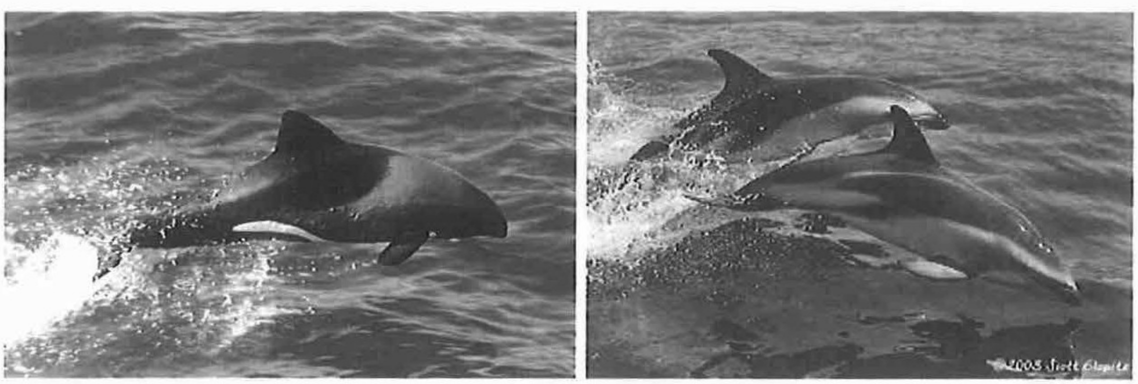

Figure 19: The endemic Benguela Dolphin *Cephalorhynchus heavisidii* (left) (Photo: De Beers Marine Namibia), and Dusky dolphin *Lagenorhynchus obscurus* (right) (Photo: scottelowitzphotography.com).

Heaviside's dolphins (Figure 19, left) are abundant in the southern Benguela, extending from the coat to at least 200 m depth (Elwen *et al.* 2006; Best 2007). It is estimated that around 10,000 animals live in the 400 km stretch of coast between Cape Town and Lambert's

Bay (Elwen *et al.* 2009). This species shows a strong diurnal movement pattern being most abundant in nearshore waters (<2 km from shore) in the early mornings, and moving offshore at night to feed (Elwen *et al.* 2006, Elwen *et al.* 2009). Their small group sizes and inconspicuous behaviour when offshore, will make monitoring their presence at night very difficult.

In summary, the majority of data available on the seasonality and distribution of large whales in the proposed Exploration Right area is largely the result of commercial whaling activities mostly dating from the 1960s. Changes in the timing and distribution of migration may have occurred since these data were collected due to extirpation of populations or behaviours (e.g. migration routes may be learnt behaviours). The large whale species for which there are current data available are the humpback and southern right whale, although with almost all data being limited to the continental shelf. Both these species are known to use a feeding ground around Cape Columbine with numbers here highest between September and February, and not during winter as is common on the South Coast breeding grounds. Whaling data indicates that several other large whale species are also most abundant on the West Coast during this period: fin whales peak in May-July and October-November; sei whale numbers peak in May-June and again in August-October and offshore Bryde's whale numbers are likely to be highest in January-February. Whale numbers on the shelf and in offshore waters are thus likely to be highest between October and February.

Of the migratory cetaceans, the Blue, Sei and Humpback whales are listed as "Endangered" and the Southern Right and Fin whale as "Vulnerable" in the IUCN Red Data book. All whales and dolphins are given protection under the South African Law. The Marine Living Resources Act, 1998 (No. 18 of 1998) states that no whales or dolphins may be harassed, killed or fished. No vessel or aircraft may, without a permit, approach closer than 300 m to any whale and a vessel should move to a minimum distance of 300 m from any whales if a whale surfaces closer than 300 m from a vessel or aircraft.

The Cape fur seal (*Arctocephalus pusillus pusillus*) (Figure 20) is the only species of seal resident along the west coast of Africa, occurring at numerous breeding and non-breeding sites on the mainland and on nearshore islands and reefs (see Figure 21). Vagrant records from four other species of seal more usually associated with the subantarctic environment have also been recorded: southern elephant seal (*Mirounga leoninas),* subantarctic fur seal (*Arctocephalus tropicalis),* crabeater *(Lobodon carcinophagus)* and leopard seals (*Hydrurga leptonyx)* (David 1989).

There are two Cape fur seal breeding colonies within the study area: at Kleinzee (incorporating Robeiland), and at Bucchu Twins near Alexander Bay. The colony at Kleinzee has the highest seal population and produces the highest seal pup numbers on the South African Coast (Wickens 1994). The colony at Buchu Twins, formerly a non-breeding colony, has also attained breeding status (M. Meyer, SFRI, pers. comm.). Non-breeding colonies occur south of Hondeklip Bay at Strandfontein Point and on Bird Island at Lamberts Bay, with the McDougalls Bay islands and Wedge Point being haul-out sites only and not permanently occupied by seals. All have important conservation value since they are largely undisturbed at present. Seals are highly mobile animals with a general foraging area covering the continental shelf up to 120 nautical miles offshore (Shaughnessy 1979), with bulls ranging further out to sea than females. The timing of the annual breeding cycle is very regular occurring between November and January. Breeding success is highly dependent on the local abundance of food, territorial bulls and lactating females being most vulnerable to local fluctuations as they feed in the vicinity of the colonies prior to and after the pupping season (Oosthuizen 1991).

Figure 20: Colony of Cape fur seals *Arctocephalus pusillus pusillus* (Photo: Dirk Heinrich).

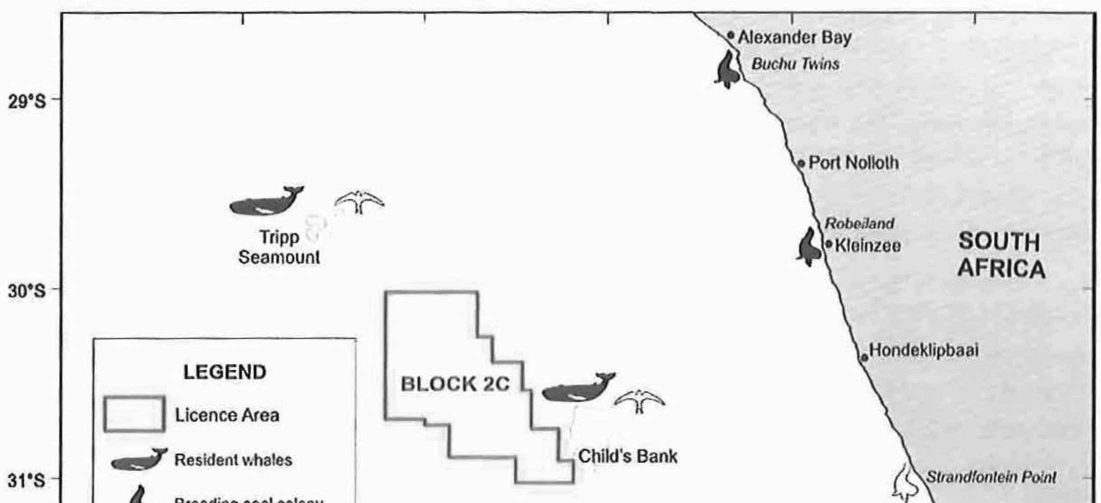

Figure 21: Project - environment interaction points on the West Coast, illustrating the location of seabird and seal colonies and resident whale populations in relation to the proposed Exploration Right area (red polygon).

3.4. Other Uses of the proposed Exploration Right Areas

3.4.1 Beneficial Uses

The proposed Exploration Right area is located offshore beyond the 300 m depth contour. Other users of the offshore areas include the commercial fishing industry (see Specialist Report on Fisheries) and marine diamond mining concession holders (see Figure 22). Recreational use of the Exploration Right area will be negligible due to its location offshore. The coastal area onshore of Block 2C falls within the Alexkor, De Beers Namaqualand and TransHex coastal diamond mining areas and as public access is restricted, recreational activities along the coastline between Hondeklipbaai and Alexander Bay is limited to the area around Port Nolloth.

The proposed Exploration Right area overlaps with a number of marine diamond mining concession areas (Figure 22). Mining activities in De Beers Marine's Mining Licence 3 (ML3), to the northeast of the Exploration Right area ceased in 2010, and no deep-water diamond mining is currently underway in the South African offshore concession areas. On the Namaqualand coast marine diamond mining activity is restricted to nearshore, diver-assisted operations from small, converted fishing vessels working in the a-concessions, which extend to 1,000 m offshore of the high water mark. In Namibian waters, deep-water diamond mining by De Beers Marine Namibia is currently operational in the Atlantic 1 Mining Licence Area. These mining operations are typically conducted to depths of 150 m from fully self-contained mining vessels with on board processing facilities, using either large-diameter drill or seabed crawler technology. The vessels operate as semi-mobile mining platforms, anchored by a dynamic positioning system, commonly on a three to four anchor spread (Figure 23). Computer-controlled positioning winches enable the vessels to locate themselves precisely over a mining block of up to 400 m x 400 m. These mining vessels thus have limited manoeuvrability and other vessels should remain at a safe distance.

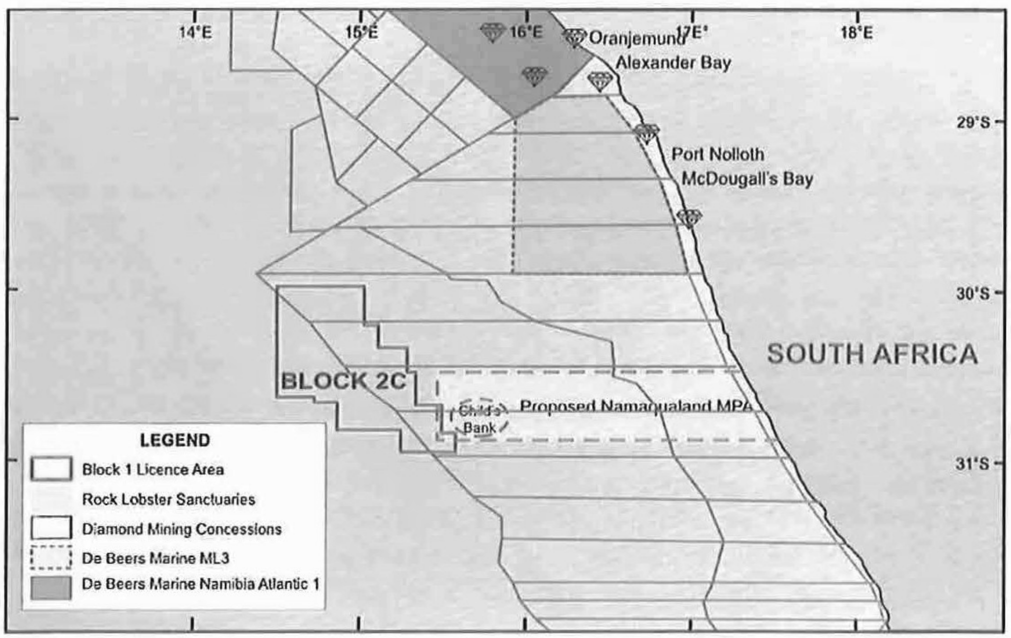

Figure 22: Reserves and Marine Protected Areas on the West Coast in relation to the proposed Exploration Right area (red polygon).

Figure 23: Typical crawler-vessel (left) and drillship (right) operating in the Atlantic 1 Mining Licence Area (Photos: De Beers Marine).

Other industrial uses of the marine environment include the intake of feed-water for mariculture, or diamond-gravel treatment. None of these activities should in any way be affected by seismic survey activities offshore.

3.3.4 Conservation Areas and Marine Protected Areas

Numerous conservation areas and a marine protected area (MPA) exist along the coastline of the Western Cape, although none fall directly within the proposed Exploration Right area (see Figure 19). The only conservation area east of Block 2C in which restrictions apply is the McDougall's Bay rock lobster sanctuary near Port Nolloth, which is closed to commercial exploitation of rock lobsters (Figure 21).

As 'no-take' MPAs offering protection of the Namaqua biozones (sub-photic, deep-photic, shallow-photic, intertidal and supratidal zones) are absent northwards from Cape Columbine (Emanuel *et al.* 1992, Lombard *et al.* 2004), marine biodiversity in the area north of Cape Columbine has been rated as 'critically endangered', with commercial fishing and marine mining primarily being held responsible for this status (Lombard *et al.* 2004). Impacts of these activities are predicted to increase over the next decade and immediate conservation intervention has been identified as a priority. To this end, a proposed National Park stretching along 50 km of coast from just north of the Spoeg River to Island Point in the south was gazetted in February 2004. The northern border of the park will extend offshore to the shelf break, whereas the southern border will extend beyond the shelf-break and will include Child's Bank (Figure 22). The proposed Namaqualand MPA was opposed due to a lack of consultation with industry. However, the South African National Biodiversity Institute (SANBI) is partnering with the World Wildlife Fund (WWF) to implement an Offshore Marine Protected Areas Project, whose principal objective is to facilitate the development of a representative Offshore MPA network that has broad support from the various offshore marine-use.

4. ACOUSTIC IMPACTS OF SEISMIC SURVEYS ON MARINE FAUNA

The ocean is a naturally noisy place and marine animals are continually subjected to both physically produced sounds from sources such as wind, rainfall, breaking waves and natural seismic noise, or biologically produced sounds generated during reproductive displays, territorial defence, feeding, or in echolocation (see references in McCauley 1994). Such acoustic cues are thought to be important to many marine animals in the perception of their environment as well as for navigation purposes, predator avoidance, and in mediating social and reproductive behaviour. Anthropogenic sound sources in the ocean can thus be expected to interfere directly or indirectly with such activities thereby affecting the physiology and behaviour of marine organisms (NRC 2003). Of all human-generated sound sources, the most persistent in the ocean is the noise of shipping. Depending on size and speed, the sound levels radiating from vessels range from 160 to 220 dB re 1 µPa at 1 m (NRC 2003). Especially at low frequencies between 5 to 100 Hz, vessel traffic is a major contributor to noise in the world's oceans, and under the right conditions, these sounds can propagate 100s of kilometres thereby affecting very large geographic areas (Coley 1994, 1995; NRC 2003; Pidcock *et al.* 2003). Other forms of anthropogenic noise include 1) aircraft flyovers, 2) multi-beam sonar systems, 3) seismic acquisition, 4) hydrocarbon and mineral exploration and recovery, and 5) noise associated with underwater blasting, pile driving, and construction. Below follows a detailed review of the effects of seismics on marine fauna and brief summaries of the effects of multi-beam sonars.

4.1. Seismics

Seismic surveys are another source of anthropogenic noise. The airguns used in modern seismic surveys produce some of the most intense non-explosive sound sources used by humans in the marine environment (Gordon *et al.* 2004). However, the transmission and attenuation of seismic sound is probably of equal or greater importance in the assessment of environmental impacts than the produced source levels themselves, as transmission losses and attenuation are very site specific, and are affected by propagation conditions, distance or range, water and receiver depth and bathymetrical aspect with respect to the source array. In water depths of 25 - 50 m airgun arrays are often audible to ranges of 50 -75 km, and with efficient propagation conditions such as experienced on the continental shelf or in deep oceanic water, detection ranges can exceed 100 km and 1,000 km, respectively (Bowles *et al.* 1991; Richardson *et al.* 1995; see also references in McCauley 1994). The signal character of seismic shots also changes considerably with propagation effects. Reflective boundaries include the sea surface, the sea floor and boundaries between water masses of different temperatures or salinities, with each of these preferentially scattering or absorbing different frequencies of the source signal. This results in the received signal having a different spectral makeup from the initial source signal. In shallow water (<50 m) at ranges exceeding 4 km from the source, signals tend to increase in length from <30 milliseconds, with a frequency peak between 10-100 Hz and a short rise time, to a longer signal of 0.25-0.75 seconds, with a downward frequency sweep of between 200 - 500 Hz and a longer rise time (McCauley 1994; McCauley *et al.* 2000).

In contrast, in deep water received levels vary widely with range and depth of the exposed animals, and exposure levels cannot be adequately estimated using simple geometric spreading laws (Madsen *et al.* 2006). These authors found that the received levels fell to a minimum between 5 - 9 km from the source and then started increasing again at ranges between 9 - 13 km, so that absolute received levels were as high at 12 km as they were at 2 km, with the complex sound reception fields arising from multi-path sound transmission.

Acoustic pressure variation is usually considered the major physical stimulus in animal hearing, but certain taxa are capable of detecting either or both the pressure and particle velocity components of a sound (Turl 1993). An important component of hearing is the ability to detect sounds over and above the ambient background noise. Auditory masking of a sound occurs when its' received level is at a similar level to background noise within the same frequencies. The signal to noise ratio required to detect a pure tone signal in the presence of background noise is referred to as the critical ratio.

The auditory thresholds of many species are affected by the ratio of the sound stimulus duration to the total time (duty cycle) of impulsive sounds of <200 millisecond duration. The lower the duty cycle the higher the hearing threshold usually is. Although seismic sound impulses are extremely short and have a low duty cycle at the source, received levels may be longer due to the transmission and attenuation of the sound (as discussed above).

Below follows a brief review of the impacts of seismic surveys on marine faunal communities. This information is largely drawn from McCauley (1994), McCauley *et al.* (2000), the Generic EMPR for Oil and Gas Prospecting off the Coast of South Africa (CCA & CMS 2001) and the very comprehensive reviews by Cetus Projects (2007, 2008), compiled as part of the Environmental Impact Assessment for the Ibhubesi Gas Field and the CGGVeritas surveys on the Namibian shelf, respectively. Although the discussion and assessments focus primarily on marine mammals and turtles, the effects on pelagic and benthic invertebrates, fish and seabirds are also covered.

4.1.1 Impacts on Plankton

As the movement of phytoplankton and zooplankton is largely limited by currents, they are not able to actively avoid the seismic vessel and thus are likely to come into close contact with the sound sources. Phytoplankton are not known to be affected by seismic surveys and are unlikely to show any significant effects of exposure to airgun impulses outside of a 1 m distance (Kosheleva 1992; McCauley 1994).

Zooplankton comprises meroplankton (organisms which spend a portion of their life cycle as plankton, such as fish and invertebrate larvae and eggs) and holoplankton (organisms that remain planktonic for their entire life cycle, such as siphonophores, nudibranchs and barnacles). The abundance and spatial distribution of zooplankton is highly variable and dependent on factors such as fecundity, seasonality in production, tolerances to temperature, length of time spent in the water column, hydrodynamic processes and natural mortality. Zooplankton densities are generally low and patchily distributed. The amount of exposure to the influence of seismic airgun arrays is thus dependent on a wide range of variables. Invertebrate members of the plankton that have a gas-filled flotation aid, may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for other plankton. However, for a large seismic array, a pathological effect out to 10 m from the array is considered a generous value with known effects demonstrated to 5 m only (Kostyuchenko 1971).

McCauley (1994) concludes that when compared with total population sizes or natural mortality rates of planktonic organisms, the relative influence of seismic sound sources on these populations can be considered insignificant. The wash from ships propellers and bow waves can be expected to have a similar, if not greater, volumetric effect on plankton than the sounds generated by airgun arrays.

Due to their importance in commercial fisheries, numerous studies have been undertaken experimentally exposing the eggs and larvae of various ichthyoplankton species to airgun sources (reviewed in McCauley 1994). These are discussed further in Section 4.3.

4.1.2 Impacts on Marine Invertebrates

Many marine invertebrates have tactile organs or hairs (termed mechanoreceptors), which are sensitive to hydro-acoustic near-field disturbances, and some have highly sophisticated statocysts, which have some resemblance to the ears of fishes (Offutt 1970; Hawkins & Myrberg 1983; Budelmann 1988, 1992; Packard *et al.* 1990; Popper *et al.* 2001) and are thought to be sensitive to the particle acceleration component of a sound wave in the far-field. However, information on hearing by invertebrates, and noise impacts on them is sparse. Although many invertebrates cannot sense the pressure of a sound wave or the lower amplitude component of high frequency sounds, low frequency high amplitude sounds may be detected *via* the mechanoreceptors, particularly in the near-field of such sound sources (McCauley 1994). Sensitivity to near-field low-frequency sounds or hydroacoustic disturbances has been recorded for the lobster *Homarus americanus* (Offut 1970), and various other invertebrate species (Horridge 1965, 1966; Horridge & Boulton 1967; Moore & Cobb 1986; Packard *et al.* 1990; Turnpenney & Nedwell 1994).

Despite no quantitative records of invertebrate mortality from seismic sound exposure under field operating conditions, lethal and sub-lethal effects have been observed under experimental conditions where invertebrates were exposed to airguns up to five metres away. These include reduced growth and reproduction rates and behavioural changes in crustaceans (DFO 2004; McCauley 1994; McCauley *et al.* 2000). The effects of seismic survey energy on snow crab (*Chionoecetes opilo*) on the Atlantic coast of Canada, for example ranged from no physiological damage but effects on developing fertilized eggs at 2 m range (Christian *et al.* 2003) to possible bruising of the heptopancreas and ovaries, delayed embryo development, smaller larvae, and indications of greater leg loss but no acute or longer term mortality and no changes in embryo survival or post hatch larval mobility (DFO 2004). The ecological significance of sub-lethal or physiological effects could thus range from trivial to important depending on their nature.

Giant squid strandings coincident with seismic surveys have been reported (Guerra *et al.* 2004). Although animals showed no external damage, all had severe internal injuries (including disintegrated muscles and unrecognisable organs) indicative of having ascended from depth too quickly. The causative link to seismic surveys has, however, not been established with certainty.

Behavioural responses of invertebrates to particle motion of low frequency stimulation has been measured by numerous researchers (reviewed in McCauley 1994). Again a wide range of responses are reported ranging from no avoidance by free ranging invertebrates (crustaceans, echinoderms and molluscs) of reef areas subjected to pneumatic airgun fire (Wardle *et al.* 2001), and no reduction in catch rates of brown shrimp (Webb & Kempf 1998), prawns (Steffe & Murphy 1992, in McCauley, 1994) or rock lobsters (Parry & Gasson 2006) in the near-field during or after seismic surveys.

Cephalopods, in contrast, may be receptive to the far-field sounds of seismic airguns, although responses are unknown. Behavioural response range from attraction at 600 Hz pure tone (Maniwa 1976), through startle responses at received levels of 174 dB re 1 μPa, to increase levels of alarm responses once levels had reached 156 - 161 dB re 1 μPa (McCauley *et al.* 2000). Based on the results of caged experiments, McCauley *et al.* (2000) therefore suggest that squid would significantly alter their behaviour at an estimated 2 - 5 km from an approaching large seismic source.

4.1.3 Impacts on Fish

Fish hearing has been reviewed by numerous authors including Popper and Fay (1973), Hawkins (1973), Tavolga *et al.* (1981), Lewis (1983), Atema *et al.* (1988), and Fay (1988). Fish have two different systems to detect sounds namely 1) the ear (and the otolith organ of their inner ear) that is sensitive to sound pressure and 2) the lateral line organ that is sensitive to particle motion. Certain species utilise separate inner ear and lateral line mechanisms for detecting sound; each system having its own hearing threshold (Tavolga & Wodinsky 1963), and it has been suggested that fish can shift from particle velocity sensitivity to pressure sensitivity as frequency increases (Cahn *et al.* 1970, in Turl 1993).

In fish, the proximity of the swim-bladder to the inner ear is an important component in the hearing as it acts as the pressure receiver and vibrates in phase with the sound wave. Vibrations of the otoliths, however, result from both the particle velocity component of the sound as well as stimulus from the swim-bladder. The resonant frequency of the swim-bladder is important in the assessment of impacts of sounds as species with swim-bladders of a resonant frequency similar to the sound frequency would be expected to be most susceptible to injury. Although the higher frequency energy of received seismic impulses needs to be taken into consideration, the low frequency sounds of seismic surveys would be most damaging to swim-bladders of larger fish. The lateral line is sensitive to low frequency (between 20 and 500 Hz) stimuli through the particle velocity component of sound.

Most species of fish and elasmobranchs are able to detect sounds from well below 50 Hz (some as low as 10 or 15 Hz) to upward of 500 - 1,000 Hz (Popper & Fay 1999; Popper 2003; Popper *et al.* 2003), and consequently can detect sounds within the frequency range of most widely occurring anthropogenic noises. Within the frequency range of 100 - 1,000 Hz at which most fish hear best, hearing thresholds vary considerably (50 and 110 dB re 1 μPa). They are able to discriminate between sounds, determine the direction of a sound, and detect biologically relevant sounds in the presence of noise. In addition, some clupeid fish can detect ultrasonic sounds to over 200 kHz (Popper & Fay 1999; Mann *et al.* 2001; Popper *et al.* 2004). Fish that possess a coupling between the ear and swim-bladder have probably the best hearing of fish species (McCauley 1994). Consequently, there is a wide range of susceptibility among fish to seismic sounds, with those with a swim-bladder will be more susceptible to anthropogenic sounds than those without this organ.

Studies have shown that fish can be exposed directly to the sound of seismic survey without lethal effects, outside of a very localised range of physiological effects. Physiological effects of impulsive airgun sounds on fish species include swim-bladder damage (Falk & Lawrence 1973), transient stunning (Hastings 1990, in Turnpenney & Nedwell 1994), short-term biochemical variations in different tissues typical of primary and secondary stress response (Santulli *et al.* 1999; Smith *et al.* 2004), and temporary hearing loss due to destruction of the hair cells in the hearing maculae (Enger 1981; Lombarte *et al.* 1993; Hastings *et al.* 1996; McCauley *et al.* 2000; Scholik & Yan 2001, 2002; McCauley *et al.* 2003; Popper *et al.* 2005; Smith *et al.* 2006). Popper (2008) concludes that as the vast majority of fish exposed to seismic sounds will in all likelihood be some distance from the source, where the sound level has attenuated considerably, only a very small number of animals in a large population will ever be directly killed or damaged by sounds from seismic airgun arrays.

Behavioural responses to impulsive sounds are varied and include leaving the area of the noise source (Suzuki *et al.* 1980; Dalen & Rakness 1985; Dalen & Knutsen 1987; Løkkeborg 1991; Skalski *et al.* 1992; Løkkeborg & Soldal 1993; Engås *et al.* 1996; Wardle *et al.* 2001; Engås & Løkkeborg 2002; Hassel *et al.* 2004), changes in depth distribution (Chapman & Hawkins 1969; Dalen 1973; Pearson *et al.* 1992; Slotte *et al.* 2004), spatial changes in schooling behaviour (Slotte *et al.* 2004), and startle response to short range start up or high level sounds (Pearson *et al.* 1992; Wardle *et al.* 2001). In some cases behavioural responses were observed at up to 5 km distance from the firing airgun array (Santulli *et al.* 1999; Hassel *et al.* 2004). Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound (McCauley *et al.* 2000). In some cases behaviour patterns returned to normal within minutes of commencement of surveying indicating habituation to the noise. Disturbance of fish is believed to cease at noise levels below 160 dB re 1μPa. The ecological significance of such effects is therefore expected to be low, except in cases where they influence reproductive activity.

Although the effects of airgun noise on spawning behaviour of fish have not been quantified to date, it is predicted that if fish are exposed to powerful external forces on their migration paths or spawning grounds, they may be disturbed or even cease spawning altogether. The deflection from migration paths may be sufficient to disperse spawning aggregations and displace spawning geographically and temporally, thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Dalen *et al.* (1996), however, recommended that in areas with concentrated spawning or spawning migration seismic shooting be avoided at a distance of ~50 km from these areas.

Indirect effects of seismic shooting on fish include reduced catches resulting from changes in feeding behaviour or vertical distribution (Skalski *et al.* 1992), but information on feeding success of fish (or larger predators) in association with seismic survey noise is lacking.

The physiological effects of seismic sounds from airgun arrays will mainly affect the younger life stages of fish such as eggs, larvae and fry, many of which form a component of the meroplankton and thus have limited ability to escape from their original areas in the event of various influences. Numerous studies have been undertaken experimentally exposing the eggs and larvae of various fish species to airgun sources (Kostyuchenko 1971; Dalen & Knutsen 1987;

Holliday *et al.* 1987; Booman *et al.* 1992; Kosheleva 1992; Popper *et al.* 2005, amongst others). These studies generally identified mortalities and physiological injuries at very close range (<5 m) only. For example, increased mortality rates for fish eggs were proven out to ~5 m distance from the air guns. A mortality rate of 40-50% was recorded for yolk sac larvae (particularly for turbot) at a distance of 2-3 m (Booman *et al.* 1996), although mortality figures for yolk sac larvae of anchovies at the same distances were lower (Holliday *et al.* 1987). Yolk sac larvae of cod experienced significant eye injuries (retinal stratification) at a distance of 1 m from an air gun array (Matishov 1992), and Booman *et al.* (1996) report damage to brain cells and lateral line organs at <2 m distance from an airgun array. Increased mortality rates (10-20%) at later stages (larvae, post-larvae and fry) were proven for several species at distances of 1-2 m. Changes have also been observed in the buoyancy of the organisms, in their ability to avoid predators and effects that affect the general condition of larvae, their growth rate and thus their ability to survive. Temporary disorientation juvenile fry was recorded for some species (McCauley 1994). Fish larvae with swim-bladders may be more receptive to the sounds produced by seismic airgun arrays, and the range of effects may extend further for these species than for others.

From a fish resource perspective, these effects may potentially contribute to a certain diminished net production in fish populations. However, Sætre & Ona (1996) calculated that under the "worst case" scenario, the number of larvae killed during a typical seismic survey was 0.45% of the total larvae population. When more realistic "expected values" were applied to each parameter of the calculation model, the estimated value for killed larvae during one run was equal to 0.03% of the larvae population. If the same larval population was exposed to multiple seismic runs, the effect would add up for each run. For species such as cod, herring and capelin, the natural mortality is estimated at 5-15% per day of the total population for eggs and larvae. This declines to 1-3% per day once the species reach the 0 group stage *i.e.* at approximately 6 months (Sætre & Ona 1996). Consequently, Dalen *et al.* (1996) concluded that seismic-created mortality is so low that it can be considered to have an inconsequential impact on recruitment to the populations.

4.1.4 Impacts on Seabirds

Among the marine avifauna of South African waters, it is only the diving birds, or birds which rest on the water surface, that may be affected by the underwater noise of seismic surveys. The African penguin (*Spheniscus demersus*), which is flightless and occurs along the West Coast, would be particularly susceptible to impacts from underwater seismic noise. In African penguins the best hearing is in the 600 Hz to 4 kHz range with the upper limit of hearing at 15 kHz and the lower limit at 100 Hz (Wever *et al.* 1969). No critical ratios have, however, been measured. Principal energy of vocalisation of African penguins was found at <2 kHz, although some energy was measured at up to 6 kHz (Wever *et al.* 1969).

The continuous nature of the intermittent seismic survey pulses, however, suggest that birds would hear the sound sources at distances where levels would not induce mortality or injury, and consequently be able to flee an approaching sound source. Consequently, the potential for injury to seabirds from seismic surveys in the open ocean is deemed to be low (see also Stemp 1985, in Turnpenny & Nedwell 1994; Lacroix *et al.* 2003), particularly given the extensive feeding range of the plunge-diving seabird species.

4.1.5 Impacts on Turtles

The potential effects of seismic surveys on turtles include:

- Physiological injury (including disorientation) or mortality from seismic noise;
- Behavioural avoidance of seismic survey areas;
- Collision with or entanglement in towed seismic apparatus;
- Masking of environmental sounds and communication;
- Indirect effects due to effects on prey.

Available data on marine turtle hearing is limited, but suggest highest auditory sensitivity at frequencies of 250 - 700 Hz, and some sensitivity to frequencies at least as low as 60 Hz (Ridgway *et al.* 1969; Wever *et al.* 1978, in McCauley 1994; O'Hara & Wilcox, 1990; Moein-Bartol *et al.* 1999). The overlap of this hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise.

No information on physiological injury to turtle hearing could be sourced in the literature. If subjected to seismic sounds at close range, temporary or permanent hearing impairment may result, but it is unlikely to cause death or life-threatening injury. As with other large mobile marine vertebrates, it is assumed that sea turtles will avoid seismic noise at levels/distances where the noise is a discomfort. Juvenile turtles may be unable to avoid seismic sounds in the open ocean, and consequently may be more susceptible to seismic noise.

Behavioural changes in response to anthropogenic sounds have been reported for some sea turtles. Controlled exposure experiments on captive turtles found an increase in swim speed and erratic behaviour indicative of avoidance, at received airgun sound levels of 166 - 176 dB re 1 μPa (O'Hara & Wilcox 1990; McCauley *et al.* 2000). Sounds of frequency of 250 and 500 Hz resulted in a startle response from a loggerhead turtle (Lenhardt *et al.* 1983, in McCauley 1994), and avoidance by 30 m of operating airguns where the received level would have been in the order of 175 - 176 dB re 1 μPa (O'Hara 1990). McCauley (1994), however, pointed out that these results may have been influenced by echo associated with the shallow environment in which the test was undertaken.

Further trials carried out on caged loggerhead and green turtles include those of Moein *et al.* (1994) and McCauley *et al.* (2000), who investigated responses to airgun impulses by measuring avoidance behaviour, physiological response and electroencephalogram measurements of hearing capability. Results indicated that significant avoidance response occurred at received levels ranging between 172 and 176 dB re 1 μPa at 24 m, and repeated trails several days later suggest either temporary reduction in hearing capability or habituation with repeated exposure. Hearing however returned after two weeks (Moein *et al.* 1994; McCauley *et al.* 2000). McCauley *et al.* (2000) reported that above levels of 166 dB re 1 μPa turtles increased their swimming activity compared to periods when airguns were inactive. Above 175 dB re 1 μPa turtle behaviour became more erratic possibly reflecting an agitated behavioural state at which unrestrained turtles would show avoidance response by fleeing an operating sound source. These would correspond to distances of 2 km and 1 km from a seismic vessel operating in 100 - 120 m of water, respectively.

Observations of marine turtles during a ten-month seismic survey in deep water (1,000-3,000 m) off Angola found that turtle sighting rate during guns-off (0.43 turtles/h) was double that of full-array seismic activity (0.20/h) (Weir 2007). In contrast, Parente *et al.* (2006), working off Brazil found no significant differences in turtle sightings with airgun state. Weir (2007) notes that while her results are suggestive of avoidance of airguns by turtles, they should be treated with caution since a large proportion of the sightings occurred during unusually calm conditions and during peak diurnal abundance of turtles when the airguns were inactive. While there was indication that turtles occurred closer to the source during guns-off than full-array, there was no significant difference in the median distance of turtle sightings from the airguns during full-array or guns-off, suggesting a lack of movement away from active airguns. It is thus possible that during deep water surveys turtles only detect airguns at close range or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking for metabolic purposes when they may be slow to react) (Weir 2007). This is in marked contrast to previous assessments that assumed that the impact of seismic noise on behaviour of adult turtles in the open ocean environment is of low significance given the mobility of the animals (CSIR 1998; CCA & CMS 2001). In the study by Weir (2007) a confident assessment of turtle behaviour in relation to seismic status was hindered, however, by the apparent reaction of individual animals to the survey vessel and towed equipment rather than specifically to airgun sound. As these reactions occurred at close range (usually <10 m) to approaching objects, they appeared to be based principally on visual detection (Weir 2007).

Although collisions between turtles and vessels are not limited to seismic ships, the large amount of equipment towed astern of survey vessels does increase the potential for collision, or entrapped within seismic equipment and towed surface floats. Basking turtles are particularly slow to react to approaching objects may not be able to move rapidly away from approaching airguns even if motivated to do so. In the past, almost all reported turtle entrapments have been associated with the tail buoy; the large float attached to the end of each seismic cable, which is used to monitor the location of the cable. The tail buoys have a subsurface structure ('undercarriage') consisting of a 'twin-fin' design, which is primarily used for counter-balancing the upper structure to ensure stability in the water. Towing points are located on the leading edge of each side of the undercarriage, and these are attached by chains to a swivel leading to the end of the seismic cable (Ketos Ecology 2009). It is thought that entrapment occurs either as a result of 'startle diving' in front of towed equipment or following foraging on barnacles and other organisms growing along seismic cables and surfacing to breathe immediately in front of the tail buoy (primarily loggerhead and Olive Ridley turtles). In the first case the turtle becomes stuck within the angled gap between the chains and the underside of the buoy, lying on their sides across the top of the chains and underneath the float with their ventral surface facing the oncoming water thereby causing the turtle to be held firmly in position (Figure 24, left). Depending on the size of the turtle, they can also become stuck within the gap below a tail buoy, which extends to 0.8 m below water level and is ~0.6 m wide. The animal would need to be small enough to enter the gap, but too big to pass all the way through the undercarriage. Furthermore, the presence of the propeller in the undercarriage of some buoy-designs prohibits turtles that have entered the undercarriage from travelling out of the trailing end of the buoy (Figure 24, right). Once stuck inside or in front of a tail buoy, the water pressure generated by the 4-5 knot towing speed, would hold the animal against/inside the buoy with little chance of escape due to the angle of its body in relation to the forward movement of the buoy. For a trapped turtle this situation will be fatal, as it will be unable to reach the surface to breathe (Ketos Ecology 2009). To prevent entrapment, the seismic inductry has implemented the use of "turtle guards" on all tailbuoys.

Breeding adults of sea turtles undertake large migrations between their nesting sites and distant foraging areas. Although Lenhardt *et al.* (1983) speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. The effect of seismic noise in masking environmental cues such as surf noise (150-500 Hz), which overlaps the frequencies of optimal hearing in turtles (McCauley 1994), is unknown and speculative.

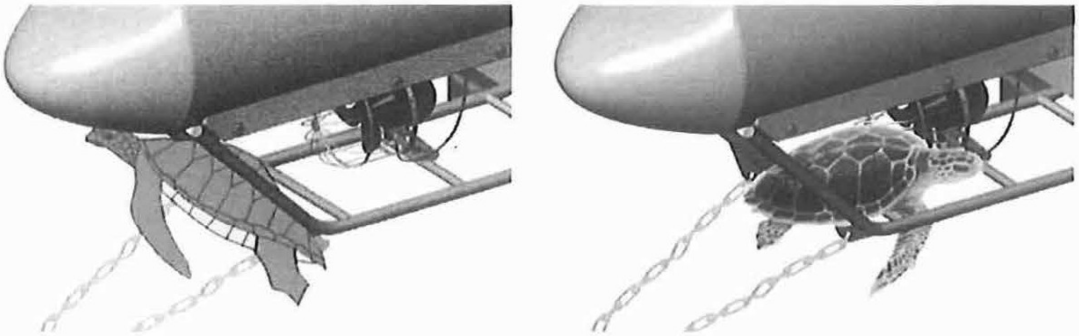

Figure 24: Turtles commonly become trapped in front of the undercarriage of the tail buoy in the area between the buoy and the towing chains (left), and inside the 'twin-fin' undercarriage structure (right) (Ketos Ecology 2009).

4.1.6 Impacts on Seals

The Cape fur seal forages over the continental shelf to depths of over 200 m and would consequently be expected to occur within the proposed seismic survey area.

Underwater behavioural audiograms have been obtained for two species of Otariidae (sea lions and fur seals), but no audiograms have been measured for Cape fur seals. Extrapolation of these audiograms to below 100 Hz would result in hearing thresholds of approximately 140-150 dB re 1 µPa for the California sea lion and well above 150 dB re 1 µPa for the Northern fur seal. The range of greatest sensitivity in fur seals lies between the frequencies of 2-32 kHz (McCauley 1994). Underwater critical ratios have been measured for two northern fur seals and averaged ranged from 19 dB at 4 kHz to 27 dB at 32 kHz. The audiograms available for otariid pinnipeds suggest they are less sensitive to low frequency sounds (<1 kHz) than to higher frequency sounds (>1 kHz). The range of low frequency sounds (30-100 Hz) typical of seismic airgun arrays thus falls below the range of greatest hearing sensitivity in fur seals. This generalisation should, however, be treated with caution as no critical ratios have been measured for Cape fur seals.

Seals produce underwater sounds over a wide frequency range, including low frequency components. Although no measurement of the underwater sounds have been made for the Cape fur seal, such measurements have been made for a con-generic species *Arctocephalus philippii*, which produced narrow-band underwater calls at 150 Hz. Aerial calls of seals range up to 6 Hz, with the dominant energy in the 2-4 kHz band. However, these calls have strong tonal components below 1 kHz, suggesting some low frequency hearing capability and therefore some susceptibility to disturbance from the higher frequency components of seismic airgun sources (Goold & Fish 1998; Madsen *et al.* 2006).

The potential impact of seismic survey noise on seals could include physiological injury to individuals, behavioural avoidance of individuals (and subsequent displacement from key habitat), masking of important environmental or biological sounds and indirect effects due to effects on predators or prey.

The physiological effects of loud low frequency sounds on seals are not well documented, but include cochlear lesions following rapid rise time explosive blasts (Bohne *et al.* 1985; 1986, in McCauley 1994), temporary threshold shifts (TTS) following exposure to octave-band noise (frequencies ranged from 100 Hz to 2000 Hz, octave-band exposure levels were approximately 60-75 dB, while noise-exposure periods lasted a total of 20-22 min) (Kastak *et al.* 1999), with recovery to baseline threshold levels within 24 h of noise exposure.

Using measured discomfort and injury thresholds for humans, Greenlaw (1987) modelled the pain threshold for seals and sea lions and speculated that this pain threshold was in the region of 185 - 200 dB re 1 µPa. The impact of physiological injury to seals from seismic noise is deemed to be low as it is assumed that highly mobile creatures such as fur seals would avoid severe sound sources at levels below those at which discomfort occurs. However, noise of moderate intensity and duration may be sufficient to induce TTS under water in pinniped species (Kastak *et al.* 1999). Reports of seals swimming within close proximity of firing airguns should thus be interpreted with caution in terms of the impacts on individuals as such individuals may well be experiencing hearing threshold shifts.

Information on the behavioural response of fur seals to seismic exploration noise is lacking (Richardson *et al.* 1995; Gordon *et al.* 2004). Reports of studies conducted with Harbour and Grey seals include initial startle reaction to airgun arrays, and range from partial avoidance of the area close to the vessel (within 150 m) (Harris *et al.* 2001) to fright response (dramatic reduction in heart rate), followed by a clear change in behaviour, with shorter erratic dives, rapid movement away from the noise source and a complete disruption of foraging behaviour (Gordon *et al.* 2004). In most cases, however, individuals quickly reverted back to normal behaviour once the seismic shooting ceased and did not appear to avoid the survey area. Seals seem to show adaptive responses by moving away from airguns and reducing the risk of sustaining hearing damage. Potential for long-term habitat exclusion and foraging disruption over longer periods of exposure (*i.e.* during full-scale surveys conducted over extended periods) is however a concern.

Cape fur seals generally appear to be relatively tolerant to noise pulses from underwater explosives, which are probably more invasive than the slower rise-time seismic sound pulses. There are also reports of Cape fur seals approaching seismic survey operations and individuals biting hydrophone streamers (CSIR 1998). This may be related to their relative insensitivity to sound below 1 kHz and their tendency to swim at or near the surface, exposing them to reduced sound levels. It has also been suggested that this attraction is a learned response to towed fishing gear being an available food supply.

4.1.7 Impacts on Whales and Dolphins

The cetaceans comprise baleen whales (mysticetes) and toothed whales and dolphins (odontocetes). Whilst the majority of baleen whales are migratory, the majority of dolphins and small toothed whales are resident.

The potential impact of seismic survey noise on cetaceans includes a) physiological injury to individuals, b) behavioural disturbance (and subsequent displacement from key habitat), c) masking of important environmental or biological sounds, or d) effects due to indirect effects on prey. Reactions of cetaceans to anthropogenic sounds have been reviewed by McCauley (1994), Richardson et al. (1995), Gordon & Moscrop (1996) and Perry (1998). More recently reviews have focused specifically on the effects of sounds from seismic surveys on marine mammals (DFO 2004; NRC 2005; Nowacek *et al.* 2007; Southall *et al.* 2007; Abgrall *et al.* 2008, amongst others).

Cetacean vocalisations

Cetaceans are highly reliant on acoustic channels for orientation in their environment, feeding and social communication (Tyack & Clark 2000). Baleen whales produce a wide repertoire of sounds ranging in frequencies from 12 Hz to 8 kHz (Richardson *et al.* 1995). Vocalisations may be produced throughout the year (Dunlop *et al.* 2007; Mussoline *et al.* 2012; Vu *et al.* 2012), with peaks in call rates during breeding seasons in some species, most notably humpback whales (Winn & Winn 1978). Odontocetes produce a spectrum of vocalizations including whistles, pulsed sounds and echolocation clicks (Popper 1980). Whistles play a key role in social communication, they are concentrated in the 1-30 kHz frequency range but may extend up to 75 kHz (Samarra *et al.* 2010) and contain high frequency harmonics *(Lammers et al.* 2003). The characteristics of burst pulsed sounds are highly variable, concentrated in the mid frequency for killer whales (Richardson *et al.* 1995), but extending well into the ultrasonic frequency range for other dolphin species (Lammers *et al.* 2003). Clicks are high intensity, short sounds associated with orientation and feeding. The frequency composition of echolocation clicks varies with species. Most delphinids produce broad band echolocation clicks with frequencies which extend well up into the ultra-sonic range > 100 kHz (Richardson *et al.* 1995). Sperm whales produce communication clicks with energy below 5 kHz (Madsen 2002) and 'usual' echolocation clicks reaching up to 30 kHz in frequency (Backus & Schevill 1966; Madsen *et al.* 2002). Neonatal sperm whales produce lower frequency sounds at 300-1700 Hz (Madsen *et al.* 2003). Porpoise, Kogia and dolphins in the genus *Cephalorhynchus* (including the Heaviside's dolphin) produce characteristic narrow band, high frequency (NBHF) echolocation clicks with a central frequency around 125 kHz (Madsen *et al.* 2005a; Morisaka *et al.* 2011). Beaked whales produce low frequency sounds (Richardson *et al.* 1995) and mid frequency echolocation clicks, burst pulse vocalisations and frequency modulated pulses with energy concentrated at 10 kHz and above (Madsen *et al.* 2005b; Rankin *et al.* 2011). Although most odontocete vocalizations are predominantly in mid and high frequency bands, there are recent descriptions of dolphins producing low frequency moans (150-240 Hz) and low frequency modulated tonal calls (990 Hz) (van der Woude 2009; Simrad *et al.* 2012), the function of which remains unclear but may be related to social behaviours.

Cetacean hearing

Cetacean hearing has received considerable attention in the international literature, and available information has been reviewed by several authors including Popper (1980), Fobes & Smock (1981), Schusterman (1981), Ridgway (1983), Watkins & Wartzok (1985), Johnson (1986), Moore & Schusterman (1987) and Au (1993).

Marine mammals as a group have wide variations in ear anatomy, frequency range and amplitude sensitivity. The hearing threshold is the amplitude necessary for detection of a sound and varies with frequency across the hearing range (Nowacek *et al.* 2007). Considerable differences also exist between the hearing sensitivities of baleen and toothed whales and dolphins and between individuals, resulting in different levels of sensitivity to sounds at varying frequencies. For most species the best frequency sensitivity corresponds closely to the frequencies at which they vocalise. Baleen whales appear to vocalise at low frequencies producing a rich and complex range of underwater sounds ranging from about 12 Hz to 8 kHz. In contrast, small odontocetes vocalise at far higher frequencies producing a wide range of whistles, clicks, pulsed sounds and echolocation clicks. The frequency range of toothed whale sounds excluding echo location clicks are mostly <20 kHz with most of the energy typically around 10 kHz, although some calls may be as low as 100 to 900 Hz. Consequently, baleen whale hearing is centred at below 1 kHz (Fleischer 1976, 1978; Norris & Leatherwood 1981), while toothed whale and dolphin hearing is centred at frequencies of between 10 and 100 kHz (Richardson *et al.*1995).

The factors that affect the response of marine mammals to sounds in their environment include the sound level and other properties of the sound, the physical and behavioural state of the animal and its prevailing acoustic characteristics, and the ecological features of the environment in which the animal encounters the sound. The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source, as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than they are one that is approaching them (Watkins 1986; Leung-Ng & Leung 2003), or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme *et al.* 1985).

Behavioural and electrophysical audiograms are available for several species of small- to medium-sized toothed whales (killer whale: Hall & Johnson 1972; Bain *et al.* 1993, false killer whale: Thomas *et al.* 1988, bottlenose dolphins: Johnson 1967, beluga: White *et al.* 1978; Awbrey *et al.* 1988, Harbour porpoise: Andersen 1970, Chinese river dolphin: Ding Wang *et al.* 1992 and Amazon river dolphin: Jacobs & Hall 1972; Risso's dolphin: Nachtigall *et al.* 1995, 1996, Harbour porpoise: Lucke *et al.* 2009). In these species, hearing is centered at frequencies between 10 and 100 kHz (Richardson *et al.*1995). The high hearing thresholds at low frequency for those species tested implies that the low frequency component of seismic shots (10 - 300 Hz) will not be audible to the small to medium odontocetes at any great distance. However, the higher frequency of an airgun array shot, which can extend to 15 kHz and above (Madsen *et al.* 2006) may be audible from tens of kilometres away, due to the very low sensitivity thresholds of many toothed whales at frequencies exceeding 1 kHz. Although the match is poor, overlap nonetheless exists between the frequency spectra of seismic shots and the hearing threshold curve with frequency for some toothed whale species, suggesting that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. They will thus not be affected as severely as many fish, and possibly sea turtles and baleen whales that have their greatest hearing sensitivity at low frequencies (McCauley 1994).

No psycho-acoustical or electrophysical work on the sensitivity of baleen whales to sound has been conducted (Richardson *et al.*, 1995) and hypotheses regarding the effects of sound in baleen whales are extrapolations from what is known to affect odontocetes or other marine mammals and from observations of behavioural responses. A partial response "audiogram" exists for the gray whale based on the avoidance of migrating whales to a pure tone source (Dahlheim & Ljungblad 1990). Frankel *et al.* (1995, in Perry 1998) found humpback whales in the wild to detect sounds ranging from 10 Hz to 10 kHz at levels of 102 to 106 dB re 1 μPa. Blue whales reduce calling in the presence of mid-frequency sonar (1-8 kHz) providing evidence that they are receptive to sound in this range (Melcón *et al.* 2012). Based on the low frequency calls produced by larger toothed whales, and anatomical and paleaontological evidence for baleen whales, it is predicted that these whales hear best in the low frequencies (Fleischer 1976, 1978; McCauley 1994) with hearing likely to be most acute below 1 kHz (Fleischer 1976, 1978; Norris & Leatherwood 1981). The available information demonstrates that the larger toothed whales and baleen whales will be very receptive to the sound produced by seismic airgun arrays and consequently this group may be more affected by this type of disturbance than toothed whales (Nowacek *et al.* 2007).

Physiological injury

Exposure to high sound levels can result in physiological injury to cetaceans through a number of avenues, including shifts of hearing thresholds (as either permanent (PTS) or temporary threshold shifts (TTS)) (Richardson *et al.* 1995; Au *et al.* 1999; Schlundt *et al.* 2000; Finneran *et al.* 2000, 2001, 2003), tissue damage (Lien *et al.* 1993; Ketten *et al.* 1993), acoustically induced decompression sickness particularly in beaked whales (Crum & Mao 1996; Cox *et al.* 2006), and non-auditory physiological effects including elevated blood pressures, increased heart and respiration rates, and temporary increases in blood catecholamines and glucocorticoids (Bowles & Thompson 1996), which may have secondary impacts on reproduction. Most studies conducted on sound-related injuries in cetaceans, however, investigated the effects of explosive pulses (Bohne *et al.* 1985, 1986; Lien *et al.* 1993; Ketten *et al.* 1993) and mid-frequency sonar pulses (Simmonds & Lopez-Jurado 1991; Crum & Mao 1996; Frantzis 1998; Balcomb & Claridge 2001; Evans & England 2001; Jepson *et al.* 2003; Cox *et al.* 2006), and the results are thus not directly applicable to non-explosive seismic sources such as those from airgun arrays.

Noise induced stress resulting from exposure to sources of marine sound can cause detrimental changes in blood hormones, including cortisol (Romano *et al.* 2004). However, quantifying stress caused by noise in wild populations is difficult as it is not possible to determine the physiological responses of an animal to a noise stressor based on behavioural observations alone (Wright *et al.* 2007). The timing of the stressor relative to seasonal feeding and breeding cycles (such as those observed in migrating baleen whales) may also influence the degree of stress induced by noise exposure (Tyack 2008)

There are no data on received levels that would induce permanent threshold shifts (PTS) in cetaceans, although Richardson *et al.* (1995) speculated that very prolonged exposure to noise levels of about 120 dB re 1μPa may induce PTS in beluga whales. Gradual PTS in marine mammals is highly unlikely to occur from seismic surveys. However, permanent hearing damage does not always develop gradually, but may result from brief exposure to high sound levels. Experiments to induce threshold shifts have only recently been conducted on captive marine mammals (Au *et al.* 1999; Schlundt *et al.* 2000, Finneran *et al.* 2000, 2001, 2002, 2003). Temporary threshold shifts (TTS) became evident at received levels of 194 - 201 dB re 1 μPa at 3 kHz, 193-196 dB at 20 kHz and 192-194 dB at 75 kHz in a bottlenose dolphin exposed to 1-second pulses underwater. However, the relatively long 1-second pulse that elicited the TTS response supplies considerably more energy to the water column than a very much shorter seismic pulse. Finneran *et al.* (2003) found a 226 dB re 1 μPa (peak) was required to create TTS in a beluga, and no TTS was observed in a dolphin at up to 230 dB (peak) using a water gun. Airgun stimuli played back to harbor porpoise (a NBHF species with similar vocal characteristics and body size to Heaviside's dolphin) generated a TTS in the 4 kHz band at a received sound pressure level of 199.7 db_{pk-pk} re 1 μPa and a sound exposure level of of 164.3 dB re 1 _Pa^2 s. Avoidance of the sound source was also observed (Luke *et al.* 2009). Based on statistical simulations accounting for uncertainty in the available data and variability in individual hearing thresholds, Gedamke *et al.* (2011) conclude that the possibility of seismic activity leading to TTS in baleen whales must be considered at distances up to several kilometers. As cetaceans are highly reliant on sound, hearing damage leading to TTS and PTS are likely to result in a reduction in foraging efficiency, reproductive potential, social cohesion and ability to detect predators (Weilgart 2007).

Overlap between the frequency spectra of seismic shots and the hearing threshold curve with frequency for some toothed whale species, suggests that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. They will thus not be affected as severely as many fish, and possibly sea turtles and baleen whales that have their greatest hearing sensitivity at low frequencies (McCauley 1994). Richardson *et al.* (1995) speculated that the Damage Risk Criteria (DRC) (*i.e.* the tolerable limits for noise exposure) for a marine mammal exposed to 100 seismic pulses might be in the order of 178 - 208 dB re 1μPa. They note, however, that as the duration of peak pressure is less than 200 ms, hearing damage is unlikely unless peak to peak pressure is several dB above these.

Behavioural disturbance

Typical behavioural response in cetaceans to seismic airgun noise include initial startle responses (Malme *et al.* 1985; Ljungblad *et al.* 1988; McCauley *et al.* 2000), changes in surfacing behaviour (Ljungblad *et al.* 1988; Richardson *et al.* 1985a; McCauley *et al.* 1996, 2000), shorter dives (Ljungblad *et al.* 1988), changes in respiration rate (Ljungblad *et al.* 1988; Richardson *et al.* 1985, 1986; Malme *et al.* 1983, 1985,1986), slowing of travel (Malme *et al.* 1983, 1984), and changes in vocalisations (McDonald *et al.* 1993, 1995) and call rate (Di Iorio & Clarke 2010). These subtle changes in behavioural measures are often the only observable reaction of whales to reception of anthropogenic stimuli, and there is no evidence that these changes are biologically significant for the animals (see for example McCauley 1994). Possible exceptions are impacts at individual (through reproductive success) and population level through disruption of feeding within preferred areas (as reported by Weller *et al.* (2002) for

Western gray whales). For continuous noise, whales begin to avoid sounds at exposure levels of 110 dB, and more than 80% of species observed show avoidance to sounds of 130 dB. For seismic noise, most whales show avoidance behaviour above 160 dB (Malme *et al.* 1983, 1984; Ljungblad *et al.* 1988; Pidcock *et al.* 2003). Behavioural responses are often evident beyond 5 km from the sound source (Ljungblad *et al.* 1988; Richardson *et al.* 1986, 1995), with the most marked avoidance response recorded by Kolski and Johnson (1987) who reported bowhead whales swimming rapidly away from an approaching seismic vessel at a 24 km distance.

In an analysis of marine mammals sightings recorded from seismic survey vessels in United Kingdom waters Stone (2003) reported that responses to large gun seismic activity varied between species, with small odontocetes showing the strongest avoidance response. Responses of medium and large odontocetes (killer whales, pilot whales and sperm whales) were less marked, with sperm whales showing no observable avoidance effects (see also Rankin & Evans 1998; Davis *et al.* 2000; Madsen *et al.* 2006). Baleen whales showed fewer responses to seismic survey activity than small odontocetes, and although there were no effects observed for individual baleen whale species, fin and sei whales were less likely to remain submerged during firing activity. All baleen whales showed changes in behavioural responses further from the survey vessel (see also Ljungblad *et al.* 1988; McCauley 2000; Abgrall *et al.* 2008), and both orientated away from the vessel and altered course more often during shooting activity. The author suggests that different species adopt different strategies in response to seismic survey disturbance, with faster smaller odontocetes fleeing the survey area (e.g. Weir 2008), while larger slower moving baleen whales orientate away from and move slowly from the firing guns, possibly remaining on the surface as they do so (see also Richardson *et al.* 1985a, 1985b, 1986, 1995). Responses to small airguns were less, and although no difference in distance to firing and non-firing small airguns were recorded, there were fewer sightings of small odontocetes in association with firing airguns. Other reports suggest that there is little effect of seismic surveys on small odontocetes such as dolphins, as these have been reported swimming near operating seismic vessels (Duncan 1985; Evans & Nice 1996; Abgrall *et al.* 2008; but see also Schlundt *et al.* 2000).

McCauley *et al.* (1996, 2000) found no obvious evidence that humpback whales were displaced by 2D and 3D seismic surveys and no apparent gross changes in the whale's migratory path could be linked to the seismic survey. Localised avoidance of the survey vessel during airgun operation was however noted. Whales which are not migrating but using the area as a calving or nursery ground may be more seriously affected through disturbance of suckling or resting. Potential avoidance ranges of 7-12 km by nursing animals have been suggested, although these might differ in different sound propagation conditions (McCauley *et al.* 2000). Disturbance of mating behaviour (which could involve a high degree of acoustic selection) by seismic noise could be of consequence to breeding animals.

The speed of sound increases with increasing temperature, salinity and pressure (Richardson *et al.* 1995) and stratification in the water column affects the rate of propagation loss of sounds produced by an airgun array. As sound travels, acoustic shadow and convergence zones may be generated as sound is refracted towards areas of slower sound speed. These can lead to areas of high and low noise intensity (shadow zones) so that exposure to different pulse components at distances of 1-13 km from the seismic source does not necessarily lessen (attenuate) with increasing range. In some cases this can lead to received levels at 12 km being as high as those at 2 km (Madsen *et al.* 2006). Depending on the propagation conditions of the water column, animals may need to move closer to the sound source or apply vertical rather than horizontal displacement to reduce their exposure. Although such movement may reduce received levels in the short-term it may prolong the overall exposure time and accumulated sound exposure level (SEL) (Madsen *et al.* 2006).

Masking of important environmental or biological sounds

Potential interference of seismic emissions with acoustic communication in cetaceans includes direct masking of the communication signal, temporary or permanent reduction in the hearing capability of the animal through exposure to high sound levels or limited communication due to behavioural changes in response to the seismic sound source. Baleen whales generally appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic sounds, while toothed whales vocalise at much higher frequencies, and it is likely that clicks are not masked by seismic survey noise (Goold & Fish 1998). However, due to multi-path propagation, receivers (cetaceans) can be subject to several versions of each airgun pulse, which have very different temporal and spectral properties (Madsen *et al.* 2006). High frequency sound is released as a by-product of airgun firing and this can extend into the mid- and high-frequency range (up to and exceeding 15 kHz) so that the potential for masking of these sound sources should be also considered (Madsen *et al.* 2006).

Indirect effects on prey species

The majority of baleen whales will undertake little feeding within breeding ground waters and rely on blubber reserves during their migrations. Although the fish and cephalopod prey of toothed whales and dolphins may be affected by seismic surveys, impacts will be highly localised and small in relation to the feeding ranges of cetacean species.

5. ASSESSMENT OF ACOUSTIC IMPACTS ON MARINE FAUNA

5.1. Assessment Procedure

The following convention was used to determine significance ratings in the assessment:

Rating	Definition of Rating
Extent - defines the physical extent or spatial scale of the impact	
Local	Extending only as far as the activity, limited to the site and its immediate surroundings
Regional	Limited to the South African West Coast
National	Limited to the coastline of South Africa
International	Extending beyond the borders of South Africa
Duration - the time frame over which the impact will be experienced	
Short-term	0 - 5 years
Medium-term	6 - 15 years
Long-term	Where the impact would cease after the operational life of the activity, either because of natural processes or by human intervention
Permanent	Where mitigation either by natural processes or by human intervention would not occur in such a way or in such time span that the impact can be considered transient
Intensity - establishes whether the magnitude of the impact is destructive or benign in relation to the sensitivity of the receiving environment	
Zero - Very Low	Where natural environmental functions and processes are not affected
Low	Where the affected environment is altered, but natural functions and processes continue, albeit in a slightly modified way
Medium	Where the affected environment is altered, but natural functions and processes continue, albeit in a modified way
High	Where environmental functions and processes are altered to the extent that they temporarily or permanently cease

Using the core criteria above, the significance of the impact is determined:

Significance - attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity		
VERY HIGH	Impacts could be EITHER:	
		of high intensity at a regional level and endure in the long term;
	OR	of high intensity at a national level in the medium term;
	OR	of medium intensity at a national level in the long term.
HIGH	Impacts could be EITHER:	
		of high intensity at a regional level enduring in the medium term;
	OR	of high intensity at a national level in the short term;
	OR	of medium intensity at a national level in the medium term;
	OR	of low intensity at a national level in the long term;
	OR	of high intensity at a local level in the long term;
	OR	of medium intensity at a regional level in the long term.

Significance - attempts to evaluate the importance of a particular impact, and in doing so incorporates extent, duration and intensity	
MEDIUM	Impacts could be EITHER: of high intensity at a local level and endure in the medium term; OR of medium intensity at a regional level in the medium term; OR of high intensity at a regional level in the short term; OR of medium intensity at a national level in the short term; OR of medium intensity at a local level in the long term; OR of low intensity at a national level in the medium term; OR of low intensity at a regional level in the long term.
LOW	Impacts could be EITHER of low intensity at a regional level, enduring in the medium term; OR of low intensity at a national level in the short term; OR of high intensity at a local level and endure in the short term; OR of medium intensity at a regional level in the short term; OR of low intensity at a local level in the long term; OR of medium intensity at a local level, enduring in the medium term.
VERY LOW	Impacts could be EITHER of low intensity at a local level and endure in the medium term; OR of low intensity at a regional level and endure in the short term; OR of low to medium intensity at a local level, enduring in the short term.
INSIGNIFICANT	Impacts with: Zero to Very Low intensity with any combination of extent and duration.
UNKNOWN	Where it is not possible to determine the significance of an impact.

Status of the Impact - describes whether the impact would have a negative, positive or zero effect on the affected environment	
Positive	The impact benefits the environment
Negative	The impact results in a cost to the environment
Neutral	The impact has no effect
Probability - the likelihood of the impact occurring	
Improbable	Possibility very low either because of design or historic experience
Probable	Distinct possibility
Highly Probable	Most likely
Definite	Impact will occur regardless of preventive measures
Degree of confidence in predictions - in terms of basing the assessment on available information and specialist knowledge	
Low	Less than 35% sure of impact prediction.
Medium	Between 35% and 70% sure of impact prediction.
High	Greater than 70% sure of impact prediction

Additional criteria to be considered, which could "increase" the significance rating are:

- Permanent / irreversible impacts (as distinct from long-term, reversible impacts);
- Potentially substantial cumulative effects; and
- High level of risk or uncertainty, with potentially substantial negative consequences.

Additional criteria to be considered, which could "decrease" the significance rating are:

- Improbable impact, where confidence level in prediction is high.

The relationship between the significance ratings after mitigation and decision-making can be broadly defined as follows:

Significance after Mitigation - considering changes in intensity, extent and duration after mitigation and assuming effective implementation of mitigation measures	
Very Low; Low	Will not have an influence on the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
Medium	Should influence the decision to proceed with the proposed project, provided that recommended measures to mitigate negative impacts are implemented.
High; Very High	Would strongly influence the decision to proceed with the proposed project.

5.2. Impacts of Seismic Survey

5.2.1 Impacts to Plankton

Potential impacts of seismic pulses on plankton and fish eggs and larvae would include mortality or physiological injury in the immediate vicinity of the airgun sound source. Impacts would thus be of high intensity at very close range (<5 m from the airguns) only, and no more significant than the effect of the wash from ships propellers and bow waves. As plankton distribution is naturally temporally and spatially variable and natural mortality rates are high, any impacts would thus be of low to negligible intensity across the survey area and for the duration of the survey (short-term).

The proposed survey area lies to the north and offshore of the Namaqua upwelling cell, in the Orange River Cone (LUCORC) area, between approximately 29°S - 31°S. Important pelagic fish species, including anchovy, redeye round herring, horse mackerel and shallow-water hake, are reported as spawning on either side of the LUCORC area, but not within it. The area is characterised by diminished phytoplankton biomass due to high turbulence and deep mixing in the water column, and consequently is considered to be an environmental barrier to the transport of ichthyoplankton from the southern to the northern Benguela upwelling ecosystems. A deficiency of phytoplankton results in poor feeding conditions for micro-, meso- and macrozooplankton, and for ichthyoplankton. Phytoplankton, zooplankton and ichthyoplankton abundances in the survey area are thus expected to be comparatively low.

Being located far offshore, the proposed survey area does not overlap with the spring to early summer spawning areas for a number of commercially important species (see Figure 13), including anchovy, pilchard, round herring and chub mackerel, with spawning of all except chub mackerel extending southeastward onto the Agulhas Bank. There is also no overlap of the proposed survey area with the northward egg and larval drift for anchovy. Ichthyoplankton abundance are thus expected to be negligible.

The overall potential impact of seismic noise on plankton and ichthyoplankton is thus deemed to be of **VERY LOW** significance both with and without mitigation.

Mitigation

No direct mitigation measures for potential impacts on plankton and fish egg and larval stages are feasible or deemed necessary.

Impacts of seismic noise to plankton and ichthyoplankton		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

5.2.2 Impacts to Marine Invertebrates

Although some marine invertebrates have mechanoreceptors or statocyst organs that are sensitive to hydroacoustic disturbances, most do not possess hearing organs that perceive sound pressure. Potential impacts of seismic pulses on invertebrates include physiological injury and behavioural avoidance of seismic survey areas. Masking of environmental sounds and indirect impacts due to effects on predators or prey have not been documented and are highly unlikely.

Physiological injury and mortality

There is little published information on the effects of seismic surveys on invertebrate fauna. It has been postulated, however, that shellfish, crustaceans and most other invertebrates can only hear seismic survey sounds at very close range, such as less than 15 m away. This implies that only surveys conducted in very shallow water will have any detrimental effects. As the survey would mostly be conducted in excess of 300 m depth the received noise at the seabed would be within the far-field range, and outside of distances at which physiological injury of benthic invertebrates would be expected. The eastern boundary of the licence area, however, potentially encroaches into depths frequented by West Coast rock lobster *Jasus lalandii*. Rock lobsters generally exhibit strong associations with, and a preference for, nearshore creviced reef habitats and kelp beds, and avoid gravel and sand areas (Pulfrich & Penney 2001). As the seabed offshore of the Namaqualand coast is dominated by unconsolidated sediments of Orange River origin, abundances of rock lobsters beyond ~30 m depth are likely to be insignificant. Their depth distribution and availability is, however, strongly influenced by environmental conditions (Newman & Pollock 1971; Pollock 1978; Beyers 1979; Pollock & Beyers 1981; Bailey *et al.* 1985; Pollock & Shannon 1987; Tomalin 1993; Pulfrich *et al.* 2006, amongst others). During the summer lobsters typically occur inshore in response to declining bottom oxygen levels in deeper water (Pollock & Shannon 1987). In contrast, in the winter months (or when the water column is well mixed) lobsters migrate offshore and can occur to depths of 130 m when conditions are favourable.

Evidence from video footage taken on hard-substrate habitats to the south-east of Child's Bank suggests that vulnerable communities including gorgonians, octocorals and reef-building sponges occur on the continental shelf, and similar communities may thus be expected on the seamount.

The potential impact of seismic noise on physiological injury or mortality of invertebrates is consequently deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation. No mitigation measures for potential impacts on marine invertebrates and their larvae are feasible or deemed necessary.

Behavioural avoidance

Similarly, there is little published information on the effects of seismic surveys on the response of invertebrate fauna to seismic impulses. Limited avoidance of airgun sounds may occur in mobile neritic and pelagic invertebrates and is deemed to be of low intensity. Of the marine invertebrates only cephalopods are receptive to the far-field sounds of seismic airgun arrays. Although consistent avoidance has not been reported, behavioural changes have been observed at 2 - 5 km from an approaching large seismic source (McCauley *et al.* 2000). The received noise at the seabed would be within the far-field range, and thus outside of distances at which avoidance of benthic invertebrates would be expected, but potentially within the response range of cephalopods.

Most of the cephalopod resource is distributed on the mid-shelf with *Sepia australis* being most abundant at depths between 60 - 190 m, whereas *S. hieronis* densities were higher at depths between 110 - 250 m. *Rossia enigmatica* occurs more commonly on the edge of the shelf to depths of 500 m. The Exploration Right area thus lies mainly offshore of the main cephalopod distribution.

The potential impact of seismic noise on invertebrate behaviour is consequently deemed of low to negligible intensity across the survey area and for the survey duration and is considered to be of **VERY LOW** significance both with and without mitigation, and no mitigation measures are deemed necessary.

Impacts of seismic noise to marine invertebrates resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic noise to marine invertebrates resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

5.2.3 Impacts to Fish

A review of the available literature suggests that potential impacts of seismic pulses to fish (including sharks) species could include physiological injury and mortality, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on predators or prey.

Physiological injury and mortality

The greatest risk of pathological injury from seismic sound sources is for species that establish home ranges on shallow-water reefs or congregate in inshore waters to spawn or feed, and those displaying an instinctive alarm response to hide on the seabed or in the reef rather than flee. Large demersal or reef-fish species with swim-bladders are also more susceptible than those without this organ. Such species may suffer pathological injury or severe hearing damage and adverse effects may intensify and last for a considerable time after the termination of the sound source. However, as the proposed survey area is located in water depths of beyond 300 m, the received noise by demersal species at the seabed would be within the far-field range, and outside of distances at which physiological injury or avoidance would be expected.

Economically important pelagic species (e.g. sardine/pilchard, anchovy, chub mackerel, horse mackerel and round herring) generally occur within the 200 m contour and thus unlikely to be encountered in the proposed Exploration Right area. The most likely fish species to be encountered in the survey area are the large pelagic species such as the highly migratory tuna and billfish, which occur offshore of the 100 m isobath. These species show seasonal association with Child's Bank and Tripp Seamount between October and June, with commercial catches often peaking in March and April (www.fao.org/fi/fcp/en/ NAM/body.htm; Wilkinson & Japp 2009). As the survey would most likely be scheduled over the summer months (to avoid the winter migration of southern right and humpback whales) there is thus a high likelihood that the survey vessel would encounter tuna and billfish *en route* to their seasonal aggregation around the seamount. However, given the high mobility of most large pelagic species, it is assumed that the majority of these would avoid seismic noise at levels below those where physiological injury or mortality would result. Furthermore, in many of the large pelagic species, the swim-bladders are either underdeveloped or absent, and the risk of physiological injury through damage of this organ is therefore lower. Possible injury or mortality in pelagic species could occur on initiation of a sound source at full pressure in the immediate vicinity of fish, or where reproductive or feeding behaviour override a flight response to seismic survey sounds. The potential physiological impact on pelagic species, would be of high intensity. The potential physiological impact on demersal species would, however, be insignificant as they would only be affected in the far-field range, if at all. The duration of the impact on the population would be limited to the short-term. The impact is therefore considered to be of **LOW** significance without the implementation of mitigation measures, and of **VERY LOW** significance with mitigation measures.

Behavioural avoidance

Behavioural responses such as avoidance of seismic survey areas and changes in feeding behaviours of some fish to seismic sounds have been documented at received levels of about 160 dB re 1 μPa. Behavioural effects are generally short-term, however, with duration of the effect being less than or equal to the duration of exposure, although these vary between species and individuals, and are dependent on the properties of the received sound. The potential impact on fish behaviour could therefore be of high intensity (particularly in the near-field of the airgun array), over the short term, but limited to the survey area. Considering the distribution ranges of most large migratory pelagic fish, the impact is considered to be of **LOW** significance without mitigation and **VERY LOW** significance with mitigation.

Reproductive success / spawning

Fish populations can be further impacted if behavioural responses result in deflection from migration paths or disturbance of spawning. If fish on their migration paths or spawning grounds are exposed to powerful external forces, they may be disturbed or even cease spawning altogether thereby affecting recruitment to fish stocks. The magnitude of effect in these cases will depend on the biology of the species and the extent of the dispersion or deflection. Studies undertaken experimentally exposing the eggs and larvae of various fish species to airgun sources, however, identified mortalities and physiological injuries at very close range (<5 m) only. As the surveys will primarily be conducted at depths in excess of

300 m and well offshore of the major spawning areas (Figure 13), the impact is considered to be of **VERY LOW** significance both without and with mitigation.

Considering the spatial extent of the spawning areas, the lack of overlap with the survey area and the low frequency and short duration of the proposed seismic survey, any indirect effects of mortality to ichthyoplankton (assessed in Section 5.2.1) on recruitment to adult fish populations is also considered to be of **VERY LOW** significance both with and without mitigation.

Masking of environmental sounds and communication

Communication and the use of environmental sounds by fish in the offshore environment off the southern African west coast are unknown. Impacts arising from masking of sounds are expected to be of low intensity due to the duty cycle of seismic surveys in relation to the more continuous biological noise. Such impacts would occur across the survey area and for the duration of the survey and are consequently considered of **VERY LOW** significance both with and without mitigation.

Indirect impacts due to effects on predators or prey

The assessment of indirect effects of seismic surveys on fish is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the fish species concerned and the effect of seismic surveys on the diet species. Indirect impacts of seismic surveying could include attraction of predatory species such as sharks and tunas to pelagic fish stunned by seismic noise. In such cases where feeding behaviour overrides a flight response to seismic survey sounds, injury or mortality could result if the seismic sound source is initiated at full power in the immediate vicinity of the feeding predators. Little information is available on the feeding success of large migratory species in association with seismic survey noise. Although large pelagic species are known to aggregate around seamounts to feed, considering the extensive range over which large pelagic fish species can potentially feed in relation to the survey area, and the low abundance of pelagic shoaling species that constitute their main prey, the impact is likely to be of **VERY LOW** significance both with and without mitigation.

Mitigation

Recommendations for mitigation include:

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration (JNCC 2010), allowing fish to move out of the survey area and thus avoid potential physiological injury as a result of seismic noise.
- Airgun firing should be terminated if mass mortalities of fish as a direct result of shooting are observed.
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Child's Bank. On lines beyond that the low power guns can be stopped during turns, but the normal start-up proceedure should nonetheless be maintained. The reasoning behind this recommendations is that the complex food-webs that develop around seamounts may lead to the increased presence of scavengers and predators, including large pelagic fish species, in the vicinity of the seamounts.

Impacts of seismic noise on fish resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low to Medium
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Impacts of seismic noise on fish resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Medium
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Impacts of seismic noise on reproductive success and spawning		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low to Medium	Low to Medium
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

Impacts of seismic noise on fish resulting in masking of sounds		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Impacts of seismic noise on fish resulting in indirect impacts on food sources		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

5.2.4 Impacts to Seabirds

Among the marine avifauna occurring along the South African West coast, it is only the species that feed by plunge-diving or that rest on the sea surface, which may be affected by the underwater noise of seismic surveys. Potential impacts of seismic pulses to diving birds could include physiological injury, behavioural avoidance of seismic survey areas and indirect impacts due to effects on prey. The seabird species are all highly mobile and would be expected to flee from approaching seismic noise sources at distances well beyond those that could cause physiological injury, but initiation of a sound source at full power in the immediate vicinity of diving seabirds could result in injury or mortality where feeding behaviour overrides a flight response to seismic survey sounds. The potential for physiological injury or behavioural avoidance in non-diving seabird species is considered **INSIGNIFICANT** and will not be discussed further here.

Physiological injury

The continuous nature of the intermittent seismic survey pulses suggest that diving birds would hear the sound sources at distances where levels would not induce mortality or injury, and consequently be able to flee an approaching sound source. The potential for physiological impact of seismic noise on diving birds could be of high intensity but would be limited to the survey area and survey duration (short term). Of the plunge diving species that occur along the West Coast, only the Cape Gannet regularly feeds as far offshore as 100 km, the rest foraging in nearshore areas up to 40 km from the coast. The nearest nesting grounds are at Bird Island in Lambert's Bay, ~250 km to the southeast of the southern limit of Block 2C, with a cormorant roosting site at Elephant Rocks ~230 km to the southeast. To the north in Namibia, the nearest seabird breeding colonies are on Sinclair and Plumpudding Islands at Baker's Bay, ~150 km to the northwest of the Orange River mouth. The exploration right area also lies more than 100 km offshore. There is therefore a low likelihood of encountering gannets in the survey area. African Penguins are known to forage as far as 60 km offshore and juveniles have been reported to travel up the coast regularly. The nearest African Penguin nesting sites in South Africa are at the Saldanha Bay Islands and those in Namibia at Possession Island near Lüderitz, ~280 km south and ~280 km northwest of the survey area, respectively. The survey operation is thus unlikely to encounter penguins. Pelagic seabirds that dive for their prey may, however, be encountered in the area around Child's Bank, as such features act as mid-ocean focal points for a variety of pelagic species that may migrate large distances in search of food. The potential physiological impact on diving species could thus be of **LOW** significance without mitigation, and **VERY LOW** significance with mitigation.

Behavioural avoidance

Diving birds would be expected to hear seismic sounds at considerable distances as they have good hearing at low frequencies (which coincide with seismic shots). Response distances are speculative, however, as no empirical evidence is available. Behavioural avoidance by diving seabirds would be limited to within the long range of the operating airgun over the duration of the survey period. The impact is likely to be of medium to high intensity. Although there is a low likelihood off encountering gannets and penguins in the proposed Exploratin Right area due to the distance offshore, there is a likelihood of encountering pelagic seabirds around Child's Bank. The potential impact on the behaviour of diving seabirds is considered to be of **LOW** significance without mitigation, and of **VERY LOW** significance with mitigation.

Indirect impacts due to effects on prey

As with other vertebrates, the assessment of indirect effects of seismic surveys on diving seabirds is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the bird species concerned and the effect of seismic surveys on the diet species. No information is available on the feeding success of seabirds in association with seismic survey noise. With few exceptions, most plunge-diving birds forage on small shoaling species relatively close to the shore and are unlikely to feed extensively in offshore waters that would primarily be targeted during the seismic survey. In the vicinity of Child's Bank, however, there may be an increased probability of encountering foraging seabirds. The broad ranges of potential fish prey species (in relation to potential avoidance patterns of seismic surveys of such prey species) and extensive ranges over which most seabirds feed suggest that indirect impacts would be **LOW** without and **VERY LOW** with mitigation.

Other Potential Impacts

Other potential adverse interactions between seabirds and seismic surveys are (1) stranding of birds on the survey vessel due to being attracted to the vessel lights at night, and (2) oiling through accidental loss of buoyancy liquid or hydraulic fluid from the towed gear. However, while there is some potential for effects on individual seabirds through strandings or oiling, no significant effects on seabird populations are predicted, as the number of animals potentially affected will be small. The impacts are thus assessed as being **INSIGNIFICANT.**

Mitigation

Recommendations for mitigation include:

- All initiation of airgun firing be carried out as "soft-starts" of for least 20 minutes (JNCC 2010).
- An area of radius of 500 m be scanned by an independent observer for the presence of diving seabirds prior to the commencement of "soft starts" and that these be delayed until such time as this area is clear of seabirds.

- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Child's Bank.
- Seabird incidence and behaviour should be recorded by an onboard Independent Observer. Any obvious mortality or injuries to seabirds as a direct result of the survey should result in temporary termination of operations.
- Any attraction of predatory seabirds (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should be recorded by an onboard Independent Observer.

Impacts of seismic noise on diving seabirds resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Impacts of seismic noise on diving seabirds resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium to High	Low
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Improbable
Confidence	Medium	Medium

Impact: Impacts of seismic noise on seabirds resulting in indirect impacts on food sources		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Medium to High	Low
Significance	Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Impacts of seismic surveys to seabirds through stranding or oiling		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Very Low	Very Low
Significance	Insignificant	Insignificant
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Medium	Medium

5.2.5 Impacts to Turtles

Although three species of turtles occur along the West Coast, it is only the Leatherback turtle which is likely to be encountered in deeper waters. However, abundances are likely to be extremely low, comprising occasional visitors. The most likely impacts to turtles from seismic survey operations include physiological injury (including disorientation) or mortality from seismic noise or collision with or entanglement in towed seismic apparatus, behavioural avoidance of seismic survey areas, and indirect effects due to the effects of seismic sounds on prey species.

Physiological injury (including disorientation) or mortality

Although no information could be sourced on physiological injury to turtle hearing as a result of seismic sounds, the overlap of their hearing sensitivity with the higher frequencies produced by airguns, suggest that turtles may be considerably affected by seismic noise. Recent evidence, however, suggests that turtles only detect airguns at close range (<10 m) or are not sufficiently mobile to move away from approaching airgun arrays (particularly if basking). Initiation of a sound source at full power in the immediate vicinity of a swimming or basking turtle would be expected to result in physiological injury. The potential impact could therefore be of medium intensity (due to extremely low abundance), but remain within the short-term. However, as the abundance of adult turtles in the survey area is low, the likelihood of encountering turtles during the proposed survey is thus expected to be very low. The potential physiological impact on turtles is thus considered to be of **VERY LOW** significance both without and with mitigation.

The potential for collision between adult turtles and the seismic vessel, or entanglement of turtles in the towed seismic equipment and surface floats, is highly dependent on the abundance and behaviour of turtles in the survey area at the time of the survey. As the breeding areas for Leatherback turtles occur over 2,000 km to north-west of the survey area (in Republic of Congo and Gabon), turtles encountered during the survey are likely to be migrating vagrants and impacts through collision or entanglement would be of low intensity and short-term. The impacts on turtles through collision or entanglement of seismic equipment is thus considered to be of **VERY LOW** significance both without and with mitigation.

Behavioural avoidance

Behavioural changes by turtles in response to seismic sounds range from apparent lack of movement away from active airgun arrays through to startle response and avoidance by fleeing an operating sound source. The impact of seismic sounds on turtle behaviour is of medium intensity (due to extremely low abundance), but would persist only for the duration of the survey, and be restricted to the survey area. Given the general extent of turtle migrations relative to the seismic survey target grid, the impact of seismic noise on turtle migrations is deemed to be of **VERY LOW** significance both without and with mitigation.

Indirect effects due to the effects of seismic sounds on prey species

Leatherback turtles feed on jellyfish, which are pelagic and therefore have a naturally temporally and spatially variable distribution. Adverse modification of such pelagic food sources would thus be insignificant, and the effects of seismic surveys on the feeding behaviour of turtles is thus expected to be **VERY LOW** both with and without mitigation.

Masking of environmental sounds and communication

Breeding adults of sea turtles undertake large migrations between distant foraging areas and their nesting sites (which on the African West coast are >2,000 km north-west of survey area in Republic of Congo and Gabon). Although it is speculated that turtles may use acoustic cues for navigation during migrations, information on turtle communication is lacking. There is no information available in the literature on the effect of seismic noise in masking environmental cues and communication in turtles, but their low abundance in the survey area would suggest that the potential significance of this impact (should it occur) would be **INSIGNIFICANT.**

Mitigation

A number of mitigation measures are recommended for potential impacts of seismic surveys on turtles:

- All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration (JNCC 2010).
- An area of radius of 500 m be scanned by an independent observer for the presence of turtles prior to the commencement of "soft starts" and that these be delayed until such time as this area is clear of turtles.
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Child's Bank. On lines beyond that the low power guns can be stopped during turns, but the normal start-up proceedure should nonetheless be maintained.
- Daylight observations of the survey region should be carried out by onboard Independent Observers and incidence of turtles and their responses to seismic shooting should be recorded.
- Seismic shooting should be terminated when obvious changes to turtle behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun.
- Any obvious mortality or injuries to turtles as a direct result of the survey should result in temporary termination of operations.

- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.

Impacts of seismic noise on turtles resulting in physiological injury, or collision and entanglement with towed equipment		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable to Highly Probably	Probable
Confidence	Medium	Medium

Impacts of seismic noise on turtles resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Medium	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Highly Probable	Probable
Confidence	High	High

Impacts of seismic noise on turtles resulting in indirect impacts on food sources		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

Impacts of seismic noise on turtles resulting in masking of sounds		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Very Low	Very Low
Significance	Insignificant	Insignificant
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	Low	Low

5.2.6 Impacts to Seals

Physiological injury or mortality

The physiological effects of loud low frequency sounds on seals have not been well documented. The potential for physiological injury to seals from seismic noise is expected to be low as being highly mobile, fur seals would avoid severe sound sources at levels well below those at which discomfort occurs. Past studies suggest that noise of moderate intensity and duration is sufficient to induce temporary threshold shifts in seals, as individuals did not appear to avoid the survey area. Their tendency to swim at or near the surface will also expose them to reduced sound levels when in close proximity to an operating airgun array. There are two breeding colonies located east of Block 2C, namely at Buchu Twins near Alexander Bay (~200 km to the northeast), Robeiland at Kleinzee (~200 km to the east), with a further breeding colony at Elephant Rockst near the Olifants River mouth, ~230 km to the south. Non-breeding colonies are located at Strandfontein Point near the Groen River mouth and Bird Island at Lambert's Bay, ~100 km and ~270 km south, respectively. The proposed survey area therefore falls within the foraging range of seals from the nearby colonies. The potential impact of physiological injury to seals as a result of seismic noise is therefore deemed to be of medium intensity and would be limited to the survey area, although injury could extend beyond the survey duration. The significance of the impact without mitigation is **VERY LOW** with and without mitigation.

Behavioural avoidance

Although partial avoidance (to less than 250 m) of operating airguns has been recorded for some seals species, Cape fur seals appear to be relatively tolerant to loud noise pulses and, despite an initial startle reaction, individuals quickly reverted back to normal behaviour. The potential impact of seal behaviour in response to seismic surveys is thus considered to be of low to medium intensity and limited to the survey area and duration. The significance of behavioural avoidance impacts are consequently deemed **VERY LOW**, both with and without mitigation.

Masking of environmental sounds and communication

The use of underwater sounds for environmental interpretation and communication by Cape fur seals is unknown, although masking is likely to be limited by the low duty cycle of seismic pulses (one firing every 10 to 15 seconds). The impacts of masking are considered **VERY LOW**, both with and without mitigation.

Indirect effects due to the effects of seismic sounds on prey species

As with other vertebrates, the assessment of indirect effects of seismic surveys on Cape fur seals is limited by the complexity of trophic pathways in the marine environment. The impacts are difficult to determine, and would depend on the diet make-up of the species (and the flexibility of the diet), and the effect of seismic surveys on the diet species. The broad ranges of fish prey species (in relation to the avoidance patterns of seismic surveys of such prey species) and the extended foraging ranges of Cape fur seals suggest that indirect impacts due to effects on predators or prey would be **VERY LOW**, both with and without mitigation.

Mitigation

Mitigation measures recommended for potential impacts of seismic surveys on seals are:

- Daylight observations of the survey region should be carried out by onboard Marine Mammal Observers (MMOs) and the presence of seals (including number and position / distance from the vessel) and their behaviour should be recorded prior to "soft start" procedures. All initiation of airgun firing be carried out as "soft-starts" of at least 20 minutes duration (JNCC 2010).
- "Soft start" procedures should, if possible, only commence once it has been confirmed that there is no seal activity within 500 m of the airguns. If after a period of 30 minutes seals are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least a 20-minutes duration.
- The MMO should monitor seal behaviour during "soft starts" to determine if the seals display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality to seals as a direct result of seismic shooting operations.
- Seismic shooting should be terminated when obvious negative changes to seal behaviour are observed or there is any obvious mortality or injuries to seals as a direct result of the survey.
- The MMO's daily report should record general seal activity, numbers and any noticeable change in behaviour.

Impacts of seismic noise on seals resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic noise on seals resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey.	Short-term
Intensity	Low to medium	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Impacts of seismic surveys on seals resulting in masking of sounds and communication		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic surveys on seals resulting from indirect effects on their prey		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

5.2.7 Impacts to Whales and Dolphins

A wide diversity of cetaceans (whales and dolphins) occur off the West Coast. The majority of migratory cetaceans in southern African waters are baleen whales (mysticetes), while toothed whales (odontocetes) may be resident or migratory. Potential impacts of seismic pulses to whales and dolphins could include physiological injury, behavioural avoidance of seismic survey areas, masking of environmental sounds and communication, and indirect impacts due to effects on prey.

The factors that affect the response of marine mammals to sounds in their environment include the sound level and its prevailing acoustic characteristics, the ecological features of the environment in which the animal encounters the sound and the physical and behavioural state of the animal. The responses of cetaceans to noise sources are often also dependent on the perceived motion of the sound source, as well as the nature of the sound itself. For example, many whales are more likely to tolerate a stationary source than they are one that is approaching them (Watkins 1986; Leung-Ng & Leung 2003), or are more likely to respond to a stimulus with a sudden onset than to one that is continuously present (Malme *et al.* 1985). When discussing the potential effects of seismic surveys on marine mammals we should bear in mind the lack of data (uncertainty) concerning the auditory capabilities and thresholds of impacts on the different species encountered and the individual variability in hearing thresholds and behavioural responses which are likely to influence the degree of impact (Luke *et al.* 2009; Gedamke *et al.* 2011). This uncertainty and variability can have a large impact on how risk to marine mammals is assessed. Assessing the impact of seismic activity on populations in the Benguela ecosystem is further hampered by a poor understanding of the abundance and distribution of many of the species found here.

Marked differences occur in the hearing of baleen whales (mysticete cetaceans) and toothed whales and dolphins (odontocete cetaceans). The vocalisation and estimated hearing range of baleen whales (centred at below 1 kHz) overlap the highest peaks of the power spectrum of airgun sounds and consequently these animals may be more affected by disturbance from seismic surveys (Nowacek *et al.* 2007). In contrast, the hearing of toothed whales and dolphins is centred at frequencies of between 10 and 100 kHz, suggesting that these may react to seismic shots at long ranges, but that hearing damage from seismic shots is only likely to occur at close range. Mysticete and odontocete cetaceans are thus assessed separately below.

Physiological injury

There is little information available on the levels of noise that would potentially result in physiological injury to cetaceans, and no permanent threshold shifts have been recorded. Available information suggests that the animals would need to be in close proximity to operating airguns to suffer physiological injury, and being highly mobile it is assumed that they would avoid sound sources at distances well beyond those at which injury is likely to occur. Deep-diving cetacean species may, however, be more susceptible to acoustic injury, particularly in the case of seafloor-focused seismic surveys, where the downward focused impulses could trap deep diving cetaceans within the survey pulse, as escaping towards the surface would result in exposure to higher sound level pulses.

The impact of physiological injury to both mysticete and odontocete cetaceans as a result of high-amplitude seismic sounds is deemed to be of high intensity, but would be limited to the immediate vicinity of operating airguns within the survey area. The intensity of the impact is related to the location of the surveys and the time of year they are undertaken. To avoid the main winter migration periods of southern right and humpback whales, the proposed surveys would most likely be scheduled for the summer months. However, deviations from the predictable and seasonal migration patterns of souther rights and humpbacks have been reported from the Cape Columbine - Yzerfontein area (Best 2007; Barendse *et al.* 2010) with high abundances during spring and summer (September-February). Although during this time both southern right and humpback whales do undertake exploratory trips northwards along the coast from the summer feeding grounds off Saldanha Bay, the offshore location of the proposed exploration area makes encounters with whales undergoing summer migrations highly unlikely. As a consequence, the impact is considered to be of **MEDIUM** significance without mitigation and **LOW** significance with mitigation.

Behavioural avoidance

Avoidance of seismic survey activity by cetaceans, particularly mysticete species, begins at distances where levels of approximately 150 to 180 dB are received. More subtle alterations in behaviour may occur at received levels of 120 dB. Although behavioural avoidance of seismic noise in the proposed survey area by baleen whales is highly likely, such avoidance is generally considered of minimal impact in relation to the distances of migrations of the majority of baleen whale species.

Of greater concern than general avoidance of migrating whales is avoidance of critical breeding habitat or area where mating, calving or nursing occurs. Southern right whales mostly remain in the coastal area south of Lambert's Bay. The proposed survey area is located well offshore and to the north of Lambert's Bay, and therefore does not overlap with nearshore West coast regions potentially utilised by southern right whales as a mating, calving, or nursery grounds. There is, however, potential overlap with migration routes of both humpback whales to and from their breeding grounds. Similarly, the proposed survey area is located well to the north and offshore of the West Coast feeding ground around Cape Columbine, where local abundances of temporary resident humpbacks and southern rights whales occur during summer months. Interaction between the proposed survey and the summer feeding aggregations is thus unlikely.

The potential impact of behavioural avoidance of seismic survey areas by mysticete cetaceans is considered to be of high intensity, across the survey area and for the duration of the survey. Although the proposed survey would likely be scheduled over the summer months, the likelihood of the survey encountering southern right and humpback whales making exploratory trips northwards along the coast from the summer feeding grounds is extremely low. Due to the unlikley encounter rate, the impact of seismic surveying is thus considered of **LOW** significance before mitigation, and **VERY LOW** significance with mitigation.

Information available on behavioural responses of toothed whales and dolphins to seismic surveys is more limited than that for baleen whales. No seasonal patterns of abundance are known for odontocetes occupying the proposed study area and there is less evidence of avoidance of seismic surveys by toothed whales (including dolphins). A precautionary approach to avoiding impacts is thus recommended, and consequently the impact of seismic survey noise on the behaviour of toothed whales is considered to be of medium intensity over the survey area and duration. The endemic Heaviside's dolphin has a restricted distribution on the continental shelf in waters <200 m depth and therefore overlap with proposed survey area is minimal. A number of other toothed whale species, however, have a more pelagic distribution thus occurring further offshore. The overall significance will therefore vary between species, and consequently ranges between **LOW** and **VERY LOW** before mitigation and **VERY LOW** with mitigation.

Masking of environmental sounds and communication

Baleen whales appear to vocalise almost exclusively within the frequency range of the maximum energy of seismic survey noise, while toothed whales vocalise at frequencies higher than these. As the by-product noise in the mid-frequency range can travel far, masking of communication sounds produced by whistling dolphins and blackfish[2] is likely. In the migratory baleen whale species, vocalisation increases once they reach the breeding grounds and on the return journey in December - January when accompanied by calves. However, masking of communication signals is likely to be limited by the low duty cycle of seismic pulses. Consequently, the intensity of impact on baleen whales is likely to be low over the survey area and duration, but high in the case of toothed whales. Whereas for mysticetes the significance is rated as **VERY LOW**, both with and without mitigation, for odontocetes it is rated as **MEDIUM** without mitigation and **LOW** with mitigation.

Indirect impacts due to effects on prey

As with other vertebrates, the assessment of indirect effects of seismic surveys on resident odontocete cetaceans is limited by the complexity of trophic pathways in the marine environment. However, it is likely that both fish and cephalopod prey of toothed whales and dolphins may be affected over limited areas, although the impacts are difficult to determine. The broad ranges of prey species (in relation to the avoidance patterns of seismic surveys of such prey species) suggest that indirect impacts due to effects on prey would be of **VERY LOW** significance with and without mitigation. Baleen whales seldom feed within breeding ground waters and rely on blubber reserves during their migrations, so the significance of indirect effects on their food source is **VERY LOW.**

Other potential impacts

Given the slow speed (about 4 - 6 kts) of the vessel while towing the seismic array, ship strikes are also unlikely. Entanglement in gear is, however, possible.

Mitigation

Mitigation measures to reduce the impact of seismic survey impulses on cetaceans include:

- Seismic surveys should as far as possible be planned to avoid cetatean migration periods or winter breeding concentrations (June to end November), and ensure that migration paths are not blocked.
- As no seasonal patterns of abundance are known for odontocetes occupying the proposed study area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Should the survey schedules overlap with the start of the sensitive period in terms of large mammals migrating through the area, ensure that PAM technology is implemented to confirm that no cetaceans are present in the vicinity of the vessel. PAM is also to be used when surveying at night or during adverse weather conditions and thick fog. During the commencement of night-time operations, visual watches (30 minutes prior to

[2] The term blackfish refers to the delphinids: Melon-headed whale, Killer whale, Pygmy Killer Whale, False Killer Whale, Long-finned Pilot Whale, Short-finned Pilot Whale,

soft-starts) should be maintained using night-vision/infra-red binoculars and PAM technology.

- The use of Passive Acoustic Monitoring (PAM) is encouraged by most international guidelines as a mitigation tool to detect marine mammals through their vocalisations, ***particularly if species of particular conservation importance are likely to be encountered in the proposed survey area***, or where a given species or group is difficult to detect by visual observation alone. Such monitoring can provide distance and bearing of the animals from the survey vessel. Although PAM would only identify animals that are calling or vocal, it has the advantage of 24 hour per day availability as opposed to visual monitoring, which can only be confidently carried out during daylight hours, or under adequate visibility conditions. Considering that most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered", every effort should be made to ensure that the vessel is fitted with PAM technology[3].
- Survey vessels should accommodate dedicated independent MMOs with experience in seabird, turtle and marine mammal identification and observation techniques, to carry out daylight observations of the survey region and record incidence of marine mammals, and their responses to seismic shooting. Data collected should include position, distance from the vessel, swimming speed and direction, and obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns). The identification and the behaviour of the animals must be recorded accurately along with current seismic noise levels.
- All initiations of seismic surveys must be carried out as "soft-starts" for a minimum of 20 minutes (JNCC 2010). This requires that the sound source be ramped from low to full power, thus allowing a flight response to outside the zone of injury or avoidance. The rational for the 20 minute "soft-start" period is based on the flight speeds of cetacean species.
- Initiation of firing is only to begin after observations by MMOs have deemed the visual area around the vessel to a distance of 500 m to be clear of all diving cetacean species for at least 30 minutes prior to firing, so that deep- or long-diving species can be detected. In the case of small cetacean (particularly dolphins) and medium odontocetes (pilot whales), which are often attracted to survey vessels, "soft start" procedures should, if possible, only commence once it has been confirmed that there is no small/medium cetacean activity within 500 m of the airguns. If after a period of 30 minutes small/medium cetaceans are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least a 20-minutes duration. The MMO should monitor small/medium cetacean behaviour during "soft-starts" to determine if the animals display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of seismic operations.
- Maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of Child's Bank. On lines beyond that the low power guns can be stopped during turns, but the normal start-up proceedure should nonetheless be maintained.

[3] As the survey is taking place in waters up to 1,500 m depth, at night, and in the vicinity of both Tripp Seamount and Child's Bank, where sperm whales are likely to be encountered, the use of PAM is highly recommended. PAM can also be used effectively to detect Heaviside's dolphins, which produce clicks in the 125 kHz range. However, PAM can only be used to detect this species at a maximum range of about 500 m.

- During night-time line changes low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line.
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks shorter than 20 minutes should be followed by a "soft-start" of similar duration.
- Seismic shooting should be terminated when obvious changes to cetacean behaviour is observed from the survey vessel, or animals are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun.
- All data recorded by MMOs should at minimum form part of a survey close-out report. Furthermore, daily or weekly reports should be forwarded to the necessary authorities to ensure compliance with the mitigation measures.
- Marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, Department of Agriculture, Fisheries and Forestry, and the Petroleum Agency of South Africa for analyses of survey impacts in local waters.
- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area.

Potential impact of seismic noise to mysticete cetaceans

Impacts of seismic noise on baleen whales resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low to Medium
Significance	Medium	Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic noise on baleen whales resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Impacts of seismic surveys on baleen whales resulting in masking of sounds and communication		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic surveys on baleen whales resulting from indirect effects on their prey		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Potential impact of seismic noise to odontocete cetaceans.

Impacts of seismic noise on toothed whales and dolphins resulting in physiological injury		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low to Medium
Significance	Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic noise on toothed whales and dolphins resulting in behavioural avoidance		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Medium	Low to Medium
Significance	Very Low - Low (species specific)	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	High	High

Impacts of seismic surveys on toothed whales and dolphins resulting in masking of sounds and communication		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	High	Low
Significance	Medium	Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

Impacts of seismic surveys on toothed whales and dolphins resulting from indirect effects on their prey		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area.	Local
Duration	Short-term: for duration of survey	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Probable	Probable
Confidence	Medium	Medium

5.3. Impacts of Multi-beam Surveys

Although baleen whales, toothed whales and pinnepeds would be expected to hear sonar signals from most types of oceanographic sonars at frequencies within their functional hearing range, the animals would only be affected if they were within the sonar beam. As the anticipated radius of influence of a multi-beam sonar or the sub-bottom profiler is significantly less than that for an airgun array (approximately 1 000 times less than a seismic survey), and the statistical probability of crossing a cetacean or pinniped with the narrow multi-beam fan several times, or even once, is very small, the effects of high frequency sonars on these fauna can be considered to be of **VERY LOW** significance without mitigation. However, despite the low significance of impacts, the Joint Nature Conservation Committee (JNCC) provides a list of guidelines to be followed by anyone planning marine sonar operations that could cause acoustic or physical disturbance to marine mammals. These have been revised to be more applicable to the southern African situation.

- Onboard MMOs should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment.
- "Soft starts" should be carried out for any equipment of source levels greater than 210 dB re 1 μPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.

- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.
- A Marine Mammal Observer would be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

Impacts of multi-beam and sub-bottom profiling sonar on seals and cetaceans		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to survey area	Local
Duration	Short-term	Short-term
Intensity	Low	Low
Significance	Very Low	Very Low
Status	Negative	Negative
Probability	Improbable	Improbable
Confidence	High	High

5.4. Impacts of Drop-Core Sampling and Heatflow Measurements

The proposed core sampling activities are expected to result in the disturbance and loss of benthic macrofauna through removal of sediments and potential crushing of benthic epifauna in the trigger weight footprint. In the case of the heatflow probe, penetration of the probe into the seabed may lead to disturbance of benthic macrofauna in the 6-cm diameter footprint of the probe.

Assuming a core diameter of 67 mm, each drop-core sample will remove a surface area of ~0.003 m^2. Core barrels are typically 6 m in length thus resulting in the removal of 0.02 m^3 of sediment , respectively per sample at maximum penetration. It is proposed to take in the order of 200 cores, thereby impacting a total cumulative area of 0.6 m^2 and removing a maximum of 4 m^3 of sediment.

As benthic fauna typically inhabit the top 20 - 30 cm of sediment, and removal of the sediment samples would result in the elimination of the benthic infaunal and epifaunal biota in the sample footprints. Considering the available area of similar habitat on and off the edge of the continental shelf, this reduction in benthic biodiversity can be considered negligible. Discarding overboard of excess sediment may result in limited smothering effects on the seabed. Depending on the volume discarded, the sediment size of the material and the prevailing current, although most of the discarded material will be dispersed as it settles through the water column. Smothering effects will thus be negligible.

Depending on the texture of the sediments at the target sites, slumping of adjacent unconsolidated sediments into the excavation can be expected over the very short-term.

Although this may result in localised disturbance of macrofauna associated with these sediments and alteration of sediment structure, it also serves as a means of natural recovery of the excavations. Studies have shown that some mobile benthic animals are capable of actively migrating vertically through overlying sediment thereby significantly affecting the recolonization of impacted areas and the subsequent recovery of disturbed areas of seabed (Maurer *et al.* 1979, 1981a, 1981b, 1982, 1986; Ellis 2000; Schratzberger *et al.* 2000; but see Harvey *et al.* 1998; Blanchard & Feder 2003).

Natural rehabilitation of the seabed following sampling or dredging operations, through a process involving influx of sediments and recruitment of invertebrates, has been demonstrated on the southern African continental shelf (Penney & Pulfrich 2004; Steffani 2007b, 2009a, 2009b, 2010a, 2010c). Recovery rates of impacted communities are variable and dependent on the sampling/dredging/mining approach, sediment influx rates and the influence of natural disturbances on succession communities. Ellis (1996) gives typical recovery rates for different grained deposits based on several sources (Table 7). These average time scales conform to those from other studies (see Newell *et al.* 1998).

The structure of the recovering communities is also highly spatially and temporally variable confirming the high natural variability in benthic communities in the region. The community developing after an impact depends on (1) the nature of the impacted substrate, (2) differential re-settlement of larvae in different areas, and (3) environmental factors such as bedload transport, near-bottom dissolved oxygen concentrations etc. Indications of significant recruitments and natural mortalities in recovering succession communities has provided evidence of natural disturbances (Pulfrich & Penney 1999). Savage *et al.* (2001) noted similarities in apparent levels of disturbance between mined and unmined areas off the southern African west coast, and areas of the Oslofjord in the NE Atlantic Ocean, which is known to be subject to periodic low oxygen events. They concluded that the lack of clear separation of impacted from reference samples suggests that short-term physical disturbance resulting from mining or dredging is no more stressful than the regular naturally occurring anoxic events typical of the West Coast continental shelf area.

The very low-intensity negative impact of sediment removal is unavoidable, but as it will be extremely localised (*i.e.* confined to the core footprints) the impact can confidently be rated as being **INSIGNIFICANT**.

Table 7: Timing for recovery of seabed habitats after dredging (after Ellis 1996).

Sediment type	Recovery time
Fine-grained deposits: muds, silts, clays, which can contain some rocks and boulders	1 year
Medium-grained deposits: sand, which can contain some silts, clay and gravel	1-3 years
Coarse-grained deposits: gravels, which can contain some finer fraction and some rock and boulders	5 years
Coarse-grained deposits: gravels with many rocks and boulders	>5 years

Some disturbance or loss of adjacent benthic biota can also be expected as a result of the placement on the seabed of the trigger weight, and the penetration into the sediments of the heatflow probe. Epifauna and infauna beneath the footprint of the weight/probe may be smothered or crushed resulting in a reduction in benthic biodiversity. Crushing is likely to primarily affect soft-bodied species as some molluscs and crustaceans may be robust enough to survive (see for example Savage *et al.* 2001). The impacts would be of very low intensity but highly localised, and short-term as recolonization would occur rapidly from adjacent undisturbed sediments. The potential impact is consequently deemed to **INSIGNIFICANT.**

Mitigation

No mitigation measures are possible, or considered necessary for the direct loss of macrobenthos due to core sampling or indirect loss due to crushing by the trigger weight.

Impacts of drop-core survey on benthic macrofauna through removal or crushing		
	Without Mitigation	**Assuming Mitigation**
Extent	Local: limited to core area or trigger weight footprint	Local
Duration	Short-term	Short-term
Intensity	Very Low	Very Low
Significance	Insignificant	Insignificant
Status	Negative	Negative
Probability	Definite	Definite
Confidence	High	High

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Conclusions

If all environmental guidelines, and appropriate mitigation measures advanced in this report are implemented, there is no reason why the proposed exploration activities should not proceed. If the proposed seismic survey component is undertaken outside the cetacean migration period (June to November) it would mitigate the potential impact on migratory cecateans to a large extent. Data collected by independent onboard observers should form part of a survey close-out report to be forwarded to the necessary authorities, and any incidence data and seismic source output data arising from surveys should be made available for analyses of survey impacts in Southern African waters.

The assessments of impacts of seismic sounds provided in the scientific literature usually consider short-term responses at the level of individual animals only, as our understanding of how such short-term effects relate to adverse residual effects at the population level are limited. Data on behavioural reactions acquired over the short-term could, however, easily be misinterpreted as being less significant than the cumulative effects over the long-term, *i.e.* what is initially interpreted as an impact not having a detrimental effect and thus being of low significance, may turn out to result in a long-term decline in the population. A significant adverse residual environmental effect is considered one that affects marine biota by causing a decline in abundance or change in distribution of a population(s) over more than one generation within an area. Natural recruitment may not re-establish the population(s) to its original level within several generations or avoidance of the area becomes permanent. However, the southern right whale population is reported to be increasing by 7% per annum (Best 2000) over a time when seismic surveying frequency has increased, suggesting that, for the southern right population at least, there is no evidence of long-term negative change to population size as a direct result of seismic survey activities.

Reactions to sound by marine fauna depend on a multitude of factors including species, state of maturity, experience, current activity, reproductive state, time of day (Wartzok *et al.* 2004; Southall *et al.* 2007). If a marine animal does react briefly to an underwater sound by changing its behaviour or moving a small distance, the impacts of the change are unlikely to be significant to the individual, let alone the population as a whole (NRC 2005). However, if a sound source displaces a species from an important feeding or breeding area for a prolonged period, impacts at the population level could be significant.

The significance of the impacts both before and after mitigation are summarised in the table overleaf.

Seismic Surveys

Impact	Significance (before mitigation)	Significance (after mitigation)
Plankton		
Physiological injury and mortality	Very Low	Very Low
Marine Invertebrates		
Physiological injury and mortality	Very Low	Very Low
Behavioural avoidance	Very Low	Very Low
Fish		
Mortality and/or physiological injury	Low	Very Low
Avoidance behaviour	Low	Very Low
Reproductive success / spawning	Very Low	Very Low
Masking of sounds	Very Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Seabirds		
Physiological injury	Low	Very Low
Avoidance behaviour	Low	Very Low
Indirect impacts on food sources	Low	Very Low
Stranding and oiling	Insignificant	Insignificant
Turtles		
Physiological injury, collision and entanglement	Very Low	Very Low
Avoidance behaviour	Very Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Masking of sounds	Insignificant	Insignificant
Seals		
Physiological injury or mortality	Very Low	Very Low
Avoidance behaviour	Very Low	Very Low
Masking of sounds	Very Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Whales and dolphins		
Baleen whales		
Physiological injury	Medium	Low
Avoidance behaviour	Low	Very Low
Masking of sounds	Very Low	Very Low
Indirect impacts on food sources	Very Low	Very Low
Toothed whales and dolphins		
Physiological injury	Low	Very Low
Avoidance behaviour	Very Low/Low	Very Low
Masking of sounds	Medium	Low
Indirect impacts on food sources	Very Low	Very Low
Other Potential Impacts		
Interaction with vessel traffic	Insignificant	Insignificant

Multi-beam Surveys

Impact	Significance (before mitigation)	Significance (after mitigation)
Marine Fauna		
Auditory and behavioural disturbance of turtles	Insignificant	Insignificant
Auditory and behavioural disturbance of seals and cetaceans	Very Low	Very low

Sediment Sampling and Heatflow Measurements

Impact	Significance (before mitigation)	Significance (after mitigation)
Benthic Macrofauna		
Injury and loss of benthic macrofauna through Drop-core sampling and Heatflow Measurements	Insignificant	Insignificant

6.2. Recommended Mitigation Measures

6.2.1 Seismic Surveys

Detailed mitigation measures for seismic surveys in other parts of the world are provided by Weir *et al.* (2006), Compton *et al.* (2007) and US Department of Interior (2007). Many of the international guidelines presented in these documents are extremely conservative as they are designed for areas experiencing repeated, high intensity surveys and harbouring particularly sensitive species, or species with high conservation status. The guidelines currently applied for seismic surveying in South African waters are those proposed in the Generic EMPR (CCA & CMS 2001), and to date these have not resulted in any known or recorded mortalities of marine mammals, turtles or seabirds. The mitigation measures proposed below are based largely on the guidelines currently accepted for seismic surveys in South Africa, but have been revised to include salient points from international guidelines discussed in the documents cited above.

- Seismic surveys should as far as possible be planned to avoid cetatean migration periods or winter breeding concentrations (June to end November), and ensure that migration paths are not blocked.
- As no seasonal patterns of abundance are known for odontocetes occupying the proposed study area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Should the survey schedules overlap with the start of the sensitive period in terms of large mammals migrating through the area, ensure that PAM technology is implemented to confirm that no cetaceans are present in the vicinity of the vessel. PAM is also to be used when surveying at night or during adverse weather conditions and thick fog. During the commencement of night-time operations, visual watches (30 minutes prior to soft-starts) should be maintained using night-vision/infra-red binoculars and PAM technology.
- The use of Passive Acoustic Monitoring (PAM) is encouraged by most international guidelines as a mitigation tool to detect marine mammals through their vocalisations,

particularly if species of particular conservation importance are likely to be encountered in the proposed survey area, or where a given species or group is difficult to detect by visual observation alone. Such monitoring can provide distance and bearing of the animals from the survey vessel. Although PAM would only identify animals that are calling or vocal, it has the advantage of 24 hour per day availability as opposed to visual monitoring, which can only be confidently carried out during daylight hours, or under adequate visibility conditions. Considering that most of the offshore migrating baleen whale species likely to be encountered are listed as "Endangered", every effort should be made to ensure that the vessel is fitted with PAM technology.

- The use of the lowest practicable airgun volume should be defined and enforced, and airgun use should be prohibited outside of the licence area.
- Prior to the commencement of "soft starts" an area of 500-m radius around the survey vessel (exclusion zone) should be scanned for the presence of diving seabirds, turtles, seals and cetaceans. There should be a dedicated pre-shoot watch of at least 30 minutes for deep-diving species. "Soft starts" should be delayed until such time as this area is clear of individuals of diving seabirds, turtles and cetaceans. Soft-start should not begin until 30 minutes after the animals depart the exclusion zone or 30 minutes after they are last seen. In the case of fur seals and small odontocetes, which may occur commonly around the vessel, the presence of seals, and small and medium odontocetes (including number and position / distance from the vessel) and their behaviour should be recorded prior to "soft start" procedures. If possible, "soft starts" should only commence once it has been confirmed that there is no seal and small/medium odontocetes activity within 500 m of the airguns. However, if after a period of 30 minutes they are still within 500 m of the airguns, the normal "soft start" procedure should be allowed to commence for at least a 20-minute duration (JNCC 2010). Their activity should be carefully monitored during "soft starts" to determine if they display any obvious negative responses to the airguns and gear or if there are any signs of injury or mortality as a direct result of the seismic activities.
- The implementation of "soft-start" procedures of a minimum of 20 minutes' duration on initiation of seismic surveying would mitigate any extent of physiological injury in most mobile vertebrate species as a result of seismic noise and is consequently considered a mandatory management measure for the implementation of the proposed seismic survey. "Soft start" procedures should not be initiated during times of poor visibility or darkness without the use of existing PAM technology to confirm that no cetaceans are present.
- An onboard independent MMO must be appointed for the duration of the seismic survey[4]. The MMO should have experience in seabird, turtle and marine mammal identification and observation techniques. The duties of the MMO would be to:
    - Record initiation of seismic firing activity and associated "soft starts", airgun activities and seismic noise levels;
    - Observe and record responses of marine fauna to seismic shooting, including seabird, turtle and cetacean incidence and behaviour and any mortality or

[4] One observer is the norm, but in high latitudes two are required during summer months due to the longer daylight hours. Brazilian guidelines in contrast require at least three observers to be aboard, in order to allow efficient rotation of duties and maintain full coverage.

injuries of marine fauna as a result of the seismic survey. Data captured should include species identification, position (latitude/longitude), distance from the vessel, swimming speed and direction (if applicable) and any obvious changes in behaviour (e.g. startle responses or changes in surfacing/diving frequencies, breathing patterns) as a result of the seismic activities. Both the identification and the behaviour of the animals must be recorded accurately along with current seismic sound levels. Any attraction of predatory seabirds, large pelagic fish or cetaceans (by mass disorientation or stunning of fish as a result of seismic survey activities) and incidents of feeding behaviour among the hydrophone streamers should also be recorded;

    - Sightings of any injured or dead protected species (marine mammals and sea turtles) should be recorded, regardless of whether the injury or death was caused by the seismic vessel itself. If the injury or death was caused by a collision with the seismic vessel, the date and location (latitude/longitude) of the strike, and the species identification or a description of the animal should be recorded.
    - Record meteorological conditions;
    - Request the temporarily termination of the seismic survey or adjusting of seismic shooting, as appropriate. It is important that MMOs have a full understanding of the financial implications of terminating firing, and that such decisions are made confidently and expediently. A log of all termination decisions must be kept (for inclusion in both daily and "close-out" reports);
    - Prepare daily reports of all observations, to be forwarded to the necessary authorities on a daily or weekly basis to ensure compliance with the mitigation measures.

- Seismic shooting should be terminated on observation of any obvious mortality or injuries to cetaceans, turtles, seals or large mortalities of invertebrate and fish species as a direct result of the survey. Such mortalities would be of particular concern where a) commercially important species are involved, or b) mortality events attract higher order predator and scavenger species into the seismic area during the survey, thus subjecting them to acoustic impulses. Seismic shooting should also be terminated when obvious negative changes to turtle, seal or cetacean behaviours are observed from the survey vessel, or turtles and cetaceans (not seals) are observed within the immediate vicinity (within 500 m) of operating airguns and appear to be approaching firing airgun[5]. The rationale for this is that animals at close distances (*i.e.* where physiological injury may occur) may be suffering from reduced hearing as a result of seismic sounds, that frequencies of seismic sound energy lies below best hearing frequencies (certain toothed cetaceans and seals), or that animals have become trapped within the ensonified area through diving behaviour.

[5] Recommended safety zones in some of the international guidelines include implementation of an observation zone of 3 km radius, low-power zone of 1.5 - 2 km radius (to cater for cow-calf pairs), and safety shut-down zone of 500 m radius around the survey vessel. Alternatively, a safety zone of 160 dB root mean squared (rms) can be calculated based on site-specific sound speed profiles and airgun parameters. The application of propagation loss models to calculate safety radii based on sound pressure levels represents a more scientific approach than the arbitrary designation of a 500 m radius (see Compton *et al.* (2007) for details).

- During night-time line changes low level warning airgun discharges should be fired at regular intervals in order to keep animals away from the survey operation while the vessel is repositioned for the next survey line.
- All breaks in airgun firing of longer than 20 minutes must be followed by a "soft-start" procedure of at least 20 minutes prior to the survey operation continuing. Breaks of shorter than 20 minutes should be followed by a "soft-start" of similar duration.
- Ideally, airgun use should be prohibited at night, and restricted during adverse weather conditions and thick fog. However, to ensure that the seismic survey has minimal overall duration within the study area, airgun use should only be permitted at night on condition PAM technology is implemented to confirm that no cetaceans are present. During the commencement of night-time operations, visual watches should be maintained using night-vision/infra-red binoculars.
- Ensure that 'turtle-friendly' tail buoys are used by the survey contractor or that existing tail buoys are fitted with either exclusion or deflector 'turtle guards'.
- Seabird, turtle and marine mammal incidence data and seismic source output data arising from surveys should be made available on request to the Marine Mammal Institute, Department of Agriculture, Fisheries and Forestry, and the Petroleum Agency of South Africa for analyses of survey impacts in local waters.
- No seismic survey-related activities (including line turns) are to take place within declared Marine Protected Areas.

In the case of survey lines located west of Child's Bank, it is recommended that the survey vessel maintain the firing of low-power guns during line turns that encroach within a 5 nautical mile radius of the seamount. On lines beyond that the low power guns can be stopped during turns, but the normal start-up proceedure should nonetheless be maintained. The reasoning behind this recommendations is that seamounts such as Child's Bank and Tripp Seamount to the northwest of the survey area result in complex localised current regimes resulting in the development of detritivore-based food-webs, which in turn leads to the increased presence of scavengers and predators in the vicinity of the seamounts. These include large pelagic fish species, seabirds and marine mammals, which aggregate around these features for either spawning or feeding. There is thus an increased likelihood of the survey vessel encountering such species whilst in the vicinity of the seamount, and mitigation measures need to be in place to ensure that seismic impacts on these fauna is kept to a minimum.

6.2.3 Multi-beam Surveys

The mitigation measures recommended for multi-beam and sub-bottom profiling surveys are:

- Onboard MMOs should conduct visual scans for the presence of cetaceans around the survey vessel prior to the initiation of any acoustic impulses.
- Pre-survey scans should be limited to 15 minutes prior to the start of survey equipment.
- "Soft starts" should be carried out for any equipment of source levels greater than 210 dB re 1 µPa at 1 m over a period of 20 minutes to give adequate time for marine mammals to leave the vicinity.
- Terminate the survey if any marine mammals show affected behaviour within 500 m of the survey vessel or equipment until the mammal has vacated the area.

- Avoid planning geophysical surveys during the movement of migratory cetaceans (particularly baleen whales) from their southern feeding grounds into low latitude waters (beginning of June to end of November), and ensure that migration paths are not blocked by sonar operations. As no seasonal patterns of abundance are known for odontocetes occupying the proposed exploration area, a precautionary approach to avoiding impacts throughout the year is recommended.
- Ensure that PAM (passive acoustic monitoring) is incorporated into any surveying taking place between June and November.
- A Marine Mammal Observer would be appointed to ensure compliance with mitigation measures during seismic geophysical surveying.

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APPENDIX 3

THIRD PARTY LIABILITY

CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY): 2/6/2013

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

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INSURED Anadarko South Africa (Pty) Ltd	

INSURER(S) AFFORDING COVERAGE	NAIC #
INSURER A: KM International Insurance LTD	
INSURER B:	
INSURER C:	
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INSURER F:	

COVERAGES CERTIFICATE NUMBER: REVISION NUMBER:

THIS IS TO CERTIFY THAT THE POLICIES OF INSURANCE LISTED BELOW HAVE BEEN ISSUED TO THE INSURED NAMED ABOVE FOR THE POLICY PERIOD INDICATED, NOTWITHSTANDING ANY REQUIREMENT, TERM OR CONDITION OF ANY CONTRACT OR OTHER DOCUMENT WITH RESPECT TO WHICH THIS CERTIFICATE MAY BE ISSUED OR MAY PERTAIN, THE INSURANCE AFFORDED BY THE POLICIES DESCRIBED HEREIN IS SUBJECT TO ALL THE TERMS, EXCLUSIONS AND CONDITIONS OF SUCH POLICIES. LIMITS SHOWN MAY HAVE BEEN REDUCED BY PAID CLAIMS.

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS	
	GENERAL LIABILITY COMMERCIAL GENERAL LIABILITY CLAIMS-MADE / OCCUR GEN'L AGGREGATE LIMIT APPLIES PER: POLICY / PRO-JECT / LOC						EACH OCCURRENCE	$
							DAMAGE TO RENTED PREMISES (Ea occurrence)	$
							MED EXP (Any one person)	$
							PERSONAL & ADV INJURY	$
							GENERAL AGGREGATE	$
							PRODUCTS - COMP/OP AGG	$
								$
	AUTOMOBILE LIABILITY ANY AUTO ALL OWNED AUTOS / SCHEDULED AUTOS HIRED AUTOS / NON-OWNED AUTOS						COMBINED SINGLE LIMIT (Ea accident)	$
							BODILY INJURY (Per person)	$
							BODILY INJURY (Per accident)	$
							PROPERTY DAMAGE (Per accident)	$
								$
A	UMBRELLA LIAB / X OCCUR X EXCESS LIAB / CLAIMS-MADE			GL-1002012	6/30/12	6/30/13	EACH OCCURRENCE	$150,000,000
							AGGREGATE	$150,000,000
	DED / RETENTION $							$
	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY Y/N ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	N/A					WC STATU-TORY LIMITS / OTH-ER	
							E.L. EACH ACCIDENT	$
							E.L. DISEASE – EA EMPLOYEE	$
							E.L. DISEASE – POLICY LIMIT	$

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (Attach ACORD 101, Additional Remarks Schedule, if more space is required)

Ref: Exploration Rights Agreement for exploration area Block 2C

CERTIFICATE HOLDER	CANCELLATION
Petroleum Agency of South Africa PO Box 5111 Tygervalley 7536	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS.
	AUTHORIZED REPRESENTATIVE J.M-Davis

APPENDIX 4

UNDERTAKING BY APPLICANT

ANADARKO SOUTH AFRICA (PTY) LTD 21 FLOOR #1 THIBAULT SQUARE 1 LONG STREET CAPE TOWN 8001
P O BOX 7980 · ROGGEBAAI CAPE TOWN 8012

Anadarko South Africa (Pty) Ltd.

LETTER OF UNDERTAKING

UNDERTAKING in terms of Regulation 51(b)(viii) of the Minerals and Petroleum Resources Development Act, 2002 (No. 28 of 2002) (MPRDA):

Anadarko South Africa (Pty) Ltd hereby undertakes to:

1. Comply with the specifications in the forgoing Environmental Management Programme;
2. Comply with the provisions of the MPRDA and the Regulations thereto.

Signed on the 28th day of February 2013.

For and on behalf of Anadarko South Africa (Pty) Ltd

Name: **Marek Ranoszek**

Designation: **Country Manager**

APPENDIX 5

MARPOL 73/78

Appendix 5.1:	Annex I: Regulations for the prevention of pollution by oil
Appendix 5.2:	Annex III: Regulations for the prevention of pollution by harmful substances carried by sea in packaged form
Appendix 5.3:	Annex IV: Regulations for the prevention of pollution by sewage
Appendix 5.4:	Annex V: Regulations for the prevention of pollution by garbage from ships
Appendix 5.5:	Annex VI: Regulations for the prevention of air pollution from ships

APPENDIX 5.1

ANNEX I: REGULATIONS FOR THE PREVENTION OF POLLUTION BY OIL

Annex I of MARPOL 73/78: *Regulations for the Prevention of Pollution by Oil*

Chapter I - *General*

Regulation 1	Definitions
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Regulation 3	Equivalents
Regulation 4	Surveys and inspections
Regulation 5	Issue or endorsement of Certificate
Regulation 6	Issue or endorsement of Certificate by another Government
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Regulation 8	Duration and validity of Certificate
Regulation 8A	Port State control on operational requirements

Chapter II - *Requirements for control of operational pollution*

Regulation 9	Control of discharge of oil
Regulation 10	Methods for the prevention of oil pollution from ships while operating in special areas
Regulation 11	Exceptions
Regulation 12	Reception facilities
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Regulation 13B	Requirements for crude oil washing
Regulation 13C	Existing tankers engaged in specific trades
Regulation 13D	Existing oil tankers having special ballast arrangements
Regulation 13E	Protective location of segregated ballast spaces
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Regulation 15	Retention of oil on board
Regulation 16	Oil discharge monitoring and control system and oil filtering equipment
Regulation 17	Tanks for oil residues (sludge)
Regulation 18	Pumping, piping and discharge arrangements of oil tankers
Regulation 19	Standard discharge connection
Regulation 20	Oil Record Book
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Chapter III - *Requirements for minimizing oil pollution from oil tankers due to side and bottom damages*

Regulation 22	Damage assumptions
Regulation 23	Hypothetical outflow of oil
Regulation 24	Limitation of size and arrangement of cargo tanks
Regulation 25	Subdivision and stability
Regulation 25A	Intact stability

Chapter IV - *Prevention of pollution arising from an oil pollution incident*

Regulation 26	Shipboard oil pollution emergency plan

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Appendix I	List of oils
Appendix II	Form of IOPP Certificate
Appendix III	Form of Oil Record Book

Unified Interpretations of Annex I

Appendices to Unified Interpretations of Annex I

Appendix 1	Guidance to Administrations concerning draughts recommended for segregated ballast tankers below 150 m in length
Appendix 2	Interim recommendations for a unified interpretation of regulation 13E
Appendix 3	Equivalent provisions for the carriage of oil by a chemical tanker
Appendix 4	Connection of small diameter line to the manifold valve
Appendix 5	Specifications for the design, installation and operation of a part flow system for control of overboard discharges
Appendix 6	Offshore platform discharges
Appendix 7	Interim guidelines for the approval of alternative methods of design and construction of oil tankers under regulation 13F(5) of Annex I of MARPOL 73/78
Appendix 8	Guidelines for approval of alternative structural or operational arrangements as called for in MARPOL 73/78, Annex I, regulation 13G(7)
Appendix 9	Interpretation of requirements for application of hydrostatic balance loading in cargo tanks (resolution MEPC.64(36))

Annex I of MARPOL 73/78
(including amendments)

Regulations for the Prevention of Pollution by Oil

Chapter I – General

Regulation 1
Definitions

For the purposes of this Annex:

(1) *Oil* means petroleum in any form including crude oil, fuel oil, sludge, oil refuse and refined products (other than petrochemicals which are subject to the provisions of Annex II of the present Convention) and, without limiting the generality of the foregoing, includes the substances listed in appendix I to this Annex.

SEE INTERPRETATION 1A.0

(2) *Oily mixture* means a mixture with any oil content.

(3) *Oil fuel* means any oil used as fuel in connection with the propulsion and auxiliary machinery of the ship in which such oil is carried.

(4) *Oil tanker* means a ship constructed or adapted primarily to carry oil in bulk in its cargo spaces and includes combination carriers and any "chemical tanker" as defined in Annex II of the present Convention when it is carrying a cargo or part cargo of oil in bulk.

SEE INTERPRETATIONS 1.0 AND 6.1

(5) *Combination carrier* means a ship designed to carry either oil or solid cargoes in bulk.

(6) *New ship* means a ship:

(a) for which the building contract is placed after 31 December 1975; or

(b) in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction after 30 June 1976; or

(c) the delivery of which is after 31 December 1979; or

(d) which has undergone a major conversion:

(i) for which the contract is placed after 31 December 1975; or

(ii) in the absence of a contract, the construction work of which is begun after 30 June 1976; or

(iii) which is completed after 31 December 1979.

SEE INTERPRETATIONS 1.1 AND 1.2

(7) *Existing ship* means a ship which is not a new ship.

(8) (a) *Major conversion* means a conversion of an existing ship:

(i) which substantially alters the dimensions or carrying capacity of the ship; or

(ii) which changes the type of the ship; or

(iii) the intent of which in the opinion of the Administration is substantially to prolong its life; or

(iv) which otherwise so alters the ship that, if it were a new ship, it would become subject to relevant provisions of the present Convention not applicable to it as an existing ship.

SEE INTERPRETATION 1.3

(b) Notwithstanding the provisions of subparagraph (a) of this paragraph, conversion of an existing oil tanker of 20,000 tons deadweight and above to meet the requirements of regulation 13 of this Annex shall not be deemed to constitute a major conversion for the purposes of this Annex.

(c) Notwithstanding the provisions of subparagraph (a) of this paragraph, conversion of an existing oil tanker to meet the requirements of regulation 13F or 13G of this Annex shall not be deemed to constitute a major conversion for the purpose of this Annex.

(9) *Nearest land.* The term "from the nearest land" means from the baseline from which the territorial sea of the territory in question is established in accordance with international law, except that, for the purposes of the present Convention "from the nearest land" off the north-eastern coast of Australia shall mean from a line drawn from a point on the coast of Australia in

latitude 11°00' S, longitude 142°08' E
to a point in latitude 10°35' S, longitude 141°55' E,
thence to a point latitude 10°00' S, longitude 142°00' E,
thence to a point latitude 09°10' S, longitude 143°52' E,
thence to a point latitude 09°00' S, longitude 144°30' E,
thence to a point latitude 10°41' S, longitude 145°00' E,
thence to a point latitude 13°00' S, longitude 145°00' E,
thence to a point latitude 15°00' S, longitude 146°00' E,
thence to a point latitude 17°30' S, longitude 147°00' E,
thence to a point latitude 21°00' S, longitude 152°55' E,
thence to a point latitude 24°30' S, longitude 154°00' E,
thence to a point on the coast of Australia
in latitude 24°42' S, longitude 153°15' E.

(10) *Special area* means a sea area where for recognized technical reasons in relation to its oceanographical and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by oil is required. Special areas shall include those listed in regulation 10 of this Annex.

(11) *Instantaneous rate of discharge of oil content* means the rate of discharge of oil in litres per hour at any instant divided by the speed of the ship in knots at the same instant.

(12) *Tank* means an enclosed space which is formed by the permanent structure of a ship and which is designed for the carriage of liquid in bulk.

(13) *Wing tank* means any tank adjacent to the side shell plating.

(14) *Centre tank* means any tank inboard of a longitudinal bulkhead.

(15) *Slop tank* means a tank specifically designated for the collection of tank drainings, tank washings and other oily mixtures.

(16) *Clean ballast* means the ballast in a tank which since oil was last carried therein, has been so cleaned that effluent therefrom if it were discharged from a ship which is stationary into clean calm water on a clear day would not produce visible traces of oil on the surface of the water or on adjoining shorelines or cause a sludge or emulsion to be deposited beneath the surface of the water or upon adjoining shorelines. If the ballast is discharged through an oil discharge monitoring and control system approved by the Administration, evidence based on such a system to the effect that the oil content of the effluent did not exceed 15 parts per million shall be determinative that the ballast was clean, notwithstanding the presence of visible traces.

(17) *Segregated ballast* means the ballast water introduced into a tank which is completely separated from the cargo oil and oil fuel system and which is permanently allocated to the carriage of ballast or to the

carriage of ballast or cargoes other than oil or noxious substances as variously defined in the Annexes of the present Convention.

SEE INTERPRETATION 1.4

(18) *Length (L)* means 96% of the total length on a waterline at 85% of the least moulded depth measured from the top of the keel, or the length from the foreside of the stem to the axis of the rudder stock on that waterline, if that be greater. In ships designed with a rake of keel the waterline on which this length is measured shall be parallel to the designed waterline. The length *(L)* shall be measured in metres.

(19) *Forward and after perpendiculars* shall be taken at the forward and after ends of the length *(L)*. The forward perpendicular shall coincide with the foreside of the stem on the waterline on which the length is measured.

(20) *Amidships* is at the middle of the length *(L)*.

(21) *Breadth (B)* means the maximum breadth of the ship, measured amidships to the moulded line of the frame in a ship with a metal shell and to the outer surface of the hull in a ship with a shell of any other material. The breadth *(B)* shall be measured in metres.

(22) *Deadweight* (DW) means the difference in metric tons between the displacement of a ship in water of a specify gravity of 1.025 at the load waterline corresponding to the assigned summer freeboard and the lightweight of the ship.

(23) *Lightweight* means the displacement of a ship in metric tons without cargo, fuel, lubricating oil, ballast water, fresh water and feed water in tanks, consumable stores, and passengers and crew and their effects.

(24) *Permeability* of a space means the ratio of the volume within that space which is assumed to be occupied by water to the total volume of that space.

(25) *Volumes* and *areas* in a ship shall be calculated in all cases to moulded lines.

(26) Notwithstanding the provisions of paragraph (6) of this regulation, for the purposes of regulations 13, 13B, 13E and 18(4) of this Annex, *new oil tanker* means an oil tanker:

(a) for which the building contract is placed after 1 June 1979; or

(b) in the absence of a building contract, the keel of which is laid or which is at a similar stage of construction after 1 January 1980; or

(c) the delivery of which is after 1 June 1982; or

(d) which has undergone a major conversion:

(i) for which the contract is placed after 1 June 1979; or

(ii) in the absence of a contract, the construction work of which is begun after 1 January 1980; or

(iii) which is completed after 1 June 1982;

except that, for oil tankers of 70,000 tons deadweight and above, the definition in paragraph (6) of this regulation shall apply for the purposes of regulation 13(1) of this Annex.

SEE INTERPRETATIONS 1.1 AND 1.2

(27) Notwithstanding the provisions of paragraph (7) of this regulation, for the purposes of regulations 13, 13A, 13B, 13C, 13D, 18(5) and 18(6)(c) of this Annex, *existing oil tanker* means an oil tanker which is not a new oil tanker as defined in paragraph (26) of this regulation.

(28) *Crude oil* means any liquid hydrocarbon mixture occurring naturally in the earth whether or not treated to render it suitable for transportation and includes:

(a) crude oil from which certain distillate fractions may have been removed; and

(b) crude oil to which certain distillate fractions may have been added.

(29) *Crude oil tanker* means an oil tanker engaged in the trade of carrying crude oil.

(30) *Product carrier* means an oil tanker engaged in the trade of carrying oil other than crude oil.

(31) *Anniversary date* means the day and the month of each year which will correspond to the date of expiry of the International Oil Pollution Prevention Certificate.

Regulation 2
Application

(1) Unless expressly provided otherwise, the provisions of this Annex shall apply to all ships.

(2) In ships other than oil tankers fitted with cargo spaces which are constructed and utilized to carry oil in bulk of an aggregate capacity of 200 cubic metres or more, the requirements of regulations 9, 10, 14, 15(1), (2) and (3), 18, 20 and 24(4) of this Annex for oil tankers shall also apply to the construction and operation of those spaces, except that where such aggregate capacity is less than 1,000 cubic metres the requirements of regulation 15(4) of this Annex may apply in lieu of regulation 15(1), (2) and (3).

(3) Where a cargo subject to the provisions of Annex II of the present Convention is carried in a cargo space of an oil tanker, the appropriate requirements of Annex II of the present Convention shall also apply.

(4) (a) Any hydrofoil, air-cushion vehicle and other new type of vessel (near-surface craft, submarine craft, etc.) whose constructional features are such as to render the application of any of the provisions of chapters II and III of this Annex relating to construction and equipment unreasonable or impracticable may be exempted by the Administration from such provisions, provided that the construction and equipment of that ship provides equivalent protection against pollution by oil, having regard to the service for which it is intended.

(b) Particulars of any such exemption granted by the Administration shall be indicated in the Certificate referred to in regulation 5 of this Annex.

(c) The Administration which allows any such exemption shall, as soon as possible, but not more than 90 days thereafter, communicate to the Organization particulars of same and the reasons therefor, which the Organization shall circulate to the Parties to the Convention for their information and appropriate action, if any.

Regulation 3
Equivalents

SEE INTERPRETATION 1.5

(1) The Administration may allow any fitting, material, appliance or apparatus to be fitted in a ship as an alternative to that required by this Annex if such fitting, material, appliance or apparatus is at least as effective as that required by this Annex. This authority of the Administration shall not extend to substitution of operational methods to effect the control of discharge of oil as equivalent to those design and construction features which are prescribed by regulations in this Annex.

(2) The Administration which allows a fitting, material, appliance or apparatus, as an alternative to that required by this Annex shall communicate to the Organization for circulation to the Parties to the Convention particulars thereof, for their information and appropriate action, if any.

Regulation 4
Surveys

(1) Every oil tanker of 150 tons gross tonnage and above, and every other ship of 400 tons gross tonnage and above shall be subject to the surveys specified below:

(a) An initial survey before the ship is put in service or before the Certificate required under regulation 5 of this Annex is issued for the first time, which shall include a complete survey of its structure, equipment, systems, fittings, arrangements and material in so far as the ship is covered by this Annex. This survey shall be such as to ensure that the structure, equipment, systems, fittings, arrangements and material fully comply with the applicable requirements of this Annex.

(b) A renewal survey at intervals specified by the Administration, but not exceeding five years, except where regulation 8(2), 8(5), 8(6) or 8(7) of this Annex is applicable. The renewal survey shall be such as to ensure that the structure, equipment, systems, fittings, arrangements and material fully comply with applicable requirements of this Annex.

(c) An intermediate survey within three months before or after the second anniversary date or within three months before or after the third anniversary date of the Certificate which shall take the place of one of the annual surveys specified in paragraph (1)(d) of this regulation. The intermediate survey shall be such as to ensure that the equipment and associated pump and piping systems, including oil discharge monitoring and control systems, crude oil washing systems, oily-water separating equipment and oil filtering systems, fully comply with the applicable requirements of this Annex and are in good working order. Such intermediate surveys shall be endorsed on the Certificate issued under regulation 5 or 6 of this Annex.

SEE INTERPRETATION 1A.1

(d) An annual survey within three months before or after each anniversary date of the Certificate, including a general inspection of the structure, equipment, systems, fittings, arrangements and material referred to in paragraph (1)(a) of this regulation to ensure that they have been maintained in accordance with paragraph (4) of this regulation and that they remain satisfactory for the service for which the ship is intended. Such annual surveys shall be endorsed on the Certificate issued under regulation 5 or 6 of this Annex.

(e) An additional survey either general or partial, according to the circumstances, shall be made after a repair resulting from investigations prescribed in paragraph (4) of this regulation, or whenever any important repairs or renewals are made. The survey shall be such as to ensure that the necessary repairs or renewals have been effectively made, that the material and workmanship of such repairs or renewals are in all respects satisfactory and that the ship complies in all respects with the requirements of this Annex.

(2) The Administration shall establish appropriate measures for ships which are not subject to the provisions of paragraph (1) of this regulation in order to ensure that the applicable provisions of this Annex are complied with.

(3) (a) Surveys of ships as regards the enforcement of the provisions of this Annex shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it.

(b) An Administration nominating surveyors or recognizing organizations to conduct surveys as set forth in subparagraph (a) of this paragraph shall, as a minimum, empower any nominated surveyor or recognized organization to:

(i) require repairs to a ship; and

(ii) carry out surveys, if requested by the appropriate authorities of a port State.

The Administration shall notify the Organization of the specific responsibilities and conditions of the authority delegated to the nominated surveyors or recognized organizations, for circulation to Parties to the present Protocol for the information of their officers.

(c) When a nominated surveyor or recognized organization determines that the condition of the ship or its equipment does not correspond substantially with the particulars of the Certificate or is such that the ship is not fit to proceed to sea without presenting an unreasonable threat of harm to the marine environment, such surveyor or organization shall immediately ensure that corrective action is taken and shall in due course notify the Administration. If such corrective action is not taken the Certificate should be withdrawn and the Administration shall be notified immediately; and if the ship is in a port of another Party, the appropriate authorities of the port State shall also be notified immediately. When an officer of the Administration, a nominated surveyor or a recognized organization has notified the appropriate authorities of the port State, the Government of the port State concerned shall give such officer, surveyor or organization any necessary assistance to carry out their obligations under this regulation. When applicable, the Government of the port State concerned shall take such steps as will ensure that the ship shall not sail until it can proceed to sea or leave the port for the purpose of proceeding to the nearest appropriate repair yard available without presenting an unreasonable threat of harm to the marine environment.

(d) In every case, the Administration concerned shall fully guarantee the completeness and efficiency of the survey and shall undertake to ensure the necessary arrangements to satisfy this obligation.

(4) (a) The condition of the ship and its equipment shall be maintained to conform with the provisions of the present Convention to ensure that the ship in all respects will remain fit to proceed to sea without presenting an unreasonable threat of harm to the marine environment.

(b) After any survey of the ship under paragraph (1) of this regulation has been completed, no change shall be made in the structure, equipment, systems, fittings, arrangements or material covered by the survey, without the sanction of the Administration, except the direct replacement of such equipment and fittings.

(c) Whenever an accident occurs to a ship or a defect is discovered which substantially affects the integrity of the ship or the efficiency or completeness of its equipment covered by this Annex the master or owner of the ship shall report at the earliest opportunity to the Administration, the recognized organization or the nominated surveyor responsible for issuing the relevant certificate, who shall cause investigations to be initiated to determine whether a survey as required by paragraph (1) of this regulation is necessary. If the ship is in a port of another Party, the master or owner shall also report immediately to the appropriate authorities of the port State and the nominated surveyor or recognized organization shall ascertain that such report has been made.

Regulation 5
Issue or endorsement of Certificate

SEE INTERPRETATIONS 2.0 and 2.1

(1) An International Oil Pollution Prevention Certificate shall be issued, after an initial or renewal survey in accordance with the provisions of regulation 4 of this Annex, to any oil tanker of 150 tons gross tonnage and above and any other ships of 400 tons gross tonnage and above

which are engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention.

SEE INTERPRETATIONS 2.2, 2.3, 2.4

(2) Such Certificate shall be issued or endorsed either by the Administration or by any persons or organization duly authorized by it. In every case the Administration assumes full responsibility for the Certificate.

(3) Notwithstanding any other provisions of the amendments to this Annex adopted by the Marine Environment Protection Committee (MEPC) by resolution MEPC.39(29), any International Oil Pollution Prevention Certificate, which is current when these amendments enter into force, shall remain valid until it expires under the terms of this Annex prior to the amendments entering into force.

Regulation 6
Issue or endorsement of a Certificate by another Government

(1) The Government of a Party to the Convention may, at the request of the Administration, cause a ship to be surveyed and, if satisfied that the provisions of this Annex are complied with, shall issue or authorize the issue of an International Oil Pollution Prevention Certificate to the ship, and where appropriate, endorse or authorize the endorsement of that Certificate on the ship, in accordance with this Annex.

(2) A copy of the Certificate and a copy of the survey report shall be transmitted as soon as possible to the requesting Administration.

(3) A Certificate so issued shall contain a statement to the effect that it has been issued at the request of the Administration and it shall have the same force and receive the same recognition as the Certificate issued under regulation 5 of this Annex.

(4) No International Oil Pollution Prevention Certificate shall be issued to a ship which is entitled to fly the flag of a State which is not a Party.

Regulation 7
Form of Certificate

SEE INTERPRETATION 2.4A

The International Oil Pollution Prevention Certificate shall be drawn up in a form corresponding to the model given in appendix II to this Annex. If the language used is neither English nor French, the text shall include a translation into one of these languages.

Regulation 8
Duration and validity of Certificate

SEE INTERPRETATION 2.5

(1) An International Oil Pollution Prevention Certificate shall be issued for a period specified by the Administration, which shall not exceed five years.

(2) (a) Notwithstanding the requirements of paragraph (1) of this regulation, when the renewal survey is completed within three months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of expiry of the existing Certificate.

(b) When the renewal survey is completed after the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of expiry of the existing Certificate.

(c) When the renewal survey is completed more than three months before the expiry date of the existing Certificate, the new Certificate shall be valid from the date of completion of the renewal survey to a date not exceeding five years from the date of completion of the renewal survey.

(3) If a Certificate is issued for a period of less than five years, the Administration may extend the validity of the Certificate beyond the expiry date to the maximum period specified in paragraph (1) of this regulation, provided that the surveys referred to in regulation 4(1)(c) and 4(1)(d) of this Annex applicable when a Certificate is issued for a period of five years are carried out as appropriate.

(4) If a renewal survey has been completed and a new Certificate cannot be issued or placed on board the ship before the expiry date of the existing Certificate, the person or organization authorized by the Administration may endorse the existing Certificate and such a Certificate shall be accepted as valid for a further period which shall not exceed five months from the expiry date.

(5) If a ship at the time when a Certificate expires is not in a port in which it is to be surveyed, the Administration may extend the period of validity of the Certificate but this extension shall be granted only for

the purpose of allowing the ship to complete its voyage to the port in which it is to be surveyed, and then only in cases where it appears proper and reasonable to do so. No Certificate shall be extended for a period longer than three months, and a ship to which an extension is granted shall not, on its arrival in the port in which it is to be surveyed, be entitled by virtue of such extension to leave that port without having a new Certificate. When the renewal survey is completed, the new Certificate shall be valid to a date not exceeding five years from the date of expiry of the existing Certificate before the extension was granted.

(6) A Certificate issued to a ship engaged on short voyages which has not been extended under the foregoing provisions of this regulation may be extended by the Administration for a period of grace of up to one month from the date of expiry stated on it. When the renewal survey is completed, the new Certificate shall be valid to a date not exceeding five years from the date of expiry of the existing Certificate before the extension was granted.

(7) In special circumstances, as determined by the Administration, a new Certificate need not be dated from the date of expiry of the existing Certificate as required by paragraph (2)(b), (5) or (6) of this regulation. In these special circumstances, the new Certificate shall be valid to a date not exceeding five years from the date of completion of the renewal survey.

(8) If an annual or intermediate survey is completed before the period specified in regulation 4 of this Annex, then:

(a) the anniversary date shown on the Certificate shall be amended by endorsement to a date which shall not be more than three months later than the date on which the survey was completed;

(b) the subsequent annual or intermediate survey required by regulation 4 of this Annex shall be completed at the intervals prescribed by that regulation using the new anniversary date;

(c) the expiry date may remain unchanged provided one or more annual or intermediate surveys, as appropriate, are carried out so that the maximum intervals between the surveys prescribed by regulation 4 of this Annex are not exceeded.

(9) A Certificate issued under regulation 5 or 6 of this Annex shall cease to be valid in any of the following cases:

(a) if the relevant surveys are not completed within the periods specified under regulation 4(1) of this Annex;

(b) if the Certificate is not endorsed in accordance with regulation 4(1)(c) or 4(1)(d) of this Annex.

(c) Upon transfer of the ship to the flag of another State. A new Certificate shall only be issued when the Government issuing the new Certificate is fully satisfied that the ship is in compliance with the requirements of regulation 4(4)(a) and 4(4)(b) of this Annex. In the case of a transfer between Parties, if requested within three months after the transfer has taken place, the Government of the Party whose flag the ship was formerly entitled to fly shall, as soon as possible, transmit to the Administration copies of the Certificate carried by the ship before the transfer and, if available, copies of the relevant survey reports.

Regulation 8A
*Port State control on operational requirements**

(1) A ship when in a port or an offshore terminal of another Party is subject to inspection by officers duly authorized by such Party concerning operational requirements under this Annex, where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by oil.

(2) In the circumstances given in paragraph (1) of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex.

(3) Procedures relating to the port State control prescribed in article 5 of the present Convention shall apply to this regulation.

(4) Nothing in this regulation shall be construed to limit the rights and obligations of a Party carrying out control over operational requirements specifically provided for in the present Convention.

* Refer to the procedures for port State control adopted by the Organization by resolution A.787(19) and amended by A.882(21); see IMO sales publication IMO-650E.

Chapter II – Requirements for control of operational pollution

Regulation 9
Control of discharge of oil

(1) Subject to the provisions of regulations 10 and 11 of this Annex and paragraph (2) of this regulation, any discharge into the sea of oil or oily mixtures from ships to which this Annex applies shall be prohibited except when all the following conditions are satisfied:

(a) for an oil tanker, except as provided for in subparagraph (b) of this paragraph:

(i) the tanker is not within a special area;

(ii) the tanker is more than 50 nautical miles from the nearest land;

(iii) the tanker is proceeding *en route*;

(iv) the instantaneous rate of discharge of oil content does not exceed 30 litres per nautical mile;

(v) the total quantity of oil discharged into the sea does not exceed for existing tankers 1/15,000 of the total quantity of the particular cargo of which the residue formed a part, and for new tankers 1/30,000 of the total quantity of the particular cargo of which the residue formed a part; and

SEE INTERPRETATION 3.2

(vi) the tanker has in operation an oil discharge monitoring and control system and a slop tank arrangement as required by regulation 15 of this Annex.

(b) from a ship of 400 tons gross tonnage and above other than an oil tanker and from machinery space bilges excluding cargo pump-room bilges of an oil tanker unless mixed with oil cargo residue:

(i) the ship is not within a special area;

(ii) the ship is proceeding *en route*;

(iii) the oil content of the effluent without dilution does not exceed 15 parts per million; and

(iv) the ship has in operation equipment as required by regulation 16 of this Annex.

SEE INTERPRETATION 3.1

(2) In the case of a ship of less than 400 tons gross tonnage other than an oil tanker whilst outside the special area, the Administration shall ensure that it is equipped as far as practicable and reasonable with installations to ensure the storage of oil residues on board and their discharge to reception facilities or into the sea in compliance with the requirements of paragraph (1)(b) of this regulation.

(3) Whenever visible traces of oil are observed on or below the surface of the water in the immediate vicinity of a ship or its wake, Governments of Parties to the Convention should, to the extent they are reasonably able to do so, promptly investigate the facts bearing on the issue of whether there has been a violation of the provisions of this regulation or regulation 10 of this Annex. The investigation should include, in particular, the wind and sea conditions, the track and speed of the ship, other possible sources of the visible traces in the vicinity, and any relevant oil discharge records.

(4) The provisions of paragraph (1) of this regulation shall not apply to the discharge of clean or segregated ballast or unprocessed oily mixtures which without dilution have an oil content not exceeding 15 parts per million and which do not originate from cargo pump-room bilges and are not mixed with oil cargo residues.

(5) No discharge into the sea shall contain chemicals or other substances in quantities or concentrations which are hazardous to the marine environment or chemicals or other substances introduced for the purpose of circumventing the conditions of discharge specified in this regulation.

(6) The oil residues which cannot be discharged into the sea in compliance with paragraphs (1), (2) and (4) of this regulation shall be retained on board or discharged to reception facilities.

(7) In the case of a ship, referred to in regulation 16(6) of this Annex, not fitted with equipment as required by regulation 16(1) or 16(2) of this Annex, the provisions of paragraph (1)(b) of this regulation will not apply until 6 July 1998 or the date on which the ship is fitted with such equipment, whichever is the earlier. Until this date any discharge from machinery space bilges into the sea of oil or oily mixtures from such a ship shall be prohibited except when all the following conditions are satisfied:

(a) the oily mixture does not originate from the cargo pump-room bilges;

(b) the oily mixture is not mixed with oil cargo residues;

(c) the ship is not within a special area;

(d) the ship is more than 12 nautical miles from the nearest land;

(e) the ship is proceeding *en route*;

(f) the oil content of the effluent is less than 100 parts per million; and

(g) the ship has in operation oily-water separating equipment of a design approved by the Administration, taking into account the specification recommended by the Organization.*

Regulation 10

Methods for the prevention of oil pollution from ships while operating in special areas

(1) For the purpose of this Annex, the special areas are the Mediterranean Sea area, the Baltic Sea area, the Black Sea area, the Red Sea area, the "Gulfs area", the Gulf of Aden area, the Antarctic area and the North-West European waters, which are defined as follows:

(a) The *Mediterranean Sea area* means the Mediterranean Sea proper including the gulfs and seas therein with the boundary between the Mediterranean and the Black Sea constituted by the 41° N parallel and bounded to the west by the Straits of Gibraltar at the meridian of 5°36′ W.

(b) The *Baltic Sea area* means the Baltic Sea proper with the Gulf of Bothnia, the Gulf of Finland and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57°44.8′ N.

(c) The *Black Sea area* means the Black Sea proper with the boundary between the Mediterranean and the Black Sea constituted by the parallel 41° N.

(d) The *Red Sea area* means the Red Sea proper including the Gulfs of Suez and Aqaba bounded at the south by the rhumb line between Ras si Ane (12°28.5′ N, 43°19.6′ E) and Husn Murad (12°40.4′ N, 43°30.2′ E).

(e) The *Gulfs area* means the sea area located north-west of the rhumb line between Ras al Hadd (22°30′ N, 59°48′ E) and Ras al Fasteh (25°04′ N, 61°25′ E).

(f) The *Gulf of Aden area* means that part of the Gulf of Aden between the Red Sea and the Arabian Sea bounded to the west by the rhumb line between Ras si Ane (12°28.5′ N, 43°19.6′ E) and Husn Murad (12°40.4′ N, 43°30.2′ E) and to the east by the rhumb line between Ras Asir (11°50′ N, 51°16.9′ E) and Ras Fartak (15°35′ N, 52°13.8′ E).

* Refer to the Guidelines and specifications for pollution prevention equipment for machinery space bilges of ships adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33); see IMO sales publication IMO-646E.

(g) The *Antarctic area* means the sea area south of latitude 60° S.

(h) The *North-West European waters* include the North Sea and its approaches, the Irish Sea and its approaches, the Celtic Sea, the English Channel and its approaches and part of the North-East Atlantic immediately to the west of Ireland. The area is bounded by lines joining the following points:

(i) 48°27' N on the French coast;
(ii) 48°27' N, 6°25' W;
(iii) 49°52' N, 7°44' W;
(iv) 50°30' N, 12° W;
(v) 56°30' N, 12° W;
(vi) 62° N, 3° W;
(vii) 62° N on the Norwegian coast;
(viii) 57°44.8' N on the Danish and Swedish coasts.

(2) Subject to the provisions of regulation 11 of this Annex:

(a) Any discharge into the sea of oil or oily mixture from any oil tanker and any ship of 400 tons gross tonnage and above other than an oil tanker shall be prohibited while in a special area. In respect of the Antarctic area, any discharge into the sea of oil or oily mixture from any ship shall be prohibited.

(b) Except as provided for in respect of the Antarctic area under subparagraph 2(a) of this regulation, any discharge into the sea of oil or oily mixture from a ship of less than 400 tons gross tonnage, other than an oil tanker, shall be prohibited while in a special area, except when the oil content of the effluent without dilution does not exceed 15 parts per million.

(3) (a) The provisions of paragraph (2) of this regulation shall not apply to the discharge of clean or segregated ballast.

(b) The provisions of subparagraph (2)(a) of this regulation shall not apply to the discharge of processed bilge water from machinery spaces, provided that all of the following conditions are satisfied:

(i) the bilge water does not originate from cargo pump-room bilges;

(ii) the bilge water is not mixed with oil cargo residues;

(iii) the ship is proceeding *en route*;

(iv) the oil content of the effluent without dilution does not exceed 15 parts per million;

(v) the ship has in operation oil filtering equipment complying with regulation 16(5) of this Annex; and

(vi) the filtering system is equipped with a stopping device which will ensure that the discharge is automatically stopped when the oil content of the effluent exceeds 15 parts per million.

SEE INTERPRETATION 3.4

(4) (a) No discharge into the sea shall contain chemicals or other substances in quantities or concentrations which are hazardous to the marine environment or chemicals or other substances introduced for the purpose of circumventing the conditions of discharge specified in this regulation.

(b) The oil residues which cannot be discharged into the sea in compliance with paragraph (2) or (3) of this regulation shall be retained on board or discharged to reception facilities.

(5) Nothing in this regulation shall prohibit a ship on a voyage only part of which is in a special area from discharging outside the special area in accordance with regulation 9 of this Annex.

(6) Whenever visible traces of oil are observed on or below the surface of the water in the immediate vicinity of a ship or its wake, the Governments of Parties to the Convention should, to the extent they are reasonably able to do so, promptly investigate the facts bearing on the issue of whether there has been a violation of the provisions of this regulation or regulation 9 of this Annex. The investigation should include, in particular, the wind and sea conditions, the track and speed of the ship, other possible sources of the visible traces in the vicinity, and any relevant oil discharge records.

(7) Reception facilities within special areas:

(a) Mediterranean Sea, Black Sea and Baltic Sea areas:

(i) The Government of each Party to the Convention the coastline of which borders on any given special area undertakes to ensure that not later than 1 January 1977 all oil loading terminals and repair ports within the special area are provided with facilities adequate for the reception and treatment of all the dirty ballast and tank washing water from oil tankers. In addition all ports within the special area shall be provided with adequate reception facilities for other residues and oily mixtures from all ships. Such facilities shall have adequate capacity to meet the needs of the ships using them without causing undue delay.

(ii) The Government of each Party having under its jurisdiction entrances to seawater courses with low depth contour which might require a reduction of draught by the discharge of ballast undertakes to ensure the provision of the facilities referred to in subparagraph (a)(i) of this paragraph but with the proviso that ships required to discharge slops or dirty ballast could be subject to some delay.

(iii) During the period between the entry into force of the present Convention (if earlier than 1 January 1977) and 1 January 1977 ships while navigating in the special areas shall comply with the requirements of regulation 9 of this Annex. However, the Governments of Parties the coastlines of which border any of the special areas under this subparagraph may establish a date earlier than 1 January 1977, but after the date of entry in force of the present Convention, from which the requirements of this regulation in respect of the special areas in question shall take effect:

(1) if all the reception facilities required have been provided by the date so established; and

(2) provided that the Parties concerned notify the Organization of the date so established at least six months in advance, for circulation to other Parties.

(iv) After 1 January 1977, or the date established in accordance with subparagraph (a)(iii) of this paragraph if earlier, each Party shall notify the Organization for transmission to the Contracting Governments concerned of all cases where the facilities are alleged to be inadequate.

(b) Red Sea area, Gulfs area, Gulf of Aden area and North-West European waters:

(i) The Government of each Party the coastline of which borders on the special areas undertakes to ensure that as soon as possible all oil loading terminals and repair ports within these special areas are provided with facilities adequate for the reception and treatment of all the dirty ballast and tank washing water from tankers. In addition all ports within the special area shall be provided with adequate reception facilities for other residues and oily mixtures from all ships. Such facilities shall have adequate capacity to meet the needs of the ships using them without causing undue delay.

(ii) The Government of each Party having under its jurisdiction entrances to seawater courses with low depth contour which might require a reduction of draught by the discharge of ballast shall undertake to ensure the provision of the facilities referred to in subparagraph (b)(i) of this paragraph but with the proviso that ships required to discharge slops or dirty ballast could be subject to some delay.

(iii) Each Party concerned shall notify the Organization of the measures taken pursuant to provisions of subparagraph (b)(i) and (ii) of this paragraph. Upon receipt of sufficient notifications the Organization shall establish a date from which the requirements of this regulation in respect of the area in question shall take effect. The Organization shall notify all Parties of the date so established no less than twelve months in advance of that date.

(iv) During the period between the entry into force of the present Convention and the date so established, ships while navigating in the special area shall comply with the requirements of regulation 9 of this Annex.

(v) After such date oil tankers loading in ports in these special areas where such facilities are not yet available shall also fully comply with the requirements of this regulation. However, oil tankers entering these special areas for the purpose of loading shall make every effort to enter the area with only clean ballast on board.

(vi) After the date on which the requirements for the special area in question take effect, each Party shall notify the Organization for transmission to the Parties concerned of all cases where the facilities are alleged to be inadequate.

(vii) At least the reception facilities as prescribed in regulation 12 of this Annex shall be provided by 1 January 1977 or one year after the date of entry into force of the present Convention, whichever occurs later.

(8) Notwithstanding paragraph (7) of this regulation, the following rules apply to the Antarctic area:

(a) The Government of each Party to the Convention at whose ports ships depart *en route* to or arrive from the Antarctic area undertakes to ensure that as soon as practicable adequate facilities are provided for the reception of all sludge, dirty ballast, tank washing water, and other oily residues and mixtures from all ships, without causing undue delay, and according to the needs of the ships using them.

(b) The Government of each Party to the Convention shall ensure that all ships entitled to fly its flag, before entering the Antarctic area, are fitted with a tank or tanks of sufficient capacity on board for the retention of all sludge, dirty ballast, tank washing water and other oily residues and mixtures while operating in the area and have concluded arrangements to discharge such oily residues at a reception facility after leaving the area.

Regulation 11
Exceptions

Regulations 9 and 10 of this Annex shall not apply to:

(a) the discharge into the sea of oil or oily mixture necessary for the purpose of securing the safety of a ship or saving life at sea; or

(b) the discharge into the sea of oil or oily mixture resulting from damage to a ship or its equipment:

(i) provided that all reasonable precautions have been taken after the occurrence of the damage or discovery of the discharge for the purpose of preventing or minimizing the discharge; and

(ii) except if the owner or the master acted either with intent to cause damage, or recklessly and with knowledge that damage would probably result; or

(c) the discharge into the sea of substances containing oil, approved by the Administration, when being used for the purpose of combating specific pollution incidents in order to minimize the damage from pollution. Any such discharge shall be subject to the approval of any Government in whose jurisdiction it is contemplated the discharge will occur.

Regulation 12
Reception facilities

(1) Subject to the provisions of regulation 10 of this Annex, the Government of each Party undertakes to ensure the provision at oil loading terminals, repair ports, and in other ports in which ships have oily residues to discharge, of facilities for the reception of such residues and oily mixtures as remain from oil tankers and other ships adequate to meet the needs of the ships using them without causing undue delay to ships.

(2) Reception facilities in accordance with paragraph (1) of this regulation shall be provided in:

Annex I

(a) all ports and terminals in which crude oil is loaded into oil tankers where such tankers have immediately prior to arrival completed a ballast voyage of not more than 72 hours or not more than 1,200 nautical miles;

(b) all ports and terminals in which oil other than crude oil in bulk is loaded at an average quantity of more than 1,000 metric tons per day;

(c) all ports having ship repair yards or tank cleaning facilities;

(d) all ports and terminals which handle ships provided with the sludge tank(s) required by regulation 17 of this Annex;

(e) all ports in respect of oily bilge waters and other residues, which cannot be discharged in accordance with regulation 9 of this Annex; and

(f) all loading ports for bulk cargoes in respect of oil residues from combination carriers which cannot be discharged in accordance with regulation 9 of this Annex.

SEE INTERPRETATION 3.5

(3) The capacity for the reception facilities shall be as follows:

(a) Crude oil loading terminals shall have sufficient reception facilities to receive oil and oily mixtures which cannot be discharged in accordance with the provisions of regulation 9(1)(a) of this Annex from all oil tankers on voyages as described in paragraph (2)(a) of this regulation.

(b) Loading ports and terminals referred to in paragraph (2)(b) of this regulation shall have sufficient reception facilities to receive oil and oily mixtures which cannot be discharged in accordance with the provisions of regulation 9(1)(a) of this Annex from oil tankers which load oil other than crude oil in bulk.

(c) All ports having ship repair yards or tank cleaning facilities shall have sufficient reception facilities to receive all residues and oily mixtures which remain on board for disposal from ships prior to entering such yards or facilities.

(d) All facilities provided in ports and terminals under paragraph (2)(d) of this regulation shall be sufficient to receive all residues retained according to regulation 17 of this Annex from all ships that may reasonably be expected to call at such ports and terminals.

(e) All facilities provided in ports and terminals under this regulation shall be sufficient to receive oily bilge waters and other residues which cannot be discharged in accordance with regulation 9 of this Annex.

(f) The facilities provided in loading ports for bulk cargoes shall take into account the special problems of combination carriers as appropriate.

(4) The reception facilities prescribed in paragraphs (2) and (3) of this regulation shall be made available no later than one year from the date of entry into force of the present Convention or by 1 January 1977, whichever occurs later.

(5) Each Party shall notify the Organization for transmission to the Parties concerned of all cases where the facilities provided under this regulation are alleged to be inadequate.

Regulation 13

Segregated ballast tanks, dedicated clean ballast tanks and crude oil washing

SEE INTERPRETATIONS 2.1 AND 4.6

Subject to the provisions of regulations 13C and 13D of this Annex, oil tankers shall comply with the requirements of this regulation.

New oil tankers of 20,000 tons deadweight and above

(1) Every new crude oil tanker of 20,000 tons deadweight and above and every new product carrier of 30,000 tons deadweight and above shall be provided with segregated ballast tanks and shall comply with paragraphs (2), (3) and (4), or paragraph (5) as appropriate, of this regulation.

(2) The capacity of the segregated ballast tanks shall be so determined that the ship may operate safely on ballast voyages without recourse to the use of cargo tanks for water ballast except as provided for in paragraphs (3) or (4) of this regulation. In all cases, however, the capacity of segregated ballast tanks shall be at least such that, in any ballast condition at any part of the voyage, including the conditions consisting of lightweight plus segregated ballast only, the ship's draughts and trim can meet each of the following requirements:

(a) the moulded draught amidships (d_m) in metres (without taking into account any ship's deformation) shall not be less than:

$$d_m = 2.0 + 0.02L;$$

(b) the draughts at the forward and after perpendiculars shall correspond to those determined by the draught amidships (d_m) as specified in subparagraph (a) of this paragraph, in association with the trim by the stern of not greater than $0.015L$; and

(c) in any case the draught at the after perpendicular shall not be less than that which is necessary to obtain full immersion of the propeller(s).

(3) In no case shall ballast water be carried in cargo tanks, except:

(a) on those rare voyages when weather conditions are so severe that, in the opinion of the master, it is necessary to carry additional ballast water in cargo tanks for the safety of the ship; and

(b) in exceptional cases where the particular character of the operation of an oil tanker renders it necessary to carry ballast water in excess of the quantity required under paragraph (2) of this regulation, provided that such operation of the oil tanker falls under the category of exceptional cases as established by the Organization.

Such additional ballast water shall be processed and discharged in compliance with regulation 9 of this Annex and in accordance with the requirements of regulation 15 of this Annex and an entry shall be made in the Oil Record Book referred to in regulation 20 of this Annex.

SEE INTERPRETATION 4.1

(4) In the case of new crude oil tankers, the additional ballast permitted in paragraph (3) of this regulation shall be carried in cargo tanks only if such tanks have been crude oil washed in accordance with regulation 13B of this Annex before departure from an oil unloading port or terminal.

SEE INTERPRETATION 4.2

(5) Notwithstanding the provisions of paragraph (2) of this regulation, the segregated ballast conditions for oil tankers less than 150 metres in length shall be to the satisfaction of the Administration.

SEE INTERPRETATION 4.3

(6) Every new crude oil tanker of 20,000 tons deadweight and above shall be fitted with a cargo tank cleaning system using crude oil washing. The Administration shall undertake to ensure that the system fully complies with the requirements of regulation 13B of this Annex within one year after the tanker was first engaged in the trade of carrying crude oil or by the end of the third voyage carrying crude oil suitable for crude oil washing, whichever occurs later. Unless such oil tanker carries crude oil which is not suitable for crude oil washing, the

oil tanker shall operate the system in accordance with the requirements of that regulation.

Existing crude oil tankers of 40,000 tons deadweight and above

(7) Subject to the provisions of paragraphs (8) and (9) of this regulation, every existing crude oil tanker of 40,000 tons deadweight and above shall be provided with segregated ballast tanks and shall comply with the requirements of paragraphs (2) and (3) of this regulation from the date of entry into force of the present Convention.

(8) Existing crude oil tankers referred to in paragraph (7) of this regulation may, in lieu of being provided with segregated ballast tanks, operate with a cargo tank cleaning procedure using crude oil washing in accordance with regulation 13B of this Annex unless the crude oil tanker is intended to carry crude oil which is not suitable for crude oil washing.

SEE INTERPRETATION 4.4

(9) Existing crude oil tankers referred to in paragraphs (7) or (8) of this regulation may, in lieu of being provided with segregated ballast tanks or operating with a cargo tank cleaning procedure using crude oil washing, operate with dedicated clean ballast tanks in accordance with the provisions of regulation 13A of this Annex for the following period:

(a) for crude oil tankers of 70,000 tons deadweight and above, until two years after the date of entry into force of the present Convention; and

(b) for crude oil tankers of 40,000 tons deadweight and above but below 70,000 tons deadweight, until four years after the date of entry into force of the present Convention.

SEE INTERPRETATION 4.5

Existing product carriers of 40,000 tons deadweight and above

(10) From the date of entry into force of the present Convention, every existing product carrier of 40,000 tons deadweight and above shall be provided with segregated ballast tanks and shall comply with the requirements of paragraphs (2) and (3) of this regulation, or, alternatively, operate with dedicated clean ballast tanks in accordance with the provisions of regulation 13A of this Annex.

SEE INTERPRETATION 4.5

An oil tanker qualified as a segregated ballast oil tanker

(11) Any oil tanker which is not required to be provided with segregated ballast tanks in accordance with paragraphs (1), (7) or (10) of this regulation may, however, be qualified as a segregated ballast tanker, provided that it complies with the requirements of paragraphs (2) and (3), or paragraph (5) as appropriate, of this regulation.

Regulation 13A
Requirements for oil tankers with dedicated clean ballast tanks

SEE INTERPRETATION 4.6

(1) An oil tanker operating with dedicated clean ballast tanks in accordance with the provisions of regulation 13(9) or (10) of this Annex shall have adequate tank capacity, dedicated solely to the carriage of clean ballast as defined in regulation 1(16) of this Annex, to meet the requirements of regulation 13(2) and (3) of this Annex.

(2) The arrangements and operational procedures for dedicated clean ballast tanks shall comply with the requirements established by the Administration. Such requirements shall contain at least all the provisions of the Specifications for Oil Tankers with Dedicated Clean Ballast Tanks adopted by the International Conference on Tanker Safety and Pollution Prevention, 1978, in resolution 14 and as may be revised by the Organization.*

(3) An oil tanker operating with dedicated clean ballast tanks shall be equipped with an oil content meter, approved by the Administration on the basis of specifications recommended by the Organization,† to enable supervision of the oil content in ballast water being discharged. The oil content meter shall be installed no later than at the first scheduled shipyard visit of the tanker following the entry into force of the present Convention. Until such time as the oil content meter is installed, it shall immediately before discharge of ballast be established

* Refer to the Revised specifications for oil tankers with dedicated clean ballast tanks adopted by the Organization by resolution A.495(XII); see IMO sales publication IMO-619E.

† For oil content meters installed on oil tankers built prior to 2 October 1986, refer to the Recommendation on international performance and test specifications for oily-water separating equipment and oil content meters adopted by the Organization by resolution A.393(X). For oil content meters as part of discharge monitoring and control systems installed on oil tankers built on or after 2 October 1986, refer to the Revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers adopted by the Organization by resolution A.586(14); see IMO sales publications IMO-608E and IMO-646E, respectively.

by examination of the ballast water from dedicated tanks that no contamination with oil has taken place.

SEE INTERPRETATIONS 4.7 AND 4.8

(4) Every oil tanker operating with dedicated clean ballast tanks shall be provided with a Dedicated Clean Ballast Tank Operation Manual* detailing the system and specifying operational procedures. Such a Manual shall be to the satisfaction of the Administration and shall contain all the information set out in the Specifications referred to in paragraph (2) of this regulation. If an alteration affecting the dedicated clean ballast tank system is made, the Operation Manual shall be revised accordingly.

Regulation 13B
Requirements for crude oil washing

SEE INTERPRETATIONS 4.6 AND 4.9

(1) Every crude oil washing system required to be provided in accordance with regulation 13(6) and (8) of this Annex shall comply with the requirements of this regulation.

(2) The crude oil washing installation and associated equipment and arrangements shall comply with the requirements established by the Administration. Such requirements shall contain at least all the provisions of the Specifications for the Design, Operation and Control of Crude Oil Washing Systems adopted by the International Conference on Tanker Safety and Pollution Prevention, 1978, in resolution 15 and as may be revised by the Organization.†

(3) An inert gas system shall be provided in every cargo tank and slop tank in accordance with the appropriate regulations of chapter II-2 of the International Convention for the Safety of Life at Sea, 1974, as modified and added to by the Protocol of 1978 relating to the International Convention for the Safety of Life at Sea, 1974 and as may be further amended.

(4) With respect to the ballasting of cargo tanks, sufficient cargo tanks shall be crude oil washed prior to each ballast voyage in order that, taking into account the tanker's trading pattern and expected weather

* See resolution A.495(XII) for the standard format of the Manual; see IMO sales publication IMO-619E.

† Refer to the Revised specifications for the design, operation and control of crude oil washing systems adopted by the Organization by resolution A.446(XI) and amended by the Organization by resolutions A.497(XII) and A.897(21); see IMO sales publication IMO-617E.

conditions, ballast water is put only into cargo tanks which have been crude oil washed.

(5) Every oil tanker operating with crude oil washing systems shall be provided with an Operations and Equipment Manual* detailing the system and equipment and specifying operational procedures. Such a Manual shall be to the satisfaction of the Administration and shall contain all the information set out in the Specifications referred to in paragraph (2) of this regulation. If an alteration affecting the crude oil washing system is made, the Operations and Equipment Manual shall be revised accordingly.

Regulation 13C
Existing tankers engaged in specific trades

SEE INTERPRETATION 4.6

(1) Subject to the provisions of paragraph (2) of this regulation, regulation 13(7) to (10) of this Annex shall not apply to an existing oil tanker solely engaged in specific trades between:

(a) ports or terminals within a State Party to the present Convention; or

(b) ports or terminals of States Parties to the present Convention, where:

(i) the voyage is entirely within a special area as defined in regulation 10(1) of this Annex; or

(ii) the voyage is entirely within other limits designated by the Organization.

(2) The provisions of paragraph (1) of this regulation shall only apply when the ports or terminals where cargo is loaded on such voyages are provided with reception facilities adequate for the reception and treatment of all the ballast and tank washing water from oil tankers using them and all the following conditions are complied with:

(a) subject to the exceptions provided for in regulation 11 of this Annex, all ballast water, including clean ballast water, and tank washing residues are retained on board and transferred to the reception facilities and the appropriate entry in the Oil Record Book referred to in regulation 20 of this Annex is endorsed by the competent port State authority;

* Refer to the Standard format of the Crude Oil Washing Operation and Equipment Manual adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.3(XII) and amended by MEPC.81(43); see IMO sales publication IMO-617E.

(b) agreement has been reached between the Administration and the Governments of the port States referred to in subparagraph (1)(a) or (b) of this regulation concerning the use of an existing oil tanker for a specific trade;

(c) the adequacy of the reception facilities in accordance with the relevant provisions of this Annex at the ports or terminals referred to above, for the purpose of this regulation, is approved by the Governments of the States Parties to the present Convention within which such ports or terminals are situated; and

(d) the International Oil Pollution Prevention Certificate is endorsed to the effect that the oil tanker is solely engaged in such specific trade.

Regulation 13D
Existing oil tankers having special ballast arrangements

SEE INTERPRETATION 4.6

(1) Where an existing oil tanker is so constructed or operates in such a manner that it complies at all times with the draught and trim requirements set out in regulation 13(2) of this Annex without recourse to the use of ballast water, it shall be deemed to comply with the segregated ballast tank requirements referred to in regulation 13(7) of this Annex, provided that all of the following conditions are complied with:

(a) operational procedures and ballast arrangements are approved by the Administration;

(b) agreement is reached between the Administration and the Governments of the port States Parties to the present Convention concerned when the draught and trim requirements are achieved through an operational procedure; and

(c) the International Oil Pollution Prevention Certificate is endorsed to the effect that the oil tanker is operating with special ballast arrangements.

(2) In no case shall ballast water be carried in oil tanks except on those rare voyages when weather conditions are so severe that, in the opinion of the master, it is necessary to carry additional ballast water in cargo tanks for the safety of the ship. Such additional ballast water shall be processed and discharged in compliance with regulation 9 of this Annex and in accordance with the requirements of regulation 15 of this Annex, and entry shall be made in the Oil Record Book referred to in regulation 20 of this Annex.

(3) An Administration which has endorsed a Certificate in accordance with subparagraph (1)(c) of this regulation shall communicate to the Organization the particulars thereof for circulation to the Parties to the present Convention.

Regulation 13E
Protective location of segregated ballast spaces

SEE INTERPRETATIONS 2.1, 4.6, 4.10 AND 4.11

(1) In every new crude oil tanker of 20,000 tons deadweight and above and every new product carrier of 30,000 tons deadweight and above, the segregated ballast tanks required to provide the capacity to comply with the requirements of regulation 13 of this Annex which are located within the cargo tank length, shall be arranged in accordance with the requirements of paragraphs (2), (3) and (4) of this regulation to provide a measure of protection against oil outflow in the event of grounding or collision.

(2) Segregated ballast tanks and spaces other than oil tanks within the cargo tank length (L_t) shall be so arranged as to comply with the following requirement:

$$\Sigma PA_c + \Sigma PA_s \geqslant J[L_t(B + 2D)]$$

where: PA_c = the side shell area in square metres for each segregated ballast tank or space other than an oil tank based on projected moulded dimensions,

PA_s = the bottom shell area in square metres for each such tank or space based on projected moulded dimensions,

L_t = length in metres between the forward and after extremities of the cargo tanks,

B = maximum breadth of the ship in metres as defined in regulation 1(21) of this Annex,

D = moulded depth in metres measured vertically from the top of the keel to the top of the freeboard deck beam at side amidships. In ships having rounded gunwales, the moulded depth shall be measured to the point of intersection of the moulded lines of the deck and side shell plating, the lines extending as though the gunwale were of angular design,

J = 0.45 for oil tankers of 20,000 tons deadweight, 0.30 for oil tankers of 200,000 tons deadweight and above, subject to the provisions of paragraph (3) of this regulation.

For intermediate values of deadweight the value of J shall be determined by linear interpolation.

Whenever symbols given in this paragraph appear in this regulation, they have the meaning as defined in this paragraph.

(3) For tankers of 200,000 tons deadweight and above the value of J may be reduced as follows:

$$J_{reduced} = \left[J - \left(a - \frac{O_c + O_s}{4O_A}\right)\right] \text{ or 0.2 whichever is greater}$$

where: a = 0.25 for oil tankers of 200,000 tons deadweight,

a = 0.40 for oil tankers of 300,000 tons deadweight,

a = 0.50 for oil tankers of 420,000 tons deadweight and above.

For intermediate values of deadweight the value of a shall be determined by linear interpolation.

O_c = as defined in regulation 23(1)(a) of this Annex,

O_s = as defined in regulation 23(1)(b) of this Annex,

O_A = the allowable oil outflow as required by regulation 24(2) of this Annex.

(4) In the determination of PA_c and PA_s for segregated ballast tanks and spaces other than oil tanks the following shall apply:

(a) the minimum width of each wing tank or space either of which extends for the full depth of the ship's side or from the deck to the top of the double bottom shall be not less than 2 metres. The width shall be measured inboard from the ship's side at right angles to the centreline. Where a lesser width is provided the wing tank or space shall not be taken into account when calculating the protecting area PA_c; and

(b) the minimum vertical depth of each double bottom tank or space shall be $B/15$ or 2 metres, whichever is the lesser. Where a lesser depth is provided the bottom tank or space shall not be taken into account when calculating the protecting area PA_s.

The minimum width and depth of wing tanks and double bottom tanks shall be measured clear of the bilge area and, in the case of minimum width, shall be measured clear of any rounded gunwale area.

Regulation 13F

Prevention of oil pollution in the event of collision or stranding

SEE INTERPRETATION 4.6

(1) This regulation shall apply to oil tankers of 600 tons deadweight and above:

(a) for which the building contract is placed on or after 6 July 1993, or

(b) in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 6 January 1994, or

(c) the delivery of which is on or after 6 July 1996, or

(d) which have undergone a major conversion:

(i) for which the contract is placed after 6 July 1993; or

(ii) in the absence of a contract, the construction work of which is begun after 6 January 1994; or

(iii) which is completed after 6 July 1996.

SEE INTERPRETATION 1.2

(2) Every oil tanker of 5,000 tons deadweight and above shall:

(a) in lieu of regulation 13E, as applicable, comply with the requirements of paragraph (3) unless it is subject to the provisions of paragraphs (4) and (5); and

(b) comply, if applicable, with the requirements of paragraph (6).

(3) The entire cargo tank length shall be protected by ballast tanks or spaces other than cargo and fuel oil tanks as follows:

(a) *Wing tanks or spaces*

Wing tanks or spaces shall extend either for the full depth of the ship's side or from the top of the double bottom to the uppermost deck, disregarding a rounded gunwale where fitted. They shall be arranged such that the cargo tanks are located inboard of the moulded line of the side shell plating, nowhere less than the distance w which, as shown in figure 1, is measured at any cross-section at right angles to the side shell, as specified below:

$$w = 0.5 + \frac{DW}{20,000} \text{ (m) or}$$

$$w = 2.0 \text{ m, whichever is the lesser.}$$

The minimum value of w = 1.0 m.

(b) *Double bottom tanks or spaces*

At any cross-section the depth of each double bottom tank or space shall be such that the distance h between the bottom of the cargo tanks and the moulded line of the bottom shell plating measured at right angles to the bottom shell plating as shown in figure 1 is not less than specified below:

$h = B/15$ (m) or

$h = 2.0$ m, whichever is the lesser.

The minimum value of $h = 1.0$ m.

(c) *Turn of the bilge area or at locations without a clearly defined turn of the bilge*

When the distances h and w are different, the distance w shall have preference at levels exceeding $1.5h$ above the baseline as shown in figure 1.

(d) *The aggregate capacity of ballast tanks*

On crude oil tankers of 20,000 tons deadweight and above and product carriers of 30,000 tons deadweight and above, the aggregate capacity of wing tanks, double bottom tanks, forepeak tanks and afterpeak tanks shall not be less than the capacity of segregated ballast tanks necessary to meet the requirements of regulation 13. Wing tanks or spaces and double bottom tanks used to meet the requirements of regulation 13 shall be located as uniformly as practicable along the cargo tank length. Additional segregated ballast capacity provided for reducing longitudinal hull girder bending stress, trim, etc., may be located anywhere within the ship.

SEE INTERPRETATION 4.12

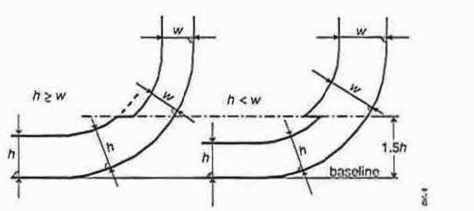

Figure 1 – Cargo tank boundary lines for the purpose of paragraph (3)

Annex I

(e) *Suction wells in cargo tanks*

Suction wells in cargo tanks may protrude into the double bottom below the boundary line defined by the distance h provided that such wells are as small as practicable and the distance between the well bottom and bottom shell plating is not less than $0.5h$.

(f) *Ballast and cargo piping*

Ballast piping and other piping such as sounding and vent piping to ballast tanks shall not pass through cargo tanks. Cargo piping and similar piping to cargo tanks shall not pass through ballast tanks. Exemptions to this requirement may be granted for short lengths of piping, provided that they are completely welded or equivalent.

(4) (a) Double bottom tanks or spaces as required by paragraph (3)(b) may be dispensed with, provided that the design of the tanker is such that the cargo and vapour pressure exerted on the bottom shell plating forming a single boundary between the cargo and the sea does not exceed the external hydrostatic water pressure, as expressed by the following formula:

$$f \times h_c \times \rho_c \times g + 100\Delta p \leqslant d_n \times \rho_s \times g$$

where:

h_c = height of cargo in contact with the bottom shell plating in metres

ρ_c = maximum cargo density in t/m^3

d_n = minimum operating draught under any expected loading condition in metres

ρ_s = density of seawater in t/m^3

Δp = maximum set pressure of pressure/vacuum valve provided for the cargo tank in bars

f = safety factor = 1.1

g = standard acceleration of gravity (9.81 m/s^2).

(b) Any horizontal partition necessary to fulfil the above requirements shall be located at a height of not less than $B/6$ or 6 m, whichever is the lesser, but not more than $0.6D$, above the baseline where D is the moulded depth amidships.

(c) The location of wing tanks or spaces shall be as defined in paragraph (3)(a) except that, below a level $1.5h$ above the baseline where h is as defined in paragraph (3)(b), the cargo tank boundary line may be vertical down to the bottom plating, as shown in figure 2.

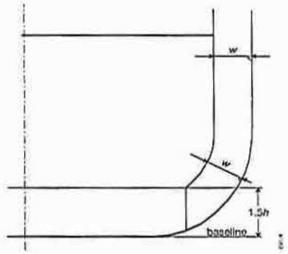

Figure 2 – Cargo tank boundary lines for the purpose of paragraph (4)

(5) Other methods of design and construction of oil tankers may also be accepted as alternatives to the requirements prescribed in paragraph (3), provided that such methods ensure at least the same level of protection against oil pollution in the event of collision or stranding and are approved in principle by the Marine Environment Protection Committee based on guidelines developed by the Organization.*

(6) For oil tankers of 20,000 tons deadweight and above the damage assumptions prescribed in regulation 25(2)(b) shall be supplemented by the following assumed bottom raking damage:

(a) longitudinal extent:

(i) ships of 75,000 tons deadweight and above: $0.6L$ measured from the forward perpendicular;

(ii) ships of less than 75,000 tons deadweight: $0.4L$ measured from the forward perpendicular;

(b) transverse extent: $B/3$ anywhere in the bottom;

(c) vertical extent: breach of the outer hull.

* Refer to the Interim guidelines for the approval of alternative methods of design and construction of oil tankers under regulation 13F(5) of Annex I of MARPOL 73/78 adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.66(37); see appendix 7 to Unified Interpretations of Annex I.

Annex I

(7) Oil tankers of less than 5,000 tons deadweight shall:

(a) at least be fitted with double bottom tanks or spaces having such a depth that the distance h specified in paragraph (3)(b) complies with the following:

$$h = B/15 \text{ (m)}$$

with a minimum value of $h = 0.76$ m;

in the turn of the bilge area and at locations without a clearly defined turn of the bilge, the cargo tank boundary line shall run parallel to the line of the midship flat bottom as shown in figure 3; and

(b) be provided with cargo tanks so arranged that the capacity of each cargo tank does not exceed 700 m^3 unless wing tanks or spaces are arranged in accordance with paragraph (3)(a) complying with the following:

$$w = 0.4 + \frac{2.4DW}{20,000} \text{ (m)}$$

with a minimum value of $w = 0.76$ m.

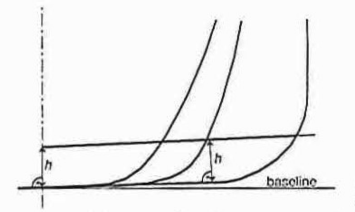

Figure 3 – Cargo tank boundary lines for the purpose of paragraph (7)

(8) Oil shall not be carried in any space extending forward of a collision bulkhead located in accordance with regulation II-1/11 of the International Convention for the Safety of Life at Sea, 1974, as amended. An oil tanker that is not required to have a collision bulkhead in accordance with that regulation shall not carry oil in any space extending forward of the transverse plane perpendicular to the centreline that is located as if it were a collision bulkhead located in accordance with that regulation.

(9) In approving the design and construction of oil tankers to be built in accordance with the provisions of this regulation, Administrations

shall have due regard to the general safety aspects including the need for the maintenance and inspections of wing and double bottom tanks or spaces.

Regulation 13G

Prevention of oil pollution in the event of collision or stranding – Measures for existing tankers

SEE INTERPRETATION 4.6

(1) This regulation shall:

(a) apply to

(i) oil tankers of 20,000 tons deadweight and above carrying crude oil, fuel oil, heavy diesel oil or lubricating oil as cargo; and

(ii) oil tankers of 30,000 tons deadweight and above other than those referred to in subparagraph (i),

which are contracted, the keels of which are laid, or which are delivered before the dates specified in regulation 13F(1) of this Annex; and

(b) not apply to oil tankers complying with regulation 13F of this Annex, which are contracted, the keels of which are laid, or are delivered before the dates specified in regulation 13F(1) of this Annex; and

(c) not apply to oil tankers covered by subparagraph (a) above which comply with regulation 13F(3)(a) and (b) or 13F(4) or 13F(5) of this Annex, except that the requirement for minimum distances between the cargo tank boundaries and the ship side and bottom plating need not be met in all respects. In that event, the side protection distances shall not be less than those specified in the International Bulk Chemical Code for type 2 cargo tank location and the bottom protection distances shall comply with regulation 13E(4)(b) of this Annex.

(2) The requirements of this regulation shall take effect as from 6 July 1995, except that the requirements of paragraph (1)(a) applicable to oil tankers of 20,000 tons deadweight and above but less than 30,000 tons deadweight carrying fuel oil, heavy diesel oil or lubricating oil as cargo shall take effect as from 1 January 2003.

(2*bis*) For the purpose of paragraphs (1) and (2) of this regulation:

(a) *Heavy diesel oil* means marine diesel oil, other than those distillates of which more than 50% by volume distils at a

temperature not exceeding 340°C when tested by the method acceptable to the Organization.*

(b) *Fuel oil* means heavy distillates or residues from crude oil or blends of such materials intended for use as a fuel for the production of heat or power of a quality equivalent to the specification acceptable to the Organization.†

(3) (a) An oil tanker to which this regulation applies shall be subject to an enhanced programme of inspections during periodical, intermediate and annual surveys, the scope and frequency of which shall at least comply with the guidelines developed by the Organization.‡

(b) An oil tanker over five years of age to which this regulation applies shall have on board, available to the competent authority of any Government of a State Party to the present Convention, a complete file of the survey reports, including the results of all scantling measurement required, as well as the statement of structural work carried out.

(c) This file shall be accompanied by a condition evaluation report, containing conclusions on the structural condition of the ship and its residual scantlings, endorsed to indicate that it has been accepted by or on behalf of the flag Administration. This file and condition evaluation report shall be prepared in a standard format as contained in the guidelines developed by the Organization.

(4) An oil tanker not meeting the requirements of a new oil tanker as defined in regulation 1(26) of this Annex shall comply with the requirements of regulation 13F of this Annex not later than 25 years after its date of delivery, unless wing tanks or double bottom spaces, not used for the carriage of oil and meeting the width and height requirements of regulation 13E(4), cover at least 30% of L_t for the full depth of the ship on each side or at least 30% of the projected bottom shell area within the length L_t, where L_t is as defined in regulation 13E(2), in which case compliance with regulation 13F is required not later than 30 years after its date of delivery.

SEE INTERPRETATION 4.13

* Refer to the American Society for Testing and Materials' Standard Test Method (Designation D86).

† Refer to the American Society for Testing and Materials' Specification for Number Four Fuel Oil (Designation D396) or heavier.

‡ Refer to the Guidelines on the enhanced programme of inspections during surveys of bulk carriers and oil tankers adopted by the Organization by resolution A.744(18), as amended by MSC.49(66), by resolution 2 of the 1997 Conference of Contracting Governments to SOLAS and by MSC.105(73); see IMO sales publication IMO-265E.

(5) An oil tanker meeting the requirements of a new oil tanker as defined in regulation 1(26) of this Annex shall comply with the requirements of regulation 13F of this Annex not later than 30 years after its date of delivery.

(6) Any new ballast and load conditions resulting from the application of paragraph (4) of this regulation shall be subject to approval of the Administration which shall have regard, in particular, to longitudinal and local strength, intact stability and, if applicable, damage stability.

(7) Other structural or operational arrangements such as hydrostatically balanced loading may be accepted as alternatives to the requirements prescribed in paragraph (4), provided that such alternatives ensure at least the same level of protection against oil pollution in the event of collision or stranding and are approved by the Administration based on guidelines developed by the Organization.*

Regulation 14

Segregation of oil and water ballast and carriage of oil in forepeak tanks

(1) Except as provided in paragraph (2) of this regulation, in new ships of 4,000 tons gross tonnage and above other than oil tankers, and in new oil tankers of 150 tons gross tonnage and above, no ballast water shall be carried in any oil fuel tank.

(2) Where abnormal conditions or the need to carry large quantities of oil fuel render it necessary to carry ballast water which is not a clean ballast in any oil fuel tank, such ballast water shall be discharged to reception facilities or into the sea in compliance with regulation 9 using the equipment specified in regulation 16(2) of this Annex, and an entry shall be made in the Oil Record Book to this effect.

SEE INTERPRETATION 5.1

(3) All other ships shall comply with the requirements of paragraph (1) of this regulation as far as is reasonable and practicable.

SEE INTERPRETATION 5.2

(4) In a ship of 400 tons gross tonnage and above, for which the building contract is placed after 1 January 1982 or, in the absence of a building

* Refer to the Guidelines for approval of alternative structural or operational arrangements as called for in regulation 13G(7) of Annex I of MARPOL 73/78 adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.64(36); see appendix 8 to Unified Interpretations of Annex I and also appendix 9.

contract, the keel of which is laid or which is at a similar stage of construction after 1 July 1982, oil shall not be carried in a forepeak tank or a tank forward of the collision bulkhead.

(5) All ships other than those subject to paragraph (4) of this regulation shall comply with the provisions of that paragraph, as far as is reasonable and practicable.

Regulation 15

Retention of oil on board

(1) Subject to the provisions of paragraphs (5) and (6) of this regulation, oil tankers of 150 tons gross tonnage and above shall be provided with arrangements in accordance with the requirements of paragraphs (2) and (3) of this regulation, provided that in the case of existing tankers the requirements for oil discharge monitoring and control systems and slop tank arrangements shall apply three years after the date of entry into force of the present Convention.

(2) (a) Adequate means shall be provided for cleaning the cargo tanks and transferring the dirty ballast residue and tank washings from the cargo tanks into a slop tank approved by the Administration. In existing oil tankers, any cargo tank may be designated as a slop tank.

(b) In this system arrangements shall be provided to transfer the oily waste into a slop tank or combination of slop tanks in such a way that any effluent discharged into the sea will be such as to comply with the provisions of regulation 9 of this Annex.

(c) The arrangements of the slop tank or combination of slop tanks shall have a capacity necessary to retain the slop generated by tank washings, oil residues and dirty ballast residues. The total capacity of the slop tank or tanks shall not be less than 3% of the oil carrying capacity of the ship, except that the Administration may accept:

(i) 2% for such oil tankers where the tank washing arrangements are such that once the slop tank or tanks are charged with washing water, this water is sufficient for tank washing and, where applicable, for providing the driving fluid for eductors, without the introduction of additional water into the system;

(ii) 2% where segregated ballast tanks or dedicated clean ballast tanks are provided in accordance with regulation 13 of this Annex, or where a cargo tank cleaning system using crude oil washing is fitted in accordance with regulation 13B of this Annex. This capacity may be further reduced to 1.5% for such oil tankers where the tank washing arrangements are such that once the slop tank or tanks are charged with washing water, this water is sufficient for tank washing and, where applicable, for providing the driving fluid for eductors, without the introduction of additional water into the system;

(iii) 1% for combination carriers where oil cargo is only carried in tanks with smooth walls. This capacity may be further reduced to 0.8% where the tank washing arrangements are such that, once the slop tank or tanks are charged with washing water, this water is sufficient for tank washing and, where applicable, for providing the driving fluid for eductors, without the introduction of additional water into the system.

SEE INTERPRETATION 6.2

New oil tankers of 70,000 tons deadweight and above shall be provided with at least two slop tanks.

(d) Slop tanks shall be designed, particularly in respect of the position of inlets, outlets, baffles or weirs where fitted, so as to avoid excessive turbulence and entrainment of oil or emulsion with the water.

SEE INTERPRETATION 6.1

(3) (a) An oil discharge monitoring and control system approved by the Administration shall be fitted. In considering the design of the oil content meter to be incorporated in the system, the Administration shall have regard to the specification recommended by the Organization.* The system shall be fitted with a recording device to provide a continuous record of the discharge in litres per nautical mile and total quantity discharged, or the oil content and rate of discharge. This record shall be identifiable as to time and date and shall be kept for at least three years. The oil discharge monitoring and control system shall come into operation when there is any discharge of effluent into the sea and shall be such as will ensure that any discharge of oily mixture is automatically stopped when the instantaneous rate of discharge of oil exceeds that permitted by regulation 9(1)(a) of this Annex. Any failure of this monitoring and control system shall stop the discharge and be noted in the Oil Record Book. A manually operated

* For oil content meters installed on tankers built prior to 2 October 1986, refer to the Recommendation on international performance and test specifications for oily-water separating equipment and oil content meters adopted by the Organization by resolution A.393(X). For oil content meters as part of discharge monitoring and control systems installed on tankers built on or after 2 October 1986, refer to the Revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers, adopted by the Organization by resolution A.586(14); see IMO sales publications IMO-608E and IMO-646E, respectively.

alternative method shall be provided and may be used in the event of such failure, but the defective unit shall be made operable as soon as possible. The port State authority may allow the tanker with a defective unit to undertake one ballast voyage before proceeding to a repair port. The oil discharge monitoring and control system shall be designed and installed in compliance with the guidelines and specifications for oil discharge monitoring and control systems for oil tankers developed by the Organization.* Administrations may accept such specific arrangements as detailed in the Guidelines and Specifications.

(b) Effective oil/water interface detectors† approved by the Administration shall be provided for a rapid and accurate determination of the oil/water interface in slop tanks and shall be available for use in other tanks where the separation of oil and water is effected and from which it is intended to discharge effluent direct to the sea.

SEE INTERPRETATIONS 6.1 AND 6.3

(c) Instructions as to the operation of the system shall be in accordance with an operational manual approved by the Administration. They shall cover manual as well as automatic operations and shall be intended to ensure that at no time shall oil be discharged except in compliance with the conditions specified in regulation 9 of this Annex.‡

(4) The requirements of paragraphs (1), (2) and (3) of this regulation shall not apply to oil tankers of less than 150 tons gross tonnage, for which the control of discharge of oil under regulation 9 of this Annex shall be effected by the retention of oil on board with subsequent discharge of all contaminated washings to reception facilities. The total quantity of oil and water used for washing and returned to a storage tank shall be recorded in the Oil Record Book. This total quantity shall be discharged to reception facilities unless adequate arrangements are made to ensure that any effluent which is allowed to be discharged

* For oil content meters installed on tankers built prior to 2 October 1986, refer to the Recommendation on international performance and test specifications for oily-water separating equipment and oil content meters adopted by the Organization by resolution A.393(X). For oil content meters as part of discharge monitoring and control systems installed on tankers built on or after 2 October 1986, refer to the Revised guidelines and specifications for oil discharge monitoring and control systems for oil tankers, adopted by the Organization by resolution A.586(14); see IMO sales publications IMO-608E and IMO-646E, respectively.

† Refer to the Specifications for oil/water interface detectors adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.5(XIII); see IMO sales publication IMO-646E.

‡ Refer to *Clean Seas Guide for Oil Tankers*, published by the International Chamber of Shipping and the Oil Companies International Marine Forum.

into the sea is effectively monitored to ensure that the provisions of regulation 9 of this Annex are complied with.

(5) (a) The Administration may waive the requirements of paragraphs (1), (2) and (3) of this regulation for any oil tanker which engages exclusively on voyages both of 72 hours or less in duration and within 50 miles from the nearest land, provided that the oil tanker is engaged exclusively in trades between ports or terminals within a State Party to the present Convention. Any such waiver shall be subject to the requirement that the oil tanker shall retain on board all oily mixtures for subsequent discharge to reception facilities and to the determination by the Administration that facilities available to receive such oily mixtures are adequate.

(b) The Administration may waive the requirements of paragraph (3) of this regulation for oil tankers other than those referred to in subparagraph (a) of this paragraph in cases where:

(i) the tanker is an existing oil tanker of 40,000 tons deadweight or above, as referred to in regulation 13C(1) of this Annex, engaged in specific trades, and the conditions specified in regulation 13C(2) are complied with; or

(ii) the tanker is engaged exclusively in one or more of the following categories of voyages:

(1) voyages within special areas; or

(2) voyages within 50 miles from the nearest land outside special areas where the tanker is engaged in:

(aa) trades between ports or terminals of a State Party to the present Convention; or

(bb) restricted voyages as determined by the Administration, and of 72 hours or less in duration;

provided that all of the following conditions are complied with:

(3) all oily mixtures are retained on board for subsequent discharge to reception facilities;

(4) for voyages specified in subparagraph (b)(ii)(2) of this paragraph, the Administration has determined that adequate reception facilities are available to receive such oily mixtures in those oil loading ports or terminals the tanker calls at;

Annex I

(5) the International Oil Pollution Prevention Certificate, when required, is endorsed to the effect that the ship is exclusively engaged in one or more of the categories of voyages specified in subparagraphs (b)(ii)(1) and (b)(ii)(2)(bb) of this paragraph; and

(6) the quantity, time, and port of discharge are recorded in the Oil Record Book.

SEE INTERPRETATION 6.4

(6) Where in the view of the Organization equipment required by regulation 9(1)(a)(vi) of this Annex and specified in subparagraph (3)(a) of this regulation is not obtainable for the monitoring of discharge of light refined products (white oils), the Administration may waive compliance with such requirement, provided that discharge shall be permitted only in compliance with procedures established by the Organization which shall satisfy the conditions of regulation 9(1)(a) of this Annex except the obligation to have an oil discharge monitoring and control system in operation. The Organization shall review the availability of equipment at intervals not exceeding twelve months.

(7) The requirements of paragraphs (1), (2) and (3) of this regulation shall not apply to oil tankers carrying asphalt or other products subject to the provisions of this Annex, which through their physical properties inhibit effective product/water separation and monitoring, for which the control of discharge under regulation 9 of this Annex shall be effected by the retention of residues on board with discharge of all contaminated washings to reception facilities.

SEE INTERPRETATION 6.5

Regulation 16

Oil discharge monitoring and control system and oil filtering equipment

(1) Any ship of 400 tons gross tonnage and above but less than 10,000 tons gross tonnage shall be fitted with oil filtering equipment complying with paragraph (4) this regulation. Any such ship which carries large quantities of oil fuel shall comply with paragraph (2) of this regulation or paragraph (1) of regulation 14.

SEE INTERPRETATIONS 7.1 AND 7.2

(2) Any ship of 10,000 tons gross tonnage and above shall be provided with oil filtering equipment, and with arrangements for an alarm and for automatically stopping any discharge of oily mixture when the oil content in the effluent exceeds 15 parts per million.

SEE INTERPRETATION 7.2

(3) (a) The Administration may waive the requirements of paragraphs (1) and (2) of this regulation for any ship engaged exclusively on voyages within special areas provided that all of the following conditions are complied with:

(i) the ship is fitted with a holding tank having a volume adequate, to the satisfaction of the Administration, for the total retention on board of the oily bilge water;

(ii) all oily bilge water is retained on board for subsequent discharge to reception facilities;

(iii) the Administration has determined that adequate reception facilities are available to receive such oily bilge water in a sufficient number of ports or terminals the ship calls at;

(iv) the International Oil Pollution Prevention Certificate, when required, is endorsed to the effect that the ship is exclusively engaged on the voyages within special areas; and

(v) the quantity, time, and port of the discharge are recorded in the Oil Record Book.

SEE INTERPRETATIONS 6.4 AND 7.3

(b) The Administration shall ensure that ships of less than 400 tons gross tonnage are equipped, as far as practicable, to retain on board oil or oily mixtures or discharge them in accordance with the requirements of regulation 9(1)(b) of this Annex.

(4) Oil filtering equipment referred to in paragraph (1) of this regulation shall be of a design approved by the Administration and shall be such as will ensure that any oily mixture discharged into the sea after passing through the system has an oil content not exceeding 15 parts per million. In considering the design of such equipment, the Administration shall have regard to the specification recommended by the Organization.*

* Refer to the Guidelines and specifications for pollution prevention equipment for machinery space bilges of ships adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33); see IMO sales publication IMO-646E.

(5) Oil filtering equipment referred to in paragraph (2) of this regulation shall be of a design approved by the Administration and shall be such as will ensure that any oily mixture discharged into the sea after passing through the system or systems has an oil content not exceeding 15 parts per million. It shall be provided with alarm arrangements to indicate when this level cannot be maintained. The system shall also be provided with arrangements such as will ensure that any discharge of oily mixtures is automatically stopped when the oil content of the effluent exceeds 15 parts per million. In considering the design of such equipment and arrangements, the Administration shall have regard to the specification recommended by the Organization.*

(6) For ships delivered before 6 July 1993 the requirements of this regulation shall apply by 6 July 1998, provided that these ships can operate with oily-water separating equipment (100 ppm equipment).

SEE INTERPRETATION 7.4

Regulation 17

Tanks for oil residues (sludge)

(1) Every ship of 400 tons gross tonnage and above shall be provided with a tank or tanks of adequate capacity, having regard to the type of machinery and length of voyage, to receive the oil residues (sludge) which cannot be dealt with otherwise in accordance with the requirements of this Annex, such as those resulting from the purification of fuel and lubricating oils and oil leakages in the machinery spaces.

SEE INTERPRETATION 8.1

(2) In new ships, such tanks shall be designed and constructed so as to facilitate their cleaning and the discharge of residues to reception facilities. Existing ships shall comply with this requirement as far as is reasonable and practicable.

SEE INTERPRETATION 8.2

(3) Piping to and from sludge tanks shall have no direct connection overboard, other than the standard discharge connection referred to in regulation 19.

SEE INTERPRETATION 8.3

* Refer to the Guidelines and specifications for pollution prevention equipment for machinery space bilges of ships adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33); see IMO sales publication IMO-646E.

Regulation 18

Pumping, piping and discharge arrangements of oil tankers

(1) In every oil tanker, a discharge manifold for connection to reception facilities for the discharge of dirty ballast water or oil contaminated water shall be located on the open deck on both sides of the ship.

(2) In every oil tanker, pipelines for the discharge to the sea of ballast water or oil contaminated water from cargo tank areas which may be permitted under regulation 9 or regulation 10 of this Annex shall be led to the open deck or to the ship's side above the waterline in the deepest ballast condition. Different piping arrangements to permit operation in the manner permitted in subparagraphs (6)(a) to (e) of this regulation may be accepted.

SEE INTERPRETATION 9.1

(3) In new oil tankers means shall be provided for stopping the discharge into the sea of ballast water or oil contaminated water from cargo tank areas, other than those discharges below the waterline permitted under paragraph (6) of this regulation, from a position on the upper deck or above located so that the manifold in use referred to in paragraph (1) of this regulation and the discharge to the sea from the pipelines referred to in paragraph (2) of this regulation may be visually observed. Means for stopping the discharge need not be provided at the observation position if a positive communication system such as a telephone or radio system is provided between the observation position and the discharge control position.

(4) Every new oil tanker required to be provided with segregated ballast tanks or fitted with a crude oil washing system shall comply with the following requirements:

(a) it shall be equipped with oil piping so designed and installed that oil retention in the lines is minimized; and

(b) means shall be provided to drain all cargo pumps and all oil lines at the completion of cargo discharge, where necessary by connection to a stripping device. The line and pump drainings shall be capable of being discharged both ashore and to a cargo tank or a slop tank. For discharge ashore a special small diameter line shall be provided and shall be connected outboard of the ship's manifold valves.

SEE INTERPRETATIONS 9.2 AND 9.3

(5) Every existing crude oil tanker required to be provided with segregated ballast tanks, or to be fitted with a crude oil washing system, or to operate with dedicated clean ballast tanks, shall comply with the provisions of paragraph (4)(b) of this regulation.

(6) On every oil tanker the discharge of ballast water or oil contaminated water from cargo tank areas shall take place above the waterline, except as follows:

(a) Segregated ballast and clean ballast may be discharged below the waterline:

(i) in ports or at offshore terminals, or

(ii) at sea by gravity,

provided that the surface of the ballast water has been examined immediately before the discharge to ensure that no contamination with oil has taken place.

(b) Existing oil tankers which, without modification, are not capable of discharging segregated ballast above the waterline may discharge segregated ballast below the waterline at sea, provided that the surface of the ballast water has been examined immediately before the discharge to ensure that no contamination with oil has taken place.

(c) Existing oil tankers operating with dedicated clean ballast tanks, which without modification are not capable of discharging ballast water from dedicated clean ballast tanks above the waterline, may discharge this ballast below the waterline provided that the discharge of the ballast water is supervised in accordance with regulation 13A(3) of this Annex.

(d) On every oil tanker at sea, dirty ballast water or oil contaminated water from tanks in the cargo area, other than slop tanks, may be discharged by gravity below the waterline, provided that sufficient time has elapsed in order to allow oil/water separation to have taken place and the ballast water has been examined immediately before the discharge with an oil/water interface detector referred to in regulation 15(3)(b) of this Annex, in order to ensure that the height of the interface is such that the discharge does not involve any increased risk of harm to the marine environment.

(e) On existing oil tankers at sea, dirty ballast water or oil contaminated water from cargo tank areas may be discharged below the waterline, subsequent to or in lieu of the discharge by the method referred to in subparagraph (d) of this paragraph, provided that:

(i) a part of the flow of such water is led through permanent piping to a readily accessible location on the upper deck or above where it may be visually observed during the discharge operation; and

(ii) such part flow arrangements comply with the requirements established by the Administration, which shall contain at least all the provisions of the Specifications for the Design, Installation and Operation of a Part Flow System for Control of Overboard Discharges adopted by the Organization.*

SEE INTERPRETATION 9.4

Regulation 19
Standard discharge connection

To enable pipes of reception facilities to be connected with the ship's discharge pipeline for residues from machinery bilges, both lines shall be fitted with a standard discharge connection in accordance with the following table:

Standard dimensions of flanges for discharge connections

Description	Dimension
Outside diameter	215 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	183 mm
Slots in flange	6 holes 22 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 22 mm
Flange thickness	20 mm
Bolts and nuts: quantity, diameter	6, each of 20 mm in diameter and of suitable length
The flange is designed to accept pipes up to a maximum internal diameter of 125 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a gasket of oil-proof material, shall be suitable for a service pressure of 6 kg/cm^2.	

* See appendix 5 to Unified Interpretations for Annex I.

Regulation 20
Oil Record Book

(1) Every oil tanker of 150 tons gross tonnage and above and every ship of 400 tons gross tonnage and above other than an oil tanker shall be provided with an Oil Record Book Part I (Machinery Space Operations). Every oil tanker of 150 tons gross tonnage and above shall also be provided with an Oil Record Book Part II (Cargo/Ballast Operations). The Oil Record Book(s), whether as a part of the ship's official log-book or otherwise, shall be in the form(s) specified in appendix III to this Annex.

(2) The Oil Record Book shall be completed on each occasion, on a tank-to-tank basis if appropriate, whenever any of the following operations take place in the ship:

(a) for machinery space operations (all ships):

(i) ballasting or cleaning of oil fuel tanks;

(ii) discharge of dirty ballast or cleaning water from tanks referred to under (i) of the subparagraph;

(iii) disposal of oily residues (sludge);

(iv) discharge overboard or disposal otherwise of bilge water which has accumulated in machinery spaces;

(b) for cargo/ballast operations (oil tankers):

(i) loading of oil cargo;

(ii) internal transfer of oil cargo during voyage;

(iii) unloading of oil cargo;

(iv) ballasting of cargo tanks and dedicated clean ballast tanks;

(v) cleaning of cargo tanks including crude oil washing;

(vi) discharge of ballast except from segregated ballast tanks;

(vii) discharge of water from slop tanks;

(viii) closing of all applicable valves or similar devices after slop tank discharge operations;

(ix) closing of valves necessary for isolation of dedicated clean ballast tanks from cargo and stripping lines after slop tank discharge operations;

(x) disposal of residues.

(3) In the event of such discharge of oil or oily mixture as is referred to in regulation 11 of this Annex or in the event of accidental or other exceptional discharge of oil not excepted by that regulation, a statement shall be made in the Oil Record Book of the circumstances of, and the reasons for, the discharge.

(4) Each operation described in paragraph (2) of this regulation shall be fully recorded without delay in the Oil Record Book so that all entries in the book appropriate to that operation are completed. Each completed operation shall be signed by the officer or officers in charge of the operations concerned and each completed page shall be signed by the master of ship. The entries in the Oil Record Book shall be in an official language of the State whose flag the ship is entitled to fly, and, for ships holding an International Oil Pollution Prevention Certificate, in English or French. The entries in an official national language of the State whose flag the ship is entitled to fly shall prevail in case of a dispute or discrepancy.

(5) The Oil Record Book shall be kept in such a place as to be readily available for inspection at all reasonable times and, except in the case of unmanned ships under tow, shall be kept on board the ship. It shall be preserved for a period of three years after the last entry has been made.

(6) The competent authority of the Government of a Party to the Convention may inspect the Oil Record Book on board any ship to which this Annex applies while the ship is in its port or offshore terminals and may make a copy of any entry in that book and may require the master of the ship to certify that the copy is a true copy of such entry. Any copy so made which has been certified by the master of the ship as a true copy of an entry in the ship's Oil Record Book shall be made admissible in any judicial proceedings as evidence of the facts stated in the entry. The inspection of an Oil Record Book and the taking of a certified copy by the competent authority under this paragraph shall be performed as expeditiously as possible without causing the ship to be unduly delayed.

(7) For oil tankers of less than 150 tons gross tonnage operating in accordance with regulation 15(4) of this Annex an appropriate Oil Record Book should be developed by the Administration.

Regulation 21

Special requirements for drilling rigs and other platforms

SEE INTERPRETATION 10

Fixed and floating drilling rigs when engaged in the exploration, exploitation and associated offshore processing of sea-bed mineral resources and other platforms shall comply with the requirements of this Annex applicable to ships of 400 tons gross tonnage and above other than oil tankers, except that:

(a) they shall be equipped as far as practicable with the installations required in regulations 16 and 17 of this Annex;

(b) they shall keep a record of all operations involving oil or oily mixture discharges, in a form approved by the Administration; and

(c) subject to the provisions of regulation 11 of this Annex, the discharge into the sea of oil or oily mixture shall be prohibited except when the oil content of the discharge without dilution does not exceed 15 parts per million.

Chapter III – Requirements for minimizing oil pollution from oil tankers due to side and bottom damages

Regulation 22
Damage assumptions

(1) For the purpose of calculating hypothetical oil outflow from oil tankers, three dimensions of the extent of damage of a parallelepiped on the side and bottom of the ship are assumed as follows. In the case of bottom damages two conditions are set forth to be applied individually to the stated portions of the oil tanker.

(a) Side damage

(i) Longitudinal extent (l_c):	$\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less
(ii) Transverse extent (t_c) (inboard from the ship's side at right angles to the centreline at the level corresponding to the assigned summer freeboard):	$\frac{B}{5}$ or 11.5 metres, whichever is less
(iii) Vertical extent (v_c):	From the baseline upwards without limit

(b) Bottom damage

	For 0.3L from the forward perpendicular of the ship	*Any other part of the ship*
(i) Longitudinal extent (l_s):	$\frac{L}{10}$	$\frac{L}{10}$ or 5 metres, whichever is less
(ii) Transverse extent (t_s):	$\frac{B}{6}$ or 10 metres, whichever is less, but not less than 5 metres	5 metres
(iii) Vertical extent from the baseline (v_s):	$\frac{B}{15}$ or 6 metres, whichever is less	

SEE INTERPRETATION 11.1

(2) Wherever the symbols given in this regulation appear in this chapter, they have the meaning as defined in this regulation.

Regulation 23
Hypothetical outflow of oil

SEE INTERPRETATION 11.2

(1) The hypothetical outflow of oil in the case of side damage (O_c) and bottom damage (O_s) shall be calculated by the following formulae with respect to compartments breached by damage to all conceivable locations along the length of the ship to the extent as defined in regulation 22 of this Annex.

(a) For side damages:

$$O_c = \Sigma W_i + \Sigma K_i C_i \qquad \text{(I)}$$

(b) For bottom damages:

$$O_s = \tfrac{1}{3}(\Sigma Z_i W_i + \Sigma Z_i C_i) \qquad \text{(II)}$$

where: W_i = volume of a wing tank in cubic metres assumed to be breached by the damage as specified in regulation 22 of this Annex; W_i for a segregated ballast tank may be taken equal to zero.

C_i = volume of a centre tank in cubic metres assumed to be breached by the damage as specified in regulation 22 of this Annex; C_i for a segregated ballast tank may be taken equal to zero.

K_i = $1 - \frac{b_i}{t_c}$; when b_i is equal to or greater than t_c, K_i shall be taken equal to zero.

Z_i = $1 - \frac{h_i}{v_s}$; when h_i is equal to or greater than v_s, Z_i shall be taken equal to zero.

b_i = width of wing tank in metres under consideration measured inboard from the ship's side at right angles to the centreline at the level corresponding to the assigned summer freeboard.

h_i = minimum depth of the double bottom in metres under consideration; where no double bottom is fitted h_i shall be taken equal to zero.

Whenever symbols given in this paragraph appear in this chapter, they have the meaning as defined in this regulation.

SEE INTERPRETATION 11.3

(2) If a void space or segregated ballast tank of a length less than l_c as defined in regulation 22 of this Annex is located between wing oil tanks, O_c in formula (I) may be calculated on the basis of volume W_i being the actual volume of one such tank (where they are of equal capacity) or the smaller of the two tanks (if they differ in capacity) adjacent to such space, multiplied by S_i as defined below and taking for all other wing tanks involved in such a collision the value of the actual full volume.

$$S_i = 1 - \frac{l_i}{l_c}$$

where l_i = length in metres of void space or segregated ballast tank under consideration.

(3) (a) Credit shall only be given in respect of double bottom tanks which are either empty or carrying clean water when cargo is carried in the tanks above.

(b) Where the double bottom does not extend for the full length and width of the tank involved, the double bottom is considered non-existent and the volume of the tanks above the area of the bottom damage shall be included in formula (II) even if the tank is not considered breached because of the installation of such a partial double bottom.

(c) Suction wells may be neglected in the determination of the value h_i provided such wells are not excessive in area and extend below the tank for a minimum distance and in no case more than half the height of the double bottom. If the depth of such a well exceeds half the height of the double bottom, h_i shall be taken equal to the double bottom height minus the well height.

Piping serving such wells if installed within the double bottom shall be fitted with valves or other closing arrangements located at the point of connection to the tank served to prevent oil outflow in the event of damage to the piping. Such piping shall be installed as high from the bottom shell as possible. These valves shall be kept closed at sea at any time when the tank contains oil cargo, except that they may be opened only for cargo transfer needed for the purpose of trimming of the ship.

(4) In the case where bottom damage simultaneously involves four centre tanks, the value of O_s may be calculated according to the formula:

$$O_s = \tfrac{1}{4}(\Sigma Z_i W_i + \Sigma Z_i C_i) \qquad \text{(III)}$$

(5) An Administration may credit as reducing oil outflow in case of bottom damage, an installed cargo transfer system having an emergency high suction in each cargo oil tank, capable of transferring from a breached tank or tanks to segregated ballast tanks or to available cargo tankage if it can be assured that such tanks will have sufficient ullage. Credit for such a system would be governed by ability to transfer in two hours of operation oil equal to one half of the largest of the breached tanks involved and by availability of equivalent receiving capacity in ballast or cargo tanks. The credit shall be confined to permitting calculation of O_s according to formula (III). The pipes for such suctions shall be installed at least at a height not less than the vertical extent of the bottom damage v_s. The Administration shall supply the Organization with the information concerning the arrangements accepted by it, for circulation to other Parties to the Convention.

Regulation 24
Limitation of size and arrangement of cargo tanks

SEE INTERPRETATION 1.2

(1) Every new oil tanker shall comply with the provisions of this regulation. Every existing oil tanker shall be required, within two years after the date of entry into force of the present Convention, to comply with the provisions of this regulation if such a tanker falls into either of the following categories:

(a) a tanker, the delivery of which is after 1 January 1977; or

(b) a tanker to which both the following conditions apply:

(i) delivery is not later than 1 January 1977; and

(ii) the building contract is placed after 1 January 1974, or in cases where no building contract has previously been placed, the keel is laid or the tanker is at a similar stage of construction after 30 June 1974.

(2) Cargo tanks of oil tankers shall be of such size and arrangements that the hypothetical outflow O_c or O_s calculated in accordance with the provisions of regulation 23 of this Annex anywhere in the length of the ship does not exceed 30,000 m^3 or 400 $\sqrt[3]{DW}$, whichever is the greater, but subject to a maximum of 40,000 m^3.

(3) The volume of any one wing cargo oil tank of an oil tanker shall not exceed 75% of the limits of the hypothetical oil outflow referred to in paragraph (2) of this regulation. The volume of any one centre cargo oil tank shall not exceed 50,000 m^3. However, in segregated ballast oil tankers as defined in regulation 13 of this Annex, the permitted

volume of a wing cargo oil tank situated between two segregated ballast tanks, each exceeding l_c in length, may be increased to the maximum limit of hypothetical oil outflow provided that the width of the wing tanks exceeds t_c.

(4) The length of each cargo tank shall not exceed 10 m or one of the following values, whichever is the greater:

(a) where no longitudinal bulkhead is provided inside the cargo tanks:

$$(0.5\frac{b_i}{B} + 0.1)L$$

but not to exceed $0.2L$

(b) where a centreline longitudinal bulkhead is provided inside the cargo tanks:

$$(0.25\frac{b_i}{B} + 0.15)L$$

(c) where two or more longitudinal bulkheads are provided inside the cargo tanks:

(i) for wing cargo tanks: $0.2L$

(ii) for centre cargo tanks:

(1) if $\frac{b_i}{B}$ is equal to or greater than one fifth: $0.2L$

(2) if $\frac{b_i}{B}$ is less than one fifth:

– where no centreline longitudinal bulkhead is provided:

$$(0.5\frac{b_i}{B} + 0.1)L$$

– where a centreline longitudinal bulkhead is provided:

$$(0.25\frac{b_i}{B} + 0.15)L$$

(d) b_i is the minimum distance from the ship's side to the outer longitudinal bulkhead of the tank in question measured inboard at right angles to the centreline at the level corresponding to the assigned summer freeboard.

(5) In order not to exceed the volume limits established by paragraphs (2), (3) and (4) of this regulation and irrespective of the accepted type of cargo transfer system installed, when such system interconnects two or more cargo tanks, valves or other similar closing devices shall be provided for separating the tanks from each other. These valves or devices shall be closed when the tanker is at sea.

(6) Lines of piping which run through cargo tanks in a position less than t_c from the ship's side or less than v_c from the ship's bottom shall be fitted with valves or similar closing devices at the point at which they open into any cargo tank. These valves shall be kept closed at sea at any time when the tanks contain cargo oil, except that they may be opened only for cargo transfer needed for the purpose of trimming of the ship.

Regulation 25
Subdivision and stability

(1) Every new oil tanker shall comply with the subdivision and damage stability criteria as specified in paragraph (3) of this regulation, after the assumed side or bottom damage as specified in paragraph (2) of this regulation, for any operating draught reflecting actual partial or full load conditions consistent with trim and strength of the ship as well as specific gravities of the cargo. Such damage shall be applied to all conceivable locations along the length of the ship as follows:

(a) in tankers of more than 225 m in length, anywhere in the ship's length;

(b) in tankers of more than 150 m, but not exceeding 225 m in length, anywhere in the ship's length except involving either after or forward bulkhead bounding the machinery space located aft. The machinery space shall be treated as a single floodable compartment; and

(c) in tankers not exceeding 150 m in length, anywhere in the ship's length between adjacent transverse bulkheads with the exception of the machinery space. For tankers of 100 m or less in length where all requirements of paragraph (3) of this regulation cannot be fulfilled without materially impairing the operational qualities of the ship, Administrations may allow relaxations from these requirements.

Ballast conditions where the tanker is not carrying oil in cargo tanks, excluding any oil residues, shall not be considered.

SEE INTERPRETATION 11.4

(2) The following provisions regarding the extent and the character of the assumed damage shall apply:

(a) Side damage

(i) Longitudinal extent: $\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less

(ii)	Transverse extent (inboard from the ship's side at right angles to the centreline at the level of the summer load line):		$\frac{B}{5}$ or 11.5 metres, whichever is less
(iii)	Vertical extent:		From the moulded line of the bottom shell plating at centre-line, upwards without limit

(b) Bottom damage

		For 0.3L from the forward perpendicular of the ship	*Any other part of the ship*
(i)	Longitudinal extent:	$\frac{1}{3}L^{\frac{2}{3}}$ or 14.5 metres, whichever is less	$\frac{1}{3}L^{\frac{2}{3}}$ or 5 metres, whichever is less
(ii)	Transverse extent:	$\frac{B}{6}$ or 10 metres, whichever is less	$\frac{B}{6}$ or 5 metres, whichever is less
(iii)	Vertical extent:	$\frac{B}{15}$ or 6 metres, whichever is less, measured from the moulded line of the bottom shell plating at centreline	$\frac{B}{15}$ or 6 metres, whichever is less, measured from the moulded line of the bottom shell plating at centreline

(c) If any damage of a lesser extent than the maximum extent of damage specified in subparagraphs (a) and (b) of this paragraph would result in a more severe condition, such damage shall be considered.

(d) Where the damage involving transverse bulkheads is envisaged as specified in subparagraphs (1)(a) and (b) of this regulation, transverse watertight bulkheads shall be spaced at least at a distance equal to the longitudinal extent of assumed damage specified in subparagraph (a) of this paragraph in order to be considered effective. Where transverse bulkheads are spaced at a lesser distance, one or more of these bulkheads within such extent of damage shall be assumed as non-existent for the purpose of determining flooded compartments.

(e) Where the damage between adjacent transverse watertight bulkheads is envisaged as specified in subparagraph (1)(c) of this regulation, no main transverse bulkhead or a transverse bulkhead bounding side tanks or double bottom tanks shall be assumed damaged, unless:

(i) the spacing of the adjacent bulkheads is less than the longitudinal extent of assumed damage specified in subparagraph (a) of this paragraph; or

(ii) there is a step or recess in a transverse bulkhead of more than 3.05 m in length, located within the extent of penetration of assumed damage. The step formed by the after peak bulkhead and after peak tank top shall not be regarded as a step for the purpose of this regulation.

(f) If pipes, ducts or tunnels are situated within the assumed extent of damage, arrangements shall be made so that progressive flooding cannot thereby extend to compartments other than those assumed to be floodable for each case of damage.

SEE INTERPRETATION 11.5

(3) Oil tankers shall be regarded as complying with the damage stability criteria if the following requirements are met:

(a) The final waterline, taking into account sinkage, heel and trim, shall be below the lower edge of any opening through which progressive flooding may take place. Such openings shall include air-pipes and those which are closed by means of weathertight doors or hatch covers and may exclude those openings closed by means of watertight manhole covers and flush scuttles, small watertight cargo tank hatch covers which maintain the high integrity of the deck, remotely operated watertight sliding doors, and sidescuttles of the non-opening type.

(b) In the final stage of flooding, the angle of heel due to unsymmetrical flooding shall not exceed 25°, provided that this angle may be increased up to 30° if no deck edge immersion occurs.

(c) The stability in the final stage of flooding shall be investigated and may be regarded as sufficient if the righting lever curve has at least a range of 20° beyond the position of equilibrium in association with a maximum residual righting lever of at least 0.1 m within the 20° range; the area under the curve within this range shall not be less than 0.0175 metre radian. Unprotected openings shall not be immersed within this range unless the space concerned is assumed to be flooded. Within this range, the immersion of any of the openings listed in subparagraph (a) of this paragraph and other openings capable of being closed weathertight may be permitted.

(d) The Administration shall be satisfied that the stability is sufficient during intermediate stages of flooding.

(e) Equalization arrangements requiring mechanical aids such as valves or cross-levelling pipes, if fitted, shall not be considered for the purpose of reducing an angle of heel or attaining the minimum range of residual stability to meet the requirements of subparagraphs (a), (b) and (c) of this paragraph and sufficient residual stability shall be maintained during all stages where equalization is used. Spaces which are linked by ducts of a large cross-sectional area may be considered to be common.

(4) The requirements of paragraph (1) of this regulation shall be confirmed by calculations which take into consideration the design characteristics of the ship, the arrangements, configuration and contents of the damaged compartments; and the distribution, specific gravities and the free surface effect of liquids. The calculations shall be based on the following:

(a) Account shall be taken of any empty or partially filled tank, the specific gravity of cargoes carried, as well as any outflow of liquids from damaged compartments.

(b) The permeabilities assumed for spaces flooded as a result of damage shall be as follows:

Spaces	*Permeabilities*
Appropriated to stores	0.60
Occupied by accommodation	0.95
Occupied by machinery	0.85
Voids	0.95
Intended for consumable liquids	0 to 0.95*
Intended for other liquids	0 to 0.95*

(c) The buoyancy of any superstructure directly above the side damage shall be disregarded. The unflooded parts of superstructures beyond the extent of damage, however, may be taken into consideration provided that they are separated from the damaged space by watertight bulkheads and the requirements of

* The permeability of partially filled compartments shall be consistent with the amount of liquid carried in the compartment. Whenever damage penetrates a tank containing liquids, it shall be assumed that the contents are completely lost from that compartment and replaced by salt water up to the level of the final plane of equilibrium.

subparagraph (3)(a) of this regulation in respect of these intact spaces are complied with. Hinged watertight doors may be acceptable in watertight bulkheads in the superstructure.

(d) The free surface effect shall be calculated at an angle of heel of 5° for each individual compartment. The Administration may require or allow the free surface corrections to be calculated at an angle of heel greater than 5° for partially filled tanks.

(e) In calculating the effect of free surfaces of consumable liquids it shall be assumed that, for each type of liquid at least one transverse pair or a single centreline tank has a free surface and the tank or combination of tanks to be taken into account shall be those where the effect of free surfaces is the greatest.

(5) The master of every new oil tanker and the person in charge of a new non-self-propelled oil tanker to which this Annex applies shall be supplied in an approved form with:

(a) information relative to loading and distribution of cargo necessary to ensure compliance with the provisions of this regulation; and

(b) data on the ability of the ship to comply with damage stability criteria as determined by this regulation, including the effect of relaxations that may have been allowed under subparagraph (1)(c) of this regulation.

Regulation 25A
Intact stability

(1) This regulation shall apply to oil tankers of 5,000 tons deadweight and above:

(a) for which the building contract is placed on or after 1 February 1999; or

(b) in the absence of a building contract, the keels of which are laid or which are at a similar stage of construction on or after 1 August 1999; or

(c) the delivery of which is on or after 1 February 2002; or

(d) which have undergone a major conversion:

(i) for which the contract is placed after 1 February 1999; or

(ii) in the absence of a contract, the construction work of which is begun after 1 August 1999; or

(iii) which is completed after 1 February 2002.

(2) Every oil tanker shall comply with the intact stability criteria specified in subparagraphs (a) and (b) of this paragraph, as appropriate, for any

operating draught under the worst possible conditions of cargo and ballast loading, consistent with good operational practice, including intermediate stages of liquid transfer operations. Under all conditions the ballast tanks shall be assumed slack.

SEE INTERPRETATION 11A.1

(a) In port, the initial metacentric height GM_o, corrected for free surface measured at 0° heel, shall be not less than 0.15 m;

(b) At sea, the following criteria shall be applicable:

(i) the area under the righting lever curve (GZ curve) shall be not less than 0.055 m·rad up to $\theta = 30°$ angle of heel and not less than 0.09 m·rad up to $\theta = 40°$ or other angle of flooding θ_f* if this angle is less than 40°. Additionally, the area under the righting lever curve (GZ curve) between the angles of heel of 30° and 40° or between 30° and θ_f, if this angle is less than 40°, shall be not less than 0.03 m·rad;

(ii) the righting lever GZ shall be at least 0.20 m at an angle of heel equal to or greater than 30°;

(iii) the maximum righting arm shall occur at an angle of heel preferably exceeding 30° but not less than 25°; and

(iv) the initial metacentric height GM_o, corrected for free surface measured at 0° heel, shall be not less than 0.15 m.

(3) The requirements of paragraph (2) shall be met through design measures. For combination carriers simple supplementary operational procedures may be allowed.

(4) Simple supplementary operational procedures for liquid transfer operations referred to in paragraph (3) shall mean written procedures made available to the master which:

(i) are approved by the Administration;

(ii) indicate those cargo and ballast tanks which may, under any specific condition of liquid transfer and possible range of cargo densities, be slack and still allow the stability criteria to be met. The slack tanks may vary during the liquid transfer operations and be of any combination provided they satisfy the criteria;

(iii) will be readily understandable to the officer-in-charge of liquid transfer operations;

* θ_f is the angle of heel at which the openings in the hull, superstructures or deck-houses, which cannot be closed weathertight, immerse. In applying this criterion, small openings through which progressive flooding cannot take place need not be considered as open.

(iv) provide for planned sequences of cargo/ballast transfer operations;

(v) allow comparisons of attained and required stability using stability performance criteria in graphical or tabular form;

(vi) require no extensive mathematical calculations by the officer-in-charge;

(vii) provide for corrective actions to be taken by the officer-in-charge in case of departure from recommended values and in case of emergency situations; and

(viii) are prominently displayed in the approved trim and stability booklet and at the cargo/ballast transfer control station and in any computer software by which stability calculations are performed.

Chapter IV – Prevention of pollution arising from an oil pollution incident

Regulation 26
Shipboard oil pollution emergency plan

(1) Every oil tanker of 150 tons gross tonnage and above and every ship other than an oil tanker of 400 tons gross tonnage and above shall carry on board a shipboard oil pollution emergency plan approved by the Administration. In the case of ships built before 4 April 1993 this requirement shall apply 24 months after that date.

SEE INTERPRETATIONS 12.1 AND 12.2

(2) Such a plan shall be in accordance with guidelines* developed by the Organization and written in the working language of the master and officers. The plan shall consist at least of:

(a) the procedure to be followed by the master or other persons having charge of the ship to report an oil pollution incident, as required in article 8 and Protocol I of the present Convention, based on the guidelines developed by the Organization;†

(b) the list of authorities or persons to be contacted in the event of an oil pollution incident;

(c) a detailed description of the action to be taken immediately by persons on board to reduce or control the discharge of oil following the incident; and

(d) the procedures and point of contact on the ship for co-ordinating shipboard action with national and local authorities in combating the pollution.

* Refer to the Guidelines for the development of shipboard oil pollution emergency plans adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.54(32) and amended by MEPC.86(44) or the Guidelines for the development of shipboard marine pollution emergency plans for oil and/or noxious liquid substances, adopted by resolution MEPC.85(44); see IMO sales publication IMO-586E.

† Refer to the General principles for ship reporting systems and ship reporting requirements, including guidelines for reporting incidents involving dangerous goods, harmful substances and/or marine pollutants adopted by the Organization by resolution A.851(20); see IMO sales publication IMO-516E.

(3) In the case of ships to which regulation 16 of Annex II of the Convention also apply, such a plan may be combined with the shipboard marine pollution emergency plan for noxious liquid substances required under regulation 16 of Annex II of the Convention. In this case, the title of such a plan shall be "Shipboard marine pollution emergency plan".

Appendices to Annex I

Appendix I

List of oils*

Asphalt solutions
Blending stocks
Roofers flux
Straight run residue

Oils
Clarified
Crude oil
Mixtures containing crude oil
Diesel oil
Fuel oil no. 4
Fuel oil no. 5
Fuel oil no. 6
Residual fuel oil
Road oil
Transformer oil
Aromatic oil (excluding vegetable oil)
Lubricating oils and blending stocks
Mineral oil
Motor oil
Penetrating oil
Spindle oil
Turbine oil

Distillates
Straight run
Flashed feed stocks

Gas oil
Cracked

Gasoline blending stocks
Alkylates – fuel
Reformates
Polymer – fuel

Gasolines
Casinghead (natural)
Automotive
Aviation
Straight run
Fuel oil no. 1 (kerosene)
Fuel oil no. 1-D
Fuel oil no. 2
Fuel oil no. 2-D

Jet fuels
JP-1 (kerosene)
JP-3
JP-4
JP-5 (kerosene, heavy)
Turbo fuel
Kerosene
Mineral spirit

Naphtha
Solvent
Petroleum
Heartcut distillate oil

* This list of oils shall not necessarily be considered as comprehensive.

Appendix II

Form of IOPP Certificate and Supplements

INTERNATIONAL OIL POLLUTION PREVENTION CERTIFICATE

(*Note:* This Certificate shall be supplemented by a Record of Construction and Equipment)

Issued under the provisions of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto, and as amended by resolution MEPC.39(29), (hereinafter referred to as "the Convention") under the authority of the Government of:

....

(full designation of the country)

by...

(full designation of the competent person or organization authorized under the provisions of the Convention)

Particulars of ship*

Name of ship ....

Distinctive number or letters ....

Port of registry ....

Gross tonnage ....

Deadweight of ship (metric tons)† ....

IMO Number‡...

* Alternatively, the particulars of the ship may be placed horizontally in boxes.

† For oil tankers.

‡ In accordance with resolution A.600(15), IMO Ship Identification Number Scheme, this information may be included voluntarily.

Type of ship:*

Oil tanker

Ship other than an oil tanker with cargo tanks coming under regulation 2(2) of Annex I of the Convention

Ship other than any of the above

THIS IS TO CERTIFY:

1. That the ship has been surveyed in accordance with regulation 4 of Annex I of the Convention.
2. That the survey shows that the structure, equipment, systems, fittings, arrangement and material of the ship and the condition thereof are in all respects satisfactory and that the ship complies with the applicable requirements of Annex I of the Convention.

This certificate is valid until . . . . †
subject to surveys in accordance with regulation 4 of Annex I of the Convention.

Issued at. . . . .
(Place of issue of certificate)

. . . . *(Date of issue)*

. . . . *(Signature of authorized official issuing the certificate)*

(Seal or stamp of the authority, as appropriate)

* Delete as appropriate.

† Insert the date of expiry as specified by the Administration in accordance with regulation 8(1) of Annex I of the Convention. The day and the month of this date correspond to the anniversary date as defined in regulation 1(31) of Annex I of the Convention, unless amended in accordance with regulation 8(8) of Annex I of the Convention.

ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEYS

THIS IS TO CERTIFY that at a survey required by regulation 4 of Annex I of the Convention the ship was found to comply with the relevant provisions of the Convention:

Annual survey: Signed . . . .
(Signature of authorized official)

Place . . . .

Date . . . .

(Seal or stamp of the authority, as appropriate)

Annual/Intermediate* survey: Signed . . . .
(Signature of authorized official)

Place . . . .

Date . . . .

(Seal or stamp of the authority, as appropriate)

Annual/Intermediate* survey: Signed . . . .
(Signature of authorized official)

Place . . . .

Date . . . .

(Seal or stamp of the authority, as appropriate)

Annual survey: Signed . . . .
(Signature of authorized official)

Place . . . .

Date . . . .

(Seal or stamp of the authority, as appropriate)

* Delete as appropriate.

ANNUAL/INTERMEDIATE SURVEY IN ACCORDANCE WITH REGULATION 8(8)(c)

THIS IS TO CERTIFY that, at an annual/intermediate* survey in accordance with regulation 8(8)(c) of Annex I of the Convention, the ship was found to comply with the relevant provisions of the Convention:

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT TO EXTEND THE CERTIFICATE IF VALID FOR LESS THAN 5 YEARS WHERE REGULATION 8(3) APPLIES

The ship complies with the relevant provisions of the Convention, and this Certificate shall, in accordance with regulation 8(3) of Annex I of the Convention, be accepted as valid until ....

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT WHERE THE RENEWAL SURVEY HAS BEEN COMPLETED AND REGULATION 8(4) APPLIES

The ship complies with the relevant provisions of the Convention, and this Certificate shall, in accordance with regulation 8(4) of Annex I of the Convention, be accepted as valid until ....

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

* Delete as appropriate.

ENDORSEMENT TO EXTEND THE VALIDITY OF THE CERTIFICATE UNTIL REACHING THE PORT OF SURVEY OR FOR A PERIOD OF GRACE WHERE REGULATION 8(5) OR 8(6) APPLIES

This Certificate shall, in accordance with regulation 8(5) or 8(6)* of Annex I of the Convention, be accepted as valid until ....

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT FOR ADVANCEMENT OF ANNIVERSARY DATE WHERE REGULATION 8(8) APPLIES

In accordance with regulation 8(8) of Annex I of the Convention, the new anniversary date is ....

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

In accordance with regulation 8(8) of Annex I of the Convention, the new anniversary date is ....

Signed ....
(Signature of authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

* Delete as appropriate.

Appendix

FORM A
(Revised 1999)

Supplement to the International Oil Pollution Prevention Certificate (IOPP Certificate)

RECORD OF CONSTRUCTION AND EQUIPMENT FOR SHIPS OTHER THAN OIL TANKERS

in respect of the provisions of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

Notes:

1. This form is to be used for the third type of ships as categorized in the IOPP Certificate, i.e. "ships other than any of the above". For oil tankers and ships other than oil tankers with cargo tanks coming under regulation 2(2) of Annex I of the Convention, Form B shall be used.
2. This Record shall be permanently attached to the IOPP Certificate. The IOPP Certificate shall be available on board the ship at all times.
3. If the language of the original Record is neither English nor French, the text shall include a translation into one of these languages.
4. Entries in boxes shall be made by inserting either a cross (x) for the answers "yes" and "applicable" or a dash (–) for the answers "no" and "not applicable" as appropriate.
5. Regulations mentioned in this Record refer to regulations of Annex I of the Convention and resolutions refer to those adopted by the International Maritime Organization.

1 Particulars of ship

1.1 Name of ship ....

1.2 Distinctive number or letters ....

1.3 Port of registry....................................

1.4 Gross tonnage....................................

1.5 Date of build:

1.5.1 Date of building contract ....

1.5.2 Date on which keel was laid or ship was at a similar stage of construction ....

1.5.3 Date of delivery ....

1.6 Major conversion (if applicable):

1.6.1 Date of conversion contract ....

1.6.2 Date on which conversion was commenced ....

1.6.3 Date of completion of conversion...................

1.7 Status of ship:

1.7.1 New ship in accordance with regulation 1(6) ☐

1.7.2 Existing ship in accordance with regulation 1(7) ☐

1.7.3 The ship has been accepted by the Administration as an "existing ship" under regulation 1(7) due to unforeseen delay in delivery ☐

2 Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks

(regulations 10 and 16)

2.1 Carriage of ballast water in oil fuel tanks:

2.1.1 The ship may under normal conditions carry ballast water in oil fuel tanks ☐

2.2 Type of oil filtering equipment fitted:

2.2.1 Oil filtering (15 ppm) equipment (regulation 16(4)) ☐

2.2.2 Oil filtering (15 ppm) equipment with alarm and automatic stopping device (regulation 16(5)) ☐

2.3 The ship is allowed to operate with the existing equipment until 6 July 1998 (regulation 16(6)) and is fitted with:

2.3.1 Oil filtering (15 ppm) equipment without alarm ☐

2.3.2 Oil filtering (15 ppm) equipment with alarm and manual stopping device ☐

2.4 Approval standards:*

2.4.1 The separating/filtering equipment:

.1 has been approved in accordance with resolution A.393(X); ☐

.2 has been approved in accordance with resolution MEPC.60(33); ☐

.3 has been approved in accordance with resolution A.233(VII); ☐

.4 has been approved in accordance with national standards not based upon resolution A.393(X) or A.233(VII); ☐

.5 has not been approved. ☐

2.4.2 The process unit has been approved in accordance with resolution A.444(XI). ☐

2.4.3 The oil content meter:

.1 has been approved in accordance with resolution A.393(X); ☐

.2 has been approved in accordance with resolution MEPC.60(33). ☐

2.5 Maximum throughput of the system is .... m^3/h.

2.6 Waiver of regulation 16:

2.6.1 The requirements of regulation 16(1) and 16(2) are waived in respect of the ship in accordance with regulation 16(3)(a). The ship is engaged exclusively on voyages within special area(s): .... ☐

* Refer to the Recommendation on international performance and test specifications of oily-water separating equipment and oil content meters adopted by the Organization on 14 November 1977 by resolution A.393(X), which superseded resolution A.233(VII); see IMO sales publication IMO-608E. Further reference is made to the Guidelines and specifications for pollution prevention equipment for machinery space bilges adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33), which, effective on 6 July 1993, superseded resolutions A.393(X) and A.444(XI); see IMO sales publication IMO-646E.

2.6.2 The ship is fitted with holding tank(s) for the total retention on board of all oily bilge water as follows: ☐

Tank identification	Tank location		Volume (m^3)
	Frames (from)-(to)	Lateral position	
			Total volume .... (m^3)

3 Means for retention and disposal of oil residues (sludge) (regulation 17) and bilge water holding tank(s)*

3.1 The ship is provided with oil residue (sludge) tanks as follows:

Tank identification	Tank location		Volume (m^3)
	Frames (from)-(to)	Lateral position	
			Total volume .... (m^3)

3.2 Means for the disposal of residues in addition to the provisions of sludge tanks:

3.2.1 Incinerator for oil residues, capacity .... l/h ☐

3.2.2 Auxiliary boiler suitable for burning oil residues ☐

3.2.3 Tank for mixing oil residues with fuel oil, capacity .... m^3 ☐

3.2.4 Other acceptable means:.. ☐

* Bilge water holding tank(s) are not required by the Convention, entries in the table under paragraph 3.3 are voluntary.

3.3 The ship is fitted with holding tank(s) for the retention on board of oily bilge water as follows:

Tank identification	Tank location		Volume (m^3)
	Frames (from)–(to)	Lateral position	
			Total volume .... (m^3)

4 Standard discharge connection
(regulation 19)

4.1 The ship is provided with a pipeline for the discharge of residues from machinery bilges to reception facilities, fitted with a standard discharge connection in accordance with regulation 19 ☐

5 Shipboard oil pollution emergency plan
(regulation 26)

5.1 The ship is provided with a shipboard oil pollution emergency plan in compliance with regulation 26 ☐

6 Exemption

6.1 Exemptions have been granted by the Administration from the requirements of chapter II of Annex I of the Convention in accordance with regulation 2(4)(a) on those items listed under paragraph(s) ....
.... of this Record ☐

7 Equivalents (regulation 3)

7.1 Equivalents have been approved by the Administration for certain requirements of Annex I on those items listed under paragraph(s) .... of this Record ☐

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at ....
(Place of issue of the Record)

....
(Signature of duly authorized officer issuing the Record)

(Seal or stamp of the issuing authority, as appropriate)

FORM B
(Revised 1999)

Supplement to International Oil Pollution Prevention Certificate (IOPP Certificate)

RECORD OF CONSTRUCTION AND EQUIPMENT FOR OIL TANKERS

in respect of the provisions of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

Notes:

1 This form is to be used for the first two types of ships as categorized in the IOPP Certificate, i.e. "oil tankers" and "ships other than oil tankers with cargo tanks coming under regulation 2(2) of Annex I of the Convention". For the third type of ships as categorized in the IOPP Certificate, Form A shall be used.

2 This Record shall be permanently attached to the IOPP Certificate. The IOPP Certificate shall be available on board the ship at all times.

3 If the language of the original Record is neither English nor French, the text shall include a translation into one of these languages.

4 Entries in boxes shall be made by inserting either a cross (×) for the answers "yes" and "applicable" or a dash (–) for the answers "no" and "not applicable" as appropriate.

5 Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex I of the Convention and resolutions refer to those adopted by the International Maritime Organization.

1 Particulars of ship

1.1 Name of ship ....
1.2 Distinctive number or letters ....
1.3 Port of registry...................................
1.4 Gross tonnage...................................
1.5 Carrying capacity of ship.........................(m^3)
1.6 Deadweight of ship........(metric tons) (regulation 1(22))
1.7 Length of ship.................. (m) (regulation 1(18))

1.8 Date of build:

1.8.1 Date of building contract ....

1.8.2 Date on which keel was laid or ship was at a similar stage of construction ....

1.8.3 Date of delivery ....

1.9 Major conversion (if applicable):

1.9.1 Date of conversion contract ....

1.9.2 Date on which conversion was commenced ....

1.9.3 Date of completion of conversion..................

1.10 Status of ship:

1.10.1 New ship in accordance with regulation 1(6) ☐

1.10.2 Existing ship in accordance with regulation 1(7) ☐

1.10.3 New oil tanker in accordance with regulation 1(26) ☐

1.10.4 Existing oil tanker in accordance with regulation 1(27) ☐

1.10.5 The ship has been accepted by the Administration as an "existing ship" under regulation 1(7) due to unforeseen delay in delivery ☐

1.10.6 The ship has been accepted by the Administration as an "existing oil tanker" under regulation 1(27) due to unforeseen delay in delivery ☐

1.10.7 The ship is not required to comply with the provisions of regulation 24 due to unforeseen delay in delivery ☐

1.11 Type of ship:

1.11.1 Crude oil tanker ☐

1.11.2 Product carrier ☐

1.11.2 *(bis)* Product carrier not carrying fuel oil or heavy diesel oil as referred to in regulation 13G(2*bis*), or lubricating oil ☐

1.11.3 Crude oil/product carrier ☐

1.11.4 Combination carrier ☐

1.11.5 Ship, other than an oil tanker, with cargo tanks coming under regulation 2(2) of Annex I of the Convention ☐

1.11.6 Oil tanker dedicated to the carriage of products referred to in regulation 15(7) ☐

1.11.7 The ship, being designated as a "crude oil tanker" operating with COW, is also designated as a "product carrier" operating with CBT, for which a separate IOPP Certificate has also been issued ☐

1.11.8 The ship, being designated as a "product carrier" operating with CBT, is also designated as a "crude oil tanker" operating with COW, for which a separate IOPP Certificate has also been issued ☐

1.11.9 Chemical tanker carrying oil ☐

2 Equipment for the control of oil discharge from machinery space bilges and oil fuel tanks

(regulations 10 and 16)

2.1 Carriage of ballast water in oil fuel tanks:

2.1.1 The ship may under normal conditions carry ballast water in oil fuel tanks ☐

2.2 Type of oil filtering equipment fitted:

2.2.1 Oil filtering (15 ppm) equipment (regulation 16(4)) ☐

2.2.2 Oil filtering (15 ppm) equipment with alarm and automatic stopping device (regulation 16(5)) ☐

2.3 The ship is allowed to operate with the existing equipment until 6 July 1998 (regulation 16(6)) and is fitted with:

2.3.1 Oil filtering (15 ppm) equipment without alarm ☐

2.3.2 Oil filtering (15 ppm) equipment with alarm and manual stopping device ☐

2.4 Approval standards:*

2.4.1 The separating/filtering equipment:

.1 has been approved in accordance with resolution A.393(X) ☐

* Refer to the Recommendation on international performance and test specifications of oily-water separating equipment and oil content meters adopted by the Organization on 14 November 1977 by resolution A.393(X), which superseded resolution A.233(VII); see IMO sales publication IMO-608E. Further reference is made to the Guidelines and specifications for pollution prevention equipment for machinery space bilges adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33), which, effective on 6 July 1993, superseded resolutions A.393(X) and A.444(XI); see IMO sales publication IMO-646E.

.2 has been approved in accordance with resolution MEPC.60(33) ☐

.3 has been approved in accordance with resolution A.233(VII); ☐

.4 has been approved in accordance with national standards not based upon resolution A.393(X) or A.233(VII) ☐

.5 has not been approved ☐

2.4.2 The process unit has been approved in accordance with resolution A.444(XI) ☐

2.4.3 The oil content meter:

.1 has been approved in accordance with resolution A.393(X); ☐

.2 has been approved in accordance with resolution MEPC.60(33). ☐

2.5 Maximum throughput of the system is .... m^3/h.

2.6 Waiver of regulation 16:

2.6.1 The requirements of regulation 16(1) and 16(2) are waived in respect of the ship in accordance with regulation 16(3)(a). The ship is engaged exclusively on voyages within special area(s): .... ☐

2.6.2 The ship is fitted with holding tank(s) for the total retention on board of all oily bilge water as follows: ☐

Tank identification	Tank location		Volume (m^3)
	Frames (from)–(to)	Lateral position	
			Total volume .... (m^3)

2.6.3 In lieu of the holding tank(s) the ship is provided with arrangements to transfer bilge water to the slop tank. ☐

3 Means for retention and disposal of oil residues (sludge) (regulation 17) and bilge water holding tank(s)*

3.1 The ship is provided with oil residue (sludge) tanks as follows:

Tank identification	Tank location		Volume (m^3)
	Frames (from)–(to)	Lateral position	
			Total volume .... (m^3)

3.2 Means for the disposal of residues in addition to the provisions of sludge tanks:

3.2.1 Incinerator for oil residues, capacity .... l/h ☐

3.2.2 Auxiliary boiler suitable for burning oil residues ☐

3.2.3 Tank for mixing oil residues with fuel oil, capacity .... m^3 ☐

3.2.4 Other acceptable means:.. ☐

3.3 The ship is fitted with holding tank(s) for the retention on board of oily bilge water as follows:

Tank identification	Tank location		Volume (m^3)
	Frames (from)–(to)	Lateral position	
			Total volume .... (m^3)

4 Standard discharge connection (regulation 19)

4.1 The ship is provided with a pipeline for the discharge of residues from machinery bilges to reception facilities, fitted with a standard discharge connection in compliance with regulation 19 ☐

* Bilge water holding tank(s) are not required by the Convention, entries in the table under paragraph 3.3 are voluntary.

5 Construction (regulations 13, 24 and 25)

5.1 In accordance with the requirements of regulation 13, the ship is:

5.1.1 Required to be provided with SBT, PL and COW ☐

5.1.2 Required to be provided with SBT and PL ☐

5.1.3 Required to be provided with SBT ☐

5.1.4 Required to be provided with SBT or COW ☐

5.1.5 Required to be provided with SBT or CBT ☐

5.1.6 Not required to comply with the requirements of regulation 13 ☐

5.2 Segregated ballast tanks (SBT):

5.2.1 The ship is provided with SBT in compliance with regulation 13 ☐

5.2.2 The ship is provided with SBT, in compliance with regulation 13, which are arranged in protective locations (PL) in compliance with regulation 13E ☐

5.2.3 SBT are distributed as follows:

Tank	Volume (m^3)	Tank	Volume (m^3)
		Total volume .... m^3	

5.3 Dedicated clean ballast tanks (CBT):

5.3.1 The ship is provided with CBT in compliance with regulation 13A, and may operate as a product carrier ☐

5.3.2 CBT are distributed as follows:

Tank	Volume (m^3)	Tank	Volume (m^3)
		Total volume .... m^3	

5.3.3 The ship has been supplied with a valid Dedicated Clean Ballast Tank Operation Manual, which is dated .... ☐

5.3.4 The ship has common piping and pumping arrangements for ballasting the CBT and handling cargo oil ☐

5.3.5 The ship has separate independent piping and pumping arrangements for ballasting the CBT ☐

5.4 Crude oil washing (COW):

5.4.1 The ship is equipped with a COW system in compliance with regulation 13B ☐

5.4.2 The ship is equipped with a COW system in compliance with regulation 13B except that the effectiveness of the system has not been confirmed in accordance with regulation 13(6) and paragraph 4.2.10 of the Revised COW Specifications (resolution A.446(XI)*) ☐

5.4.3 The ship has been supplied with a valid Crude Oil Washing Operations and Equipment Manual, which is dated .....
.... ☐

5.4.4 The ship is not required to be but is equipped with COW in compliance with the safety aspects of the Revised COW Specifications (resolution A.446(XI)*) ☐

5.5 Exemption from regulation 13:

5.5.1 The ship is solely engaged in trade between ....
....
in accordance with regulation 13C and is therefore exempted from the requirements of regulation 13 ☐

5.5.2 The ship is operating with special ballast arrangements in accordance with regulation 13D and is therefore exempted from the requirements of regulation 13 ☐

5.6 Limitation of size and arrangements of cargo tanks (regulation 24):

5.6.1 The ship is required to be constructed according to, and complies with, the requirements of regulation 24 ☐

5.6.2 The ship is required to be constructed according to, and complies with, the requirements of regulation 24(4) (see regulation 2(2)) ☐

* See IMO sales publication IMO-617E.

5.7 Subdivision and stability (regulation 25):

5.7.1 The ship is required to be constructed according to, and complies with, the requirements of regulation 25 ☐

5.7.2 Information and data required under regulation 25(5) have been supplied to the ship in an approved form ☐

5.7.3 The ship is required to be constructed according to, and complies with the requirements of, regulation 25A ☐

5.7.4 Information and data required under regulation 25A for combination carriers have been supplied to the ship in a written procedure approved by the Administration ☐

5.8 Double-hull construction:

5.8.1 The ship is required to be constructed according to regulation 13F and complies with the requirements of:

- .1 paragraph (3) (double-hull construction) ☐
- .2 paragraph (4) (mid-height deck tankers with double side construction) ☐
- .3 paragraph (5) (alternative method approved by the Marine Environment Protection Committee) ☐

5.8.2 The ship is required to be constructed according to and complies with the requirements of regulation 13F(7) (double bottom requirements) ☐

5.8.3 The ship is not required to comply with the requirements of regulation 13F ☐

5.8.4 The ship is subject to regulation 13G and:

- .1 is required to comply with regulation 13F not later than . . . . ☐
- .2 is so arranged that the following tanks or spaces are not used for the carriage of oil . . . . ☐
- .3 has been accepted in accordance with regulation 13G(7) and resolution MEPC.64(36) ☐
- .4 is provided with the operational manual approved on .... in accordance with resolution MEPC.64(36) ☐

5.8.5 The ship is not subject to regulation 13G ☐

6 Retention of oil on board (regulation 15)

6.1 Oil discharge monitoring and control system:

6.1.1 The ship comes under category . . . . oil tanker as defined in resolution A.496(XII) or A.586(14)* *(delete as appropriate)* ☐

6.1.2 The system comprises:

- .1 control unit ☐
- .2 computing unit ☐
- .3 calculating unit ☐

6.1.3 The system is:

- .1 fitted with a starting interlock ☐
- .2 fitted with automatic stopping device ☐

6.1.4 The oil content meter is approved under the terms of resolution A.393(X) or A.586(14)† *(delete as appropriate)* suitable for:

- .1 crude oil ☐
- .2 black products ☐
- .3 white products ☐
- .4 oil-like noxious liquid substances as listed in the attachment to the certificate ☐

6.1.5 The ship has been supplied with an operations manual for the oil discharge monitoring and control system ☐

6.2 Slop tanks:

6.2.1 The ship is provided with . . . . dedicated slop tank(s) with the total capacity of . . . . m^3, which is. . . . . % of the oil carrying capacity, in accordance with:

- .1 regulation 15(2)(c) ☐
- .2 regulation 15(2)(c)(i) ☐
- .3 regulation 15(2)(c)(ii) ☐
- .4 regulation 15(2)(c)(iii) ☐

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* Oil tankers the keels of which are laid, or which are at a similar stage of construction, on or after 2 October 1986 should be fitted with a system approved under resolution A.586(14); see IMO sales publication IMO-646E.

† For oil content meters installed on tankers built prior to 2 October 1986, refer to the Recommendation on international performance and test specifications for oily-water separating equipment and oil content meters adopted by the Organization by resolution A.393(X). For oil content meters as part of discharge monitoring and control systems installed on tankers built on or after 2 October 1986, refer to the Guidelines and specifications for oil discharge monitoring and control systems for oil tankers adopted by the Organization by resolution A.586(14); see IMO sales publications IMO-608E and IMO-646E, respectively.

6.2.2 Cargo tanks have been designated as slop tanks ☐

6.3 Oil/water interface detectors:

6.3.1 The ship is provided with oil/water interface detectors approved under the terms of resolution MEPC.5(XIII)* ☐

6.4 Exemptions from regulation 15:

6.4.1 The ship is exempted from the requirements of regulation 15(1), (2) and (3) in accordance with regulation 15(7) ☐

6.4.2 The ship is exempted from the requirements of regulation 15(1), (2) and (3) in accordance with regulation 2(2) ☐

6.5 Waiver of regulation 15:

6.5.1 The requirements of regulation 15(3) are waived in respect of the ship in accordance with regulation 15(5)(b). The ship is engaged exclusively on:

.1 specific trade under regulation 13C: ....
....
.... ☐

.2 voyages within special area(s): ....
....
.... ☐

.3 voyages within 50 miles of the nearest land outside special area(s) of 72 hours or less in duration restricted to: ....
....
.... ☐

7 Pumping, piping and discharge arrangements
(regulation 18)

7.1 The overboard discharge outlets for segregated ballast are located:

7.1.1 Above the waterline ☐

7.1.2 Below the waterline ☐

7.2 The overboard discharge outlets, other than the discharge manifold, for clean ballast are located:†

7.2.1 Above the waterline ☐

7.2.2 Below the waterline ☐

* Refer to the Specification for oil/water interface detectors adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.5(XIII); see IMO sales publication IMO-646E.

† Only those outlets which can be monitored are to be indicated.

7.3 The overboard discharge outlets, other than the discharge manifold, for dirty ballast water or oil-contaminated water from cargo tank areas are located:*

7.3.1 Above the waterline ☐

7.3.2 Below the waterline in conjunction with the part flow arrangements in compliance with regulation 18(6)(e) ☐

7.3.3 Below the waterline ☐

7.4 Discharge of oil from cargo pumps and oil lines (regulation 18(4) and (5)):

7.4.1 Means to drain all cargo pumps and oil lines at the completion of cargo discharge:

.1 drainings capable of being discharged to a cargo tank or slop tank ☐

.2 for discharge ashore a special small-diameter line is provided ☐

8 Shipboard oil pollution emergency plan
(regulation 26)

8.1 The ship is provided with a shipboard oil pollution emergency plan in compliance with regulation 26 ☐

9 Equivalent arrangements for chemical tankers carrying oil

9.1 As equivalent arrangements for the carriage of oil by a chemical tanker, the ship is fitted with the following equipment in lieu of slop tanks (paragraph 6.2 above) and oil/water interface detectors (paragraph 6.3 above):

9.1.1 Oily-water separating equipment capable of producing effluent with oil content less than 100 ppm, with the capacity of .... m^3/h ☐

9.1.2 A holding tank with the capacity of .... m^3 ☐

9.1.3 A tank for collecting tank washings which is:

.1 a dedicated tank ☐

.2 a cargo tank designated as a collecting tank ☐

* Only those outlets which can be monitored are to be indicated.

9.1.4 A permanently installed transfer pump for overboard discharge of effluent containing oil through the oily-water separating equipment ☐

9.2 The oily-water separating equipment has been approved under the terms of resolution A.393(X)* and is suitable for the full range of Annex I products ☐

9.3 The ship holds a valid Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk ☐

10 Oil-like noxious liquid substances

10.1 The ship is permitted, in accordance with regulation 14 of Annex II of the Convention, to carry the oil-like noxious liquid substances specified in the list† attached ☐

11 Exemption

11.1 Exemptions have been granted by the Administration from the requirements of chapters II and III of Annex I of the Convention in accordance with regulation 2(4)(a) on those items listed under paragraph(s)......................
....
.... of this Record ☐

12 Equivalents (regulation 3)

12.1 Equivalents have been approved by the Administration for certain requirements of Annex I on those items listed under paragraph(s) ....
.... of this Record ☐

THIS IS TO CERTIFY that this Record is correct in all respects.

Issued at..
(Place of issue of the Record)

....
(Signature of duly authorized officer issuing the Record)

(Seal or stamp of the issuing authority, as appropriate)

* Refer to the Guidelines and specifications for pollution prevention equipment for machinery space bilges adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33), which, effective on 6 July 1993, superseded resolution A.393(X); see IMO sales publication IMO-646E.

† The list of oil-like noxious substances permitted for carriage, signed, dated and certified by a seal or a stamp of the issuing authority, shall be attached.

Appendix III

Form of Oil Record Book

OIL RECORD BOOK

PART I – Machinery space operations
(All ships)

Name of ship:

Distinctive number or letters:

Gross tonnage:

Period from: to:

Note: Oil Record Book Part I shall be provided to every oil tanker of 150 tons gross tonnage and above and every ship of 400 tons gross tonnage and above, other than oil tankers, to record relevant machinery space operations. For oil tankers, Oil Record Book Part II shall also be provided to record relevant cargo/ballast operations.

Introduction

The following pages of this section show a comprehensive list of items of machinery space operations which are, when appropriate, to be recorded in the Oil Record Book in accordance with regulation 20 of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). The items have been grouped into operational sections, each of which is denoted by a letter code.

When making entries in the Oil Record Book, the date, operational code and item number shall be inserted in the appropriate columns and the required particulars shall be recorded chronologically in the blank spaces.

Each completed operation shall be signed for and dated by the officer or officers in charge. Each completed page shall be signed by the master of the ship.

The Oil Record Book contains many references to oil quantity. The limited accuracy of tank measurement devices, temperature variations and clingage will affect the accuracy of these readings. The entries in the Oil Record Book should be considered accordingly.

LIST OF ITEMS TO BE RECORDED

(A) Ballasting or cleaning of oil fuel tanks

1. Identity of tank(s) ballasted.
2. Whether cleaned since they last contained oil and, if not, type of oil previously carried.
3. Cleaning process:
   - .1 position of ship and time at the start and completion of cleaning;
   - .2 identify tank(s) in which one or another method has been employed (rinsing through, steaming, cleaning with chemicals; type and quantity of chemicals used);
   - .3 identity of tank(s) into which cleaning water was transferred.
4. Ballasting:
   - .1 position of ship and time at start and end of ballasting;
   - .2 quantity of ballast if tanks are not cleaned.

(B) Discharge of dirty ballast or cleaning water from oil fuel tanks referred to under section (A)

5. Identity of tank(s).
6. Position of ship at start of discharge.
7. Position of ship on completion of discharge.
8. Ship's speed(s) during discharge.
9. Method of discharge:
   - .1 through 15 ppm equipment;
   - .2 to reception facilities.
10. Quantity discharged.

(C) Collection and disposal of oil residues (sludge)

11. Collection of oil residues.

    Quantities of oil residues (sludge) retained on board at the end of a voyage, but not more frequently than once a week. When ships are on short voyages, the quantity should be recorded weekly:[1]

[1] Only in tanks listed in item 3 of Forms A and B of the Supplement to the IOPP Certificate.

.1 separated sludge (sludge resulting from purification of fuel and lubricating oils) and other residues, if applicable:
- identity of tank(s) ....
- capacity of tank(s) .... m^3
- total quantity of retention .... m^3;

.2 other residues (such as oils residues resulting from drainages, leakages, exhausted oil, etc., in the machinery spaces), if applicable due to tank arrangement in addition to .1:
- identity of tank(s) ....
- capacity of tank(s) .... m^3
- total quantity of retention .... m^3.

12. Methods of disposal of residue.
State quantity of oil residues disposed of, the tank(s) emptied and the quantity of contents retained:
.1 to reception facilities (identify port);[2]
.2 transferred to another (other) tank(s) (indicate tank(s) and the total content of tank(s));
.3 incinerated (indicate total time of operation);
.4 other method (state which).

(D) Non-automatic discharge overboard or disposal otherwise of bilge water which has accumulated in machinery spaces

13. Quantity discharged or disposed of.
14. Time of discharge or disposal (start and stop).
15. Method of discharge or disposal:
.1 through 15 ppm equipment (state position at start and end);
.2 to reception facilities (identify port);[2]
.3 transfer to slop tank or holding tank (indicate tank(s); state quantity transferred and the total quantity retained in tank(s)).

[2] Ships' masters should obtain from the operator of the reception facilities, which include barges and tank trucks, a receipt or certificate detailing the quantity of tank washings, dirty ballast, residues or oily mixtures transferred, together with the time and date of the transfer. This receipt or certificate, if attached to the Oil Record Book, may aid the master of the ship in proving that his ship was not involved in an alleged pollution incident. The receipt or certificate should be kept together with the Oil Record Book.

(E) Automatic discharge overboard or disposal otherwise of bilge water which has accumulated in machinery spaces

16. Time and position of ship at which the system has been put into automatic mode of operation for discharge overboard.
17. Time when the system has been put into automatic mode of operation for transfer of bilge water to holding tank (identify tank).
18. Time when the system has been put into manual operation.
19. Method of discharge overboard:
.1 through 15 ppm equipment.

(F) Condition of oil discharge monitoring and control system

20. Time of system failure.
21. Time when system has been made operational.
22. Reasons for failure.

(G) Accidental or other exceptional discharges of oil

23. Time of occurrence.
24. Place or position of ship at time of occurrence.
25. Approximate quantity and type of oil.
26. Circumstances of discharge or escape, the reasons therefor and general remarks.

(H) Bunkering of fuel or bulk lubricating oil

27. Bunkering:
.1 Place of bunkering.
.2 Time of bunkering.
.3 Type and quantity of fuel oil and identity of tank(s) (state quantity added and total content of tank(s)).
.4 Type and quantity of lubricating oil and identity of tank(s) (state quantity added and total content of tank(s)).

(I) Additional operational procedures and general remarks

Name of ship ....

Distinctive number or letters ....

CARGO/BALLAST OPERATIONS (OIL TANKERS)*/
MACHINERY SPACE OPERATIONS (ALL SHIPS)*

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge

Signature of master ....

* Delete as appropriate

OIL RECORD BOOK

PART II – Cargo/ballast operations
(Oil tankers)

Name of ship:

Distinctive number or letters:

Gross tonnage:

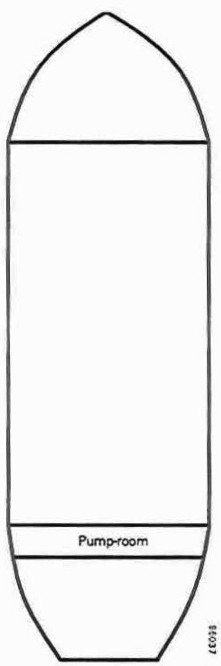
Period from: to:

Note: Every oil tanker of 150 tons gross tonnage and above shall be provided with Oil Record Book Part II to record relevant cargo/ballast operations. Such a tanker shall also be provided with Oil Record Book Part I to record relevant machinery space operations.

Name of ship . . . .

Distinctive number or letters . . . .

PLAN VIEW OF CARGO AND SLOP TANKS
(to be completed on board)



Identification of the tanks	Capacity
Depth of slop tank(s):	

(Give the capacity of each tank and the depth of slop tank(s))

Introduction

The following pages of this section show a comprehensive list of items of cargo and ballast operations which are, when appropriate, to be recorded in the Oil Record Book in accordance with regulation 20 of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78). The items have been grouped into operational sections, each of which is denoted by a code letter.

When making entries in the Oil Record Book, the date, operational code and item number shall be inserted in the appropriate columns and the required particulars shall be recorded chronologically in the blank spaces.

Each completed operation shall be signed for and dated by the officer or officers in charge. Each completed page shall be countersigned by the master of the ship. In respect of the oil tankers engaged in specific trades in accordance with regulation 13C of Annex I of MARPOL 73/78, appropriate entry in the Oil Record Book shall be endorsed by the competent port State authority.*

The Oil Record Book contains many references to oil quantity. The limited accuracy of tank measurement devices, temperature variations and clingage will affect the accuracy of these readings. The entries in the Oil Record Book should be considered accordingly.

* This sentence should only be inserted for the Oil Record Book of a tanker engaged in a specific trade.

LIST OF ITEMS TO BE RECORDED

(A) Loading of oil cargo

1. Place of loading.
2. Type of oil loaded and identity of tank(s).
3. Total quantity of oil loaded (state quantity added and the total content of tank(s)).

(B) Internal transfer of oil cargo during voyage

4. Identity of tank(s):
   .1 from:
   .2 to: (state quantity transferred and total quantity of tank(s))
5. Was (were) the tank(s) in 4.1 emptied? (If not, state quantity retained.)

(C) Unloading of oil cargo

6. Place of unloading.
7. Identity of tank(s) unloaded.
8. Was (were) the tank(s) emptied? (If not, state quantity retained.)

(D) Crude oil washing (COW tankers only)

(To be completed for each tank being crude oil washed)

9. Port where crude oil washing was carried out or ship's position if carried out between two discharge ports.
10. Identity of tank(s) washed.[1]
11. Number of machines in use.
12. Time of start of washing.
13. Washing pattern employed.[2]
14. Washing line pressure.
15. Time washing was completed or stopped.

[1] When an individual tank has more machines than can be operated simultaneously, as described in the Operations and Equipment Manual, then the section being crude oil washed should be identified, e.g. No. 2 centre, forward section.

[2] In accordance with the Operations and Equipment Manual, enter whether single-stage or multi-stage method of washing is employed. If multi-stage method is used, give the vertical arc covered by the machines and the number of times that arc is covered for that particular stage of the programme.

16. State method of establishing that tank(s) was (were) dry.
17. Remarks.[3]

(E) Ballasting of cargo tanks

18. Position of ship at start and end of ballasting.
19. Ballasting process:
   .1 identity of tank(s) ballasted;
   .2 time of start and end;
   .3 quantity of ballast received. Indicate total quantity of ballast for each tank involved in the operation.

(F) Ballasting of dedicated clean ballast tanks (CBT tankers only)

20. Identity of tank(s) ballasted.
21. Position of ship when water intended for flushing, or port ballast was taken to dedicated clean ballast tank(s).
22. Position of ship when pump(s) and lines were flushed to slop tank.
23. Quantity of the oily water which, after line flushing, is transferred to the slop tank(s) or cargo tank(s) in which slop is preliminarily stored (identify tank(s)). State the total quantity.
24. Position of ship when additional ballast water was taken to dedicated clean ballast tank(s).
25. Time and position of ship when valves separating the dedicated clean ballast tanks from cargo and stripping lines were closed.
26. Quantity of clean ballast taken on board.

(G) Cleaning of cargo tanks

27. Identity of tank(s) cleaned.
28. Port or ship's position.
29. Duration of cleaning.
30. Method of cleaning.[4]

[3] If the programmes given in the Operations and Equipment Manual are not followed, then the reasons must be given under Remarks.

[4] Hand-hosing, machine washing and/or chemical cleaning. Where chemically cleaned, the chemical concerned and amount used should be stated.

31. Tank washings transferred to:
   .1 reception facilities (state port and quantity)[5];
   .2 slop tank(s) or cargo tank(s) designated as slop tank(s) (identify tank(s); state quantity transferred and total quantity).

(H) Discharge of dirty ballast

32. Identity of tank(s).
33. Position of ship at start of discharge into the sea.
34. Position of ship on completion of discharge into the sea.
35. Quantity discharged into the sea.
36. Ship's speed(s) during discharge.
37. Was the discharge monitoring and control system in operation during the discharge?
38. Was a regular check kept on the effluent and the surface of the water in the locality of the discharge?
39. Quantity of oily water transferred to slop tank(s) (identify slop tank(s)). State total quantity.
40. Discharged to shore reception facilities (identify port and quantity involved).[5]

(I) Discharge of water from slop tanks into the sea

41. Identity of slop tanks.
42. Time of settling from last entry of residues, or
43. Time of settling from last discharge.
44. Time and position of ship at start of discharge.
45. Ullage of total contents at start of discharge.
46. Ullage of oil/water interface at start of discharge.
47. Bulk quantity discharged and rate of discharge.
48. Final quantity discharged and rate of discharge.
49. Time and position of ship on completion of discharge.

[5] Ships' masters should obtain from the operator of the reception facilities, which include barges and tank trucks, a receipt or certificate detailing the quantity of tank washings, dirty ballast, residues or oily mixtures transferred, together with the time and date of the transfer. This receipt or certificate, if attached to the Oil Record Book, may aid the master of the ship in proving that his ship was not involved in an alleged pollution incident. The receipt or certificate should be kept together with the Oil Record Book.

50. Was the discharge monitoring and control system in operation during the discharge?
51. Ullage of oil/water interface on completion of discharge.
52. Ship's speed(s) during discharge.
53. Was a regular check kept on the effluent and the surface of the water in the locality of the discharge?
54. Confirm that all applicable valves in the ship's piping system have been closed on completion of discharge from the slop tanks.

(J) Disposal of residues and oily mixtures not otherwise dealt with

55. Identity of tank(s).
56. Quantity disposed of from each tank. (State the quantity retained.)
57. Method of disposal:
   .1 to reception facilities (identify port and quantity involved);[5]
   .2 mixed with cargo (state quantity);
   .3 transferred to (an)other tank(s) (identify tank(s); state quantity transferred and total quantity in tank(s));
   .4 other method (state which); state quantity disposed of.

(K) Discharge of clean ballast contained in cargo tanks

58. Position of ship at start of discharge of clean ballast.
59. Identity of tank(s) discharged.
60. Was (were) the tank(s) empty on completion?
61. Position of ship on completion if different from 58.
62. Was a regular check kept on the effluent and the surface of the water in the locality of the discharge?

(L) Discharge of ballast from dedicated clean ballast tanks (CBT tankers only)

63. Identity of tank(s) discharged.

[5] Ships' masters should obtain from the operator of the reception facilities, which include barges and tank trucks, a receipt or certificate detailing the quantity of tank washings, dirty ballast, residues or oily mixtures transferred, together with the time and date of the transfer. This receipt or certificate, if attached to the Oil Record Book, may aid the master of the ship in proving that his ship was not involved in an alleged pollution incident. The receipt or certificate should be kept together with the Oil Record Book.

64. Time and position of ship at start of discharge of clean ballast into the sea.

65. Time and position of ship on completion of discharge into the sea.

66. Quantity discharged:
   .1 into the sea; or
   .2 to reception facility (identify port).

67. Was there any indication of oil contamination of the ballast water before or during discharge into the sea?

68. Was the discharge monitored by an oil content meter?

69. Time and position of ship when valves separating dedicated clean ballast tanks from the cargo and stripping lines were closed on completion of deballasting.

(M) Condition of oil discharge monitoring and control system

70. Time of system failure.

71. Time when system has been made operational.

72. Reasons for failure.

(N) Accidental or other exceptional discharges of oil

73. Time of occurrence.

74. Port or ship's position at time of occurrence.

75. Approximate quantity and type of oil.

76. Circumstances of discharge or escape, the reasons therefor and general remarks.

(O) Additional operational procedures and general remarks

TANKERS ENGAGED IN SPECIFIC TRADES

(P) Loading of ballast water

77. Identity of tank(s) ballasted.

78. Position of ship when ballasted.

79. Total quantity of ballast loaded in cubic metres.

80. Remarks.

(Q) Re-allocation of ballast water within the ship

81. Reasons for re-allocation.

(R) Ballast water discharge to reception facility

82. Port(s) where ballast water was discharged.

83. Name or designation of reception facility.

84. Total quantity of ballast water discharged in cubic metres.

85. Date, signature and stamp of port authority official.

Appendices to Annex I

Name of ship . . . .

Distinctive number or letters . . . .

CARGO/BALLAST OPERATIONS (OIL TANKERS)*/
MACHINERY SPACE OPERATIONS (ALL SHIPS)*

Date	Code (letter)	Item (number)	Record of operations/signature of officer in charge

Signature of master . . . .

* Delete as appropriate

Unified Interpretations of Annex I

Notes: For the purposes of the Unified Interpretations, the following abbreviations are used:

MARPOL 73/78	The 1973 MARPOL Convention as modified by the 1978 Protocol relating thereto
Regulation	Regulation in Annex I of MARPOL 73/78
IOPP Certificate	International Oil Pollution Prevention Certificate
SBT	Segregated ballast tanks
CBT	Dedicated clean ballast tanks
COW	Crude oil washing system
IGS	Inert gas systems
PL	Protective location of segregated ballast tanks
H	Date of entry into force of MARPOL 73/78 (see 2.0.1). "H + 2" means two years after the date of entry into force of MARPOL 73/78.

1 Definitions

Reg. 1(1)

1A.0 *Definition of "oil"*

1A.0.1 (Animal and vegetable oils are found to fall under the category of "noxious liquid substance", and therefore this interpretation has been deleted (see Annex II, appendix II, of MARPOL 73/78).)

Treatment for oily rags

1A.0.2 Oily rags, as defined in the Guidelines for the Implementation of Annex V of MARPOL 73/78, should be treated in accordance with Annex V and the procedures set out in the Guidelines.

Reg. 1(4)

1.0 *Definition of an "oil tanker"*

1.0.1 A gas carrier as defined in regulation 3.20 of chapter II-1 of SOLAS 74 (as amended), when carrying a cargo or part cargo of oil in bulk, should be treated as an "oil tanker" as defined in regulation 1(4).

Reg. 1(6) 1(26)

1.1 *Definition of "new ships"*

1.1.1 Regulations 1(6) and 1(26) defining "new ship" and "new oil tanker", respectively, should be construed to mean that a ship which falls into any one of the categories listed in subparagraphs (a), (b), (c), (d)(i), (d)(ii), or (d)(iii) of these paragraphs should be considered as a new ship or a new oil tanker, as appropriate.

Reg. 1(6) 1(26) 13F 24

1.2 *Unforeseen delay in delivery of ships*

1.2.1 For the purpose of defining "new" or "existing" ships under regulations 1(6), 1(26), 13F and 24, a ship for which the building contract (or keel laying) and delivery were scheduled before the dates specified in these regulations, but which has been subject to delay in delivery beyond the specified date due to unforeseen circumstances beyond the control of the builder *and* the owner, may be accepted by the Administration as an "existing ship". The treatment of such ships should be considered by the Administration *on a case by case basis*, bearing in mind the particular circumstances.

1.2.2 It is important that ships delivered after the specified dates due to unforeseen delay and allowed to be treated as existing ships by the Administration, should also be accepted as such by port States. In order to ensure this, the following practice is recommended to Administrations when considering an application for such a ship:

.1 the Administration should thoroughly consider applications on a case by case basis, bearing in mind the particular circumstances. In doing so in the case of a ship built in a foreign country, the Administration may require a formal report from the authorities of the country in which the ship was built, stating that the delay was due to unforeseen circumstances beyond the control of the builder and the owner;

.2 when a ship is treated as an existing ship upon such an application, the IOPP Certificate for the ship should be endorsed to indicate that the ship is accepted by the Administration as an existing ship; and

.3 the Administration should report to the Organization on the identity of the ship and the grounds on which the ship has been accepted as an existing ship.

1.2.3 For the purpose of the application of regulation 13F, a ship for which the building contract (or keel laying) and delivery date were scheduled before the dates specified in regulation 13F(1), but which has been subject to delay in delivery, may under the same terms and conditions given in interpretations 1.2.1 and 1.2.2 for "existing ships", be accepted by the Administration as a ship to which regulation 13F does not apply.

Reg. 1(8)

1.3 *Major conversion*

1.3.1 The deadweight to be used for determining the application of provisions of Annex I is the deadweight assigned to an oil tanker at the time of the assignment of the load lines. If the load lines are reassigned for the purpose of altering the deadweight, without alteration of the structure of the ship, any substantial alteration of the deadweight consequential upon such reassignments should not be construed as "a major conversion" as defined in regulation 1(8).

However, the IOPP Certificate should indicate only one deadweight of the ship and be renewed on every reassignment of load lines.

1.3.2 If an existing crude oil tanker of 40,000 tons deadweight and above satisfying the requirements of COW changes its trade for the carriage of product oil* conversion to CBT or SBT and reissuing of the IOPP Certificate will be necessary (see paragraph 4.5 below). Such conversion should not be considered as a "major conversion" as defined in regulation 1(8).

1.3.3 When an oil tanker is used solely for the storage of oil and is subsequently put into service in the transportation of oil, such a change of function should not be construed as a "major conversion" as defined in regulation 1(8).

1.3.4 The conversion of an existing oil tanker to a combination carrier, or the shortening of a tanker by removing a transverse section of cargo tanks, should constitute a "major conversion" as defined in regulation 1(8).

1.3.5 The conversion of an existing oil tanker to a segregated ballast tanker by the addition of a transverse section of tanks should constitute a "major conversion" as defined in regulation 1(8) only when the cargo carrying capacity of the tanker is increased.

1.3.6 When a ship built as a combination carrier operates exclusively in the bulk cargo trade, the ship may be treated as a ship other than an oil tanker and Form A of the Record of Construction and Equipment should be issued to the ship. If such a ship operates in the oil trade and is equipped to comply with the requirements for an oil tanker, the ship should be certified as an oil tanker (combination carrier) and Form B of the Record of Construction and Equipment should be issued to the ship. The change of such a ship from the bulk trade to the oil trade should not be construed as a "major conversion" as defined in regulation 1(8).

Reg. 1(17)

1.4 *Definition of "segregated ballast"*

1.4.1 The segregated ballast system should be a system which is "completely separated from the cargo oil and fuel oil systems" as required by regulation 1(17). Nevertheless, provision may be made for emergency discharge of the segregated ballast by means of a connection to a cargo pump through a portable spool piece. In this case nonreturn valves should be fitted on the segregated ballast connections to prevent the passage of oil to the segregated ballast tanks. The portable spool piece should be mounted in a conspicuous position in the pump-room and a permanent notice restricting its use should be prominently displayed adjacent to it.

1.4.2 Sliding type couplings should not be used for expansion purposes where lines for cargo oil or fuel oil pass through tanks for segregated ballast, and where lines for segregated ballast pass through cargo oil or fuel oil tanks. This interpretation is applicable to

* "Product oil" means any oil other than crude oil as defined in regulation 1(28).

ships, the keel of which is laid, or which are at a similar stage of construction, on or after 1 July 1992.

Reg. 3

1.5 *Equivalents*

1.5.1 Acceptance by an Administration under regulation 3 of any fitting, material, appliance, or apparatus as an alternative to that required by Annex I includes type approval of pollution prevention equipment which is equivalent to that specified in resolution A.393(X).* An Administration that allows such type approval shall communicate particulars thereof, including the test results on which the approval of equivalency was based, to the Organization in accordance with regulation 3(2).

1.5.2 With regard to the term "appropriate action, if any" in regulation 3(2), any Party to the Convention that has an objection to an equivalency submitted by another Party should communicate this objection to the Organization and to the Party which allowed the equivalency within one year after the Organization circulates the equivalency to the Parties. The Party objecting to the equivalency should specify whether the objection pertains to ships entering its ports.

1A Survey and inspection

Reg. 4(1)(c) and 4(3)(b)

1A.1 *Intermediate and annual survey for ships not required to hold an IOPP Certificate*

1A.1.1 The applicability of regulations 4(1)(c) and 4(3)(b)† to ships which are not required to hold an International Oil Pollution Prevention Certificate should be determined by the Administration.

2 Certificate

Reg. 5 and others

2.0 *Date of entry into force*

2.0.1 In the application of the Protocol of 1978 relating to the International Convention for the Prevention of Pollution from Ships, 1973 (1978 Protocol) the phrase "date of entry into force of the

* For oily-water separating equipment for machinery space bilges of ships, refer to the Guidelines and specifications for pollution prevention equipment for machinery space bilges adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.60(33), which, effective on 6 July 1993, superseded resolution A.393(X). For oil discharge monitoring and control systems installed on oil tankers built before 2 October 1986, refer to the Guidelines and specifications for oil discharge monitoring and control systems for oil tankers, and for oil discharge monitoring and control systems installed on oil tankers built on or after 2 October 1986, refer to the Revised guidelines and specifications for oil discharge monitoring and control systems, which were adopted by the Organization by resolutions A.496(XII) and A.586(14), respectively; see IMO sales publications IMO-608E and IMO-646E.

† Regulation 4(1)(c) was amended and the existing 4(3)(b) was removed by the HSSC amendments of MEPC.39(29), which entered into force on 3 February 2000.

present Convention" should be construed to mean the date of entry into force of the 1978 Protocol, which was 2 October 1983.

Reg. 5, 13, 13E

2.1 *Designation of the type of oil tankers*

2.1.1 Oil tankers must be designated on the IOPP Certificate as either "crude oil tanker", "product carrier" or "crude oil/product carrier". Furthermore, the requirements contained in regulations 13 to 13E differ for new and existing "crude oil tankers" and "product carriers", and compliance with these provisions is recorded on the IOPP Certificate. Oil trades in which different types of oil tankers are allowed to be engaged are as follows:

.1 *Crude oil/product carrier* is allowed to carry either crude oil or product oil, or both simultaneously;

.2 *Crude oil tanker* is allowed to carry crude oil but is prohibited from carrying product oil; and

.3 *Product carrier* is allowed to carry product oil but is prohibited from carrying crude oil.

2.1.2 In determining the designation of the type of oil tanker on the IOPP Certificate based on the compliance with the provisions for SBT, PL, CBT and COW, the following standards should apply.

2.1.3 *New oil tankers* of less than 20,000 tons deadweight*

2.1.3.1 These oil tankers may be designated as "crude oil/product carriers".

2.1.4 *New oil tankers* of 20,000 tons deadweight and above*

2.1.4.1 Oil tankers satisfying the requirements for SBT + PL + COW may be designated as "crude oil/product carrier".

2.1.4.2 Oil tankers satisfying the requirements for SBT + PL but not COW should be designated as "product carrier".

2.1.4.3 Oil tankers of 20,000 tons deadweight and above but less than 30,000 tons deadweight *not* fitted with SBT + PL should be designated as "product carrier".

2.1.5 *"New" oil tankers† of 70,000 tons deadweight and above*

2.1.5.1 These oil tankers satisfying the requirements for SBT may be designated as "crude oil/product carrier".

* As defined in regulation 1(26).

† *"New" oil tankers* in this case means oil tankers of 70,000 tons deadweight and above built after the dates specified in regulation 1(6) but before the dates specified in regulation 1(26). The term "built" in this context means building contract or keel laying or delivery as defined in paragraph (a) or (b) or (c) of regulation 1(6).

2.1.6 *Existing oil tankers* of less than 40,000 tons deadweight*

2.1.6.1 These oil tankers may be designated as "crude oil/product carrier".

2.1.7 *Existing oil tankers* of 40,000 tons deadweight and above*

2.1.7.1 Oil tankers satisfying the requirements for SBT should be designated as "crude oil/product carrier".

2.1.7.2 Oil tankers satisfying the requirements for COW only should be designated as "crude oil tanker".

2.1.7.3 Oil tankers satisfying the requirements for CBT should be designated as "crude oil/product carrier". Such designation should be valid until the expiry date of the IOPP Certificate, which should be H + 2 (see the definition of terms) for oil tankers of 70,000 tons deadweight and above and H + 4 for oil tankers of 40,000 tons deadweight and above but less than 70,000 tons deadweight.

2.1.7.4 After the above expiry date of the certificate, such an oil tanker should be designated as follows:

.1 if it continues to operate with CBT, the oil tanker should be designated as "product carrier";

.2 if it is provided with COW *only*, the oil tanker should be designated as "crude oil tanker";

.3 if it is provided with SBT, the oil tanker should be designated as "crude oil/product carrier"; and

.4 if it is provided with CBT + COW, the tanker should be designated as "crude oil/product carrier" (see paragraph 4.5 below).

Reg. 5(1) 2.2 *IOPP Certificate for existing oil tankers*

2.2.1 Under regulation 5(1) the issue of the IOPP Certificate to existing ships is not mandatory until twelve months have elapsed after the date of entry into force of MARPOL 73/78. It is, however, advisable for existing oil tankers of 40,000 tons deadweight and above to carry the IOPP Certificate or an appropriate document issued by the Administration upon entry into force of MARPOL 73/78 which can be presented to the control officers at foreign ports or terminals.

2.3 *Validity of IOPP Certificate issued before the entry into force of the Convention*

2.3.1 Where ships are surveyed and IOPP Certificates issued before the entry into force of the Convention, the period of validity of such Certificates should be calculated from the date of their issue.

* As defined in regulation 1(27).

2.4 *IOPP Certificate for crude oil/product carriers with CBT and COW*

2.4.1 When an oil tanker with CBT and COW is surveyed for the conversion from a crude oil tanker operating with COW to a product carrier operating with CBT or vice versa (see paragraph 4.5.2.1), another IOPP Certificate should be issued for a period not exceeding the remaining period of validity of the existing Certificate, unless the survey is as comprehensive as the periodical survey* required by regulation 4(1)(b) (see also paragraph 4.5.2.2).

2.4.2 The endorsement of surveys made on the existing Certificate should be recorded on another IOPP Certificate issued as above.

Reg. 7 2.4A *New form of IOPP Certificate or its Supplement*

2.4A.1 In the case where the form of the IOPP Certificate or its Supplement is amended, the existing form of the Certificate or Supplement which is current when the amendment enters into force may remain valid until the expiry of that Certificate, provided that, at the first survey after the date of entry into force of the amendment, necessary changes are indicated in the existing Certificate or Supplement by means of suitable corrections, e.g. striking over the invalid entry and typing the new entry.

Reg. 8 2.5 *Revalidation of an IOPP Certificate*

2.5.1 Where the survey required in regulation 4 of Annex I of MARPOL 73/78 is not carried out within the period specified in that regulation, the IOPP Certificate ceases to be valid. When a survey corresponding to the requisite survey is carried out subsequently, the validity of the Certificate may be restored without altering the expiry date of the original Certificate and the Certificate endorsed to this effect. The thoroughness and stringency of such survey will depend on the period for which the prescribed survey has elapsed and the conditions of the ship.

3 Controls of discharge of oil

Reg. 9(1) 3.1 *Discharges from machinery space bilges of oil tankers*

3.1.1 The wording "from machinery space bilges excluding cargo pump-room bilges of an oil tanker unless mixed with oil cargo residue" in regulation 9(1)(b) should be interpreted as follows:

.1 Regulation 9(1)(a) applies to:

.1.1 discharges of oil or oily mixture from machinery space bilges of oil tankers where mixed with cargo oil residue or when transferred to slop tanks; and

.1.2 discharges from cargo pump-room bilges of oil tankers.

.2 Regulation 9(1)(b) applies to discharges from machinery space bilges of oil tankers other than those referred to above.

* The text of regulation 4(1)(b) has been amended by the HSSC amendments of resolution MEPC.39(29).

3.1.2 The above interpretation should not be construed as relaxing any existing prohibition of piping arrangements connecting the engine-room and slop tanks which may permit cargo to enter the machinery spaces. Any arrangements provided for machinery space bilge discharges into slop tanks should incorporate adequate means to prevent any backflow of liquid cargo or gases into the machinery spaces. Any such arrangements do not constitute a relaxation of the requirements of regulation 16 with respect to oil discharge monitoring and control systems and oily-water separating equipment.

3.2 *Total quantity of discharge*

3.2.1 The phrase "the total quantity of the particular cargo of which the residue formed a part" in regulation 9(1)(a)(v) relates to the total quantity of the particular cargo which was carried on the previous voyage and should not be construed as relating only to the total quantity of cargo which was contained in the cargo tanks into which water ballast was subsequently loaded.

Reg. 9(4) — 3.3 *Discharges from ships of 400 tons gross tonnage and above but less than 10,000 tons gross tonnage within 12 miles from the nearest land* [Deleted]

Reg. 10(3) as amended — 3.4 *Automatic stopping device required by regulation 10(3) as amended*

3.4.1 Regulation 10(3)(b)(vi) requires a stopping device which will ensure that the discharge is automatically stopped when the oil content of the effluent exceeds 15 ppm. Since, however, this is not a requirement of regulation 16, ships less than 10,000 tons gross tonnage need not be required to be equipped with such stopping device if no effluent from machinery space bilges is discharged within special areas. Conversely, the discharge of effluent within special areas from ships without an automatic stopping device is a contravention of the Convention even if the oil content of the effluent is below 15 ppm.

Reg. 12(2) — 3.5 *Adequate reception facilities for substances regulated by regulation 15(7)*

3.5.1 Unloading ports receiving substances regulated by regulation 15(7) (which include *inter alia* high-density oils) should have adequate facilities dedicated for such products, allowing the entire tank-cleaning operation to be carried out in the port, and should have adequate reception facilities for the proper discharge and reception of cargo residues and solvents necessary for the cleaning operations in accordance with paragraph 6.5.2.

4 SBT, CBT, COW and PL requirements

Reg. 13(3) as amended — 4.1 *Capacity of SBT*

4.1.1 For the purpose of application of regulation 13(3)(b), as amended, the following operations of oil tankers are regarded as falling within the category of exceptional cases:

.1 when combination carriers are required to operate beneath loading or unloading gantries;

.2 when tankers are required to pass under a low bridge;

.3 when local port or canal regulations require specific draughts for safe navigation; and

.4 when loading and unloading arrangements require the tanker to be at a draught deeper than that achieved when all segregated ballast tanks are full.

Reg. 13(4) — 4.2 *Application of regulation 13(4) to new oil tankers of 70,000 tons deadweight and above*

4.2.1 New oil tankers referred to in regulation 13(4) should be taken to mean oil tankers constructed or converted after the dates specified in regulation 1(26). It is not therefore mandatory for crude oil tankers of 70,000 tons deadweight and above, built after the date specified in regulation 1(6) but before the date specified in regulation 1(26), to install COW, and such oil tankers are not subject to the provisions of regulation 13(4).

Reg. 13(5) — 4.3 *Segregated ballast conditions for oil tankers less than 150 metres in length*

4.3.1 In determining the minimum draught and trim of oil tankers less than 150 metres in length to be qualified as SBT oil tankers, the Administration should follow the guidance set out in appendix 1 hereto.*

4.3.2 The formulae set out in appendix 1 replace those set out in regulation 13(2), and these oil tankers should also comply with the conditions laid down in regulations 13(3) and (4) in order to be qualified as SBT oil tankers.

Reg. 13(8) — 4.4 *Capacity of CBT*

4.4.1 For the purposes of determining the capacity of CBT, the following tanks may be included:

.1 segregated ballast tanks; and

.2 cofferdams and fore and after peak tanks, provided that they are exclusively used for the carriage of ballast water and are connected with permanent piping to ballast water pumps.

Reg. 13(9) 13(10) — 4.5 *Existing oil tankers with CBT and COW*

4.5.1 Existing oil tankers which are fitted with CBT and COW and designated as "crude oil/product carriers" in the IOPP Certificate (see paragraph 2.1.7.4.4) should, after the expiry of the date specified in regulation 13(9), operate as follows:

.1 They should always operate with CBT when carrying crude oil or product oil or both simultaneously, and neither crude oil nor product oil should be carried in dedicated clean ballast tanks; and

* See appendix 1 to Unified Interpretations.

.2 When carrying crude oil and product oil simultaneously, or only crude oil, they should operate also with COW for sludge control.

4.5.2 If a crude oil tanker operating with COW is to change its designation to a product carrier operating with CBT, or vice versa, the following provisions shall apply:

.1 If the tanker has *common* piping and pump arrangements for ballast and cargo handling of the CBT, such tanker should be surveyed and a new IOPP Certificate should be issued. Such survey should ensure that cargo oil tanks to be designated as CBT have been thoroughly cleaned and ballast water which CBT will take can be treated as clean ballast as defined in regulation 1(16).

.2 If the tanker has *separate independent* piping and pump arrangements for ballasting the CBT, the Administration may issue to such a tanker two IOPP Certificates, the tanker being designated "crude oil tanker" on one of the Certificates and "product carrier" on the other. Only one of these Certificates which corresponds to the particular operation of the tanker should be valid at a time, but entries should be made on each of the Certificates in the remarks column as to the existence of the other Certificate. Such tanker need not be surveyed prior to each conversion of trade. When carrying only crude oil such tanker should be allowed to carry crude oil in those tanks which were designated as CBT when carrying product. When carrying only product no cargo should be carried in the CBT. The approved CBT and COW Manuals must include a chapter describing procedures necessary for the conversion from crude oil service to product service and vice versa.

Reg. 13

4.6 *Oil tankers used for the storage of oil*

4.6.1 When an oil tanker is used as a floating storage unit (FSU) or floating production storage and offloading facility (FPSO) which is used solely for the storage or storage and production of oil and is moored on a fixed location except in extreme environmental or emergency conditions, such a unit is not required to comply with the provisions of regulations 13 to 13G, unless as specified in whole or in part by the coastal State.

4.6.2 When an oil tanker is used as a floating facility to receive dirty ballast discharged from oil tankers, such a tanker is not required to comply with the provisions of regulations 13 to 13G.

Reg. 13A(3)

4.7 *Installation of oil content meter for CBT tankers*

4.7.1 The phrase "first scheduled shipyard visit" in regulation 13A(3) should be interpreted to mean that the oil content meter must be installed not later than at the first scheduled shipyard visit when cargo tanks are gas-freed and in any case not later than three

years after the date of entry into force of MARPOL 73/78 as required by regulation 15(1).

4.7.2 It should be noted that ships built after the dates specified in regulation 1(6) but before the dates specified in regulation 1(26) are treated as new ships as far as the application of regulation 15(3) is concerned. Consequently these ships must be fitted with the required oil discharge monitoring and control systems upon entry into force of the Convention.

4.8 *CBT oil content meter*

4.8.1 The discharge of ballast from the dedicated clean ballast tanks should be continuously monitored (but not necessarily recorded) by the oil content meter required by regulation 13A(3) so that the oil content, if any, in the ballast water can be observed from time to time. This oil content meter is not required to come into operation automatically.

Reg. 13B

4.9 *COW system fitted voluntarily*

4.9.1 A COW system fitted on an oil tanker as an addition to the requirements of MARPOL 73/78 should at least comply with those provisions of the revised COW Specifications relating to safety.

Reg. 13E

4.10 *Application of PL requirements to oil tankers of 70,000 tons deadweight and above*

4.10.1 Oil tankers of 70,000 tons deadweight and above built after the dates specified in regulation 1(6) but before the dates specified in regulation 1(26) must be provided with SBT but they need not be protectively located in accordance with regulation 13E.

4.11 *Protective location of SBT*

4.11.1 The measurement of the minimum width of wing tanks and of the minimum vertical depth of double bottom tanks should be taken and value of protective areas (PA_c and PA_s) should be calculated in accordance with the Interim Recommendation for a Unified Interpretation of regulation 13E – Protective Location of Segregated Ballast Spaces – set out in appendix 2 hereto.*

4.11.2 Ships being built in accordance with this interpretation should be regarded as meeting the requirements of regulation 13E and would not need to be altered if different requirements were to result from a later interpretation.

4.11.3 If, in the opinion of the Administration, any oil tanker the keel of which was laid or which was at a similar stage of construction before 1 July 1980 complies with the requirements of regulation 13E without taking into account the above Interim Recommendation, the Administration may accept such tanker as complying with regulation 13E.

* See appendix 2 to Unified Interpretations.

Reg. 13F(3)(d) 4.12 *Aggregate capacity of ballast tanks*

4.12.1 Any ballast carried in localized inboard extensions, indentations or recesses of the double hull, such as bulkhead stools, should be excess ballast above the minimum requirement for segregated ballast capacity according to regulation 13 of Annex I of MARPOL 73/78.

4.12.2 In calculating the aggregate capacity under regulation 13F(3)(d), the following should be taken into account:

.1 the capacity of engine-room ballast tanks should be excluded from the aggregate capacity of ballast tanks;

.2 the capacity of ballast tank located inboard of double hull should be excluded from the aggregate capacity of ballast tanks (see figure 1).

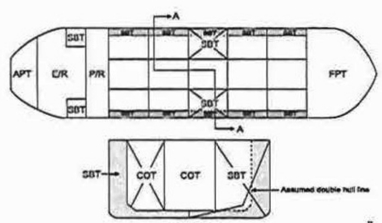


Figure 1

.3 spaces such as void spaces located in the double hull within the cargo tank length should be included in the aggregate capacity of ballast tanks (see figure 2).

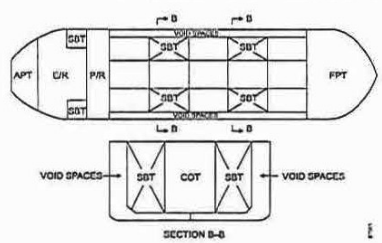


Figure 2

Reg. 13F(5) [See appendix 7 to Unified Interpretations]

Reg. 13G(4) 4.13 *Wing tanks and double bottom spaces of existing oil tankers used for water ballast*

4.13.1 If the wing tanks and double bottom tanks referred to in regulation 13G(4) are used for water ballast, the ballast arrangement should at least be in compliance with the Revised Specifications for Oil Tankers with Dedicated CBT (resolution A.495(XII)).*

Reg. 13G(7) [See appendices 8 and 9 to Unified Interpretations]

5 Fuel oil

Reg. 14(2) 5.1 *Large quantities of oil fuel*

5.1.1 The phrase "large quantities of oil fuel" in regulation 14(2) was formulated in drafting MARPOL 73/78 to take account of those ships which are required to stay at sea for extended periods because of the particular nature of their operation and trade. Under the circumstances considered these ships would be required to fill their empty oil fuel tanks with water ballast in order to maintain sufficient stability and safe navigation conditions.

5.1.2 Such ships may include *inter alia* certain large fishing vessels or ocean-going tugs. Certain other types of ships which for reasons of safety, such as stability, may be required to carry ballast in oil fuel tanks may also be included in this category.

Reg. 14(3) 5.2 *Application of regulation 14(3)*

5.2.1 The phrase "all other ships" in regulation 14(3) should include:

.1 new ships other than oil tankers of less than 4,000 tons gross tonnage;

.2 new oil tankers of less than 150 tons gross tonnage; and

.3 all existing ships irrespective of tonnage.

5.2.2 When the separation of oil fuel tanks and water ballast tanks is unreasonable or impracticable for ships mentioned in paragraph 5.2.1 above, ballast water may be carried in oil fuel tanks, provided that such ballast water is discharged into the sea in compliance with regulation 9(1)(b), 10(2) or 10(3) or into reception facilities in compliance with regulation 10(4).

6 Retention of oil on board

Reg. 1(4), 15(2), 15(3)(b) 6.1 *Equivalent provisions for the carriage of oil by a chemical tanker*

6.1.1 Under regulation 1(4) of Annex I of MARPOL 73/78 any chemical tanker when carrying a cargo or part cargo of oil in bulk is

* See IMO sales publication IMO-619E.

defined as an oil tanker and consequently must comply with the requirements of Annex I applicable to oil tankers. Such a tanker, if it is impracticable for it to be provided with slop tank arrangements in compliance with regulation 15(2) and oil/water interface detectors in accordance with regulation 15(3)(b), should comply with the equivalent provisions set out in appendix 3.*

Reg. 15(2)(c) as amended

6.2 *Tanks with smooth walls*

6.2.1 The term "tanks with smooth walls" should be taken to include the main cargo tanks of oil/bulk/ore carriers which may be constructed with vertical framing of a small depth. Vertically corrugated bulkheads are considered smooth walls.

Reg. 15(3)(b)

6.3 *Oil/water interface detectors*

6.3.1 In the case of existing tankers, the oil/water interface detector referred to in regulation 15(3)(b) should be provided no later than on the date of entry into force of MARPOL 73/78.

Reg. 15(5) 16(3)(a)

6.4 *Conditions for waiver*

6.4.1 The International Oil Pollution Prevention Certificate, when required, should contain sufficient information to permit the port State to determine if the ship complies with the waiver conditions regarding the phrase "restricted voyages as determined by the Administration". This may include a list of ports, the maximum duration of the voyage between ports having reception facilities, or similar conditions as established by the Administration.

Reg. 15(5)

6.4.1A The time limitation "of 72 hours or less in duration" in regulation 15(5)(b)(ii)(2) should be counted:

- (a) from the time the tanker leaves the special area, when a voyage starts within a special area, or
- (b) from the time the tanker leaves a port situated outside the special area to the time the tanker approaches a special area.

6.4.2 The phrase "all oily mixtures" in regulation 15(5)(a) and 15(5)(b)(ii)(3) includes all ballast water and tank washing residues from cargo oil tanks.

Reg. 15(7)

6.5 *Annex I substances which through their physical properties inhibit effective product/water separation and monitoring*

6.5.1 The Government of the receiving Party should establish appropriate measures in order to ensure that the provisions of 6.5.2 are complied with.

6.5.2 A tank which has been unloaded should, subject to the provisions of 6.5.3, be washed and all contaminated washings

* See appendix 3 to Unified Interpretations.

should be discharged to a reception facility before the ship leaves the port of unloading for another port.

6.5.3 At the request of the ship's master, the Government of the receiving Party may exempt the ship from the requirements referred to in 6.5.2, where it is satisfied that:

- .1 the tank unloaded is to be reloaded with the same substance or another substance compatible with the previous one and that the tanker will not be washed or ballasted prior to loading;
- .2 the tank unloaded is neither washed nor ballasted at sea if the ship is to proceed to another port unless it has been confirmed in writing that a reception facility at that port is available and adequate for the purpose of receiving the residues and solvents necessary for the cleaning operations.

6.5.4 An exemption referred to in 6.5.3 should only be granted by the Government of the receiving Party to a ship engaged in voyages to ports or terminals under the jurisdiction of other Parties to the Convention. When such an exemption has been granted it should be certified in writing by the Government of the receiving Party.

6.5.5 In the case of ships retaining their residues on board and proceeding to ports or terminals under the jurisdiction of other Parties to the Convention, the Government of the receiving Party is advised to inform the next port of call of the particulars of the ship and cargo residues, for their information and appropriate action for the detection of violations and enforcement of the Convention.

7 Oil discharge monitoring and control system and oil filtering equipment

Reg. 16(1)

7.1 *Control of discharge of ballast water from oil fuel tanks*

7.1.1 The second sentence of regulation 16(1) should be interpreted as follows:

- .1 Any ship of 400 tons gross tonnage and above but less than 10,000 tons gross tonnage:
- .1.1 which does not carry water ballast in oil fuel tanks should be fitted with 15 ppm oil filtering equipment for the control of discharge of machinery space bilges;
- .1.2 which carries water ballast in oil fuel tanks should be fitted with the equipment required by regulation 16(2) for the control of machinery space bilges and dirty ballast water from oil fuel tanks. Ships on which it is not reasonable to fit this equipment should retain on board dirty ballast water from oil fuel tanks and discharge it to reception facilities.

7.1.2 The above equipment should be of adequate capacity to deal with the quantities of effluent to be discharged.

Reg. 16(1) 16(2)

7.2 *Oil filtering equipment*

7.2.1 Oil filtering equipment referred to in regulation 16(1) and 16(2) may include any combination of a separator, filter or coalescer and also a single unit designed to produce an effluent with oil content not exceeding 15 ppm.

Reg. 16(3)(a)

7.3 *Waivers for restricted voyages*

7.3.1 The International Oil Pollution Prevention Certificate, when required, should contain sufficient information to permit the port State to determine if the ship complies with the waiver conditions regarding the phrase "restricted voyages as determined by the Administration". This may include a list of ports, the maximum duration of the voyage between ports having reception facilities, or similar conditions as established by the Administration.

Reg. 16(6)

7.4 *Automatic stopping device for existing ships having operated with 15 ppm oil filtering equipment*

7.4.1 The requirements for the fitting of an automatic stopping device under regulation 16(2) need not be applied to existing ships until 6 July 1998, if such ships are fitted with 15 ppm oil filtering equipment.

8 Sludge tanks

Reg. 17(1)

8.1 *Capacity of sludge tanks*

8.1.1 To assist Administrations in determining the adequate capacity of sludge tanks, the following criteria may be used as guidance. These criteria should not be construed as determining the amount of oily residues which will be produced by the machinery installation in a given period of time. The capacity of sludge tanks may, however, be calculated upon any other reasonable assumptions. For a ship the keel of which is laid or which is at a similar stage of construction on or after 31 December 1990, the guidance given in items .4 and .5 below should be used in lieu of the guidance contained in items .1 and .2.

.1 For ships which do not carry ballast water in oil fuel tanks, the minimum sludge tank capacity (V_1) should be calculated by the following formula:

$V_1 = K_1CD$ (m^3)

where: K_1 = 0.01 for ships where heavy fuel oil is purified for main engine use, or 0.005 for ships using diesel oil or heavy fuel oil which does not require purification before use,

C = daily fuel oil consumption (metric tons),

D = maximum period of voyage between ports where sludge can be discharged ashore (days). In the absence of precise data a figure of 30 days should be used.

.2 When such ships are fitted with homogenizers, sludge incinerators or other recognized means on board for the control of sludge, the minimum sludge tank capacity (V_1) should, in lieu of the above, be:

V_1 = 1 m^3 for ships of 400 tons gross and above but less than 4,000 tons gross tonnage, or 2 m^3 for ships of 4,000 tons gross tonnage and above.

.3 For ships which carry ballast water in fuel oil tanks, the minimum sludge tank capacity (V_2) should be calculated by the following formula:

$V_2 = V_1 + K_2B$ (m^3)

where: V_1 = sludge tank capacity specified in .1 or .2 above,

K_2 = 0.01 for heavy fuel oil bunker tanks, or 0.005 for diesel oil bunker tanks,

B = capacity of water ballast tanks which can also be used to carry oil fuel (metric tons).

.4 For ships which do not carry ballast water in fuel oil tanks, the minimum sludge tank capacity (V_1) should be calculated by the following formula:

$V_1 = K_1CD$ (m^3)

where: K_1 = 0.015 for ships where heavy fuel oil is purified for main engine use or 0.005 for ships using diesel oil or heavy fuel oil which does not require purification before use,

C = daily fuel oil consumption (m^3),

D = maximum period of voyage between ports where sludge can be discharged ashore (days). In the absence of precise data, a figure of 30 days should be used.

.5 For ships fitted with homogenizers, sludge incinerators or other recognized means on board for the control of sludge, the minimum sludge tank capacity should be:

.5.1 50% of the value calculated according to item .4 above; or

.5.2 1 m^3 for ships of 400 gross tonnage and above but less than 4,000 gross tonnage or 2 m^3 for ships of 4,000 gross tonnage and above;

whichever is the greater.

8.1.2 Administrations should establish that in a ship the keel of which is laid or which is at a similar stage of construction on or after 31 December 1990, adequate tank capacity, which may include the sludge tank(s) referred to under 8.1.1 above, is available also for leakage, drain and waste oils from the machinery installations. In existing installations this should be taken into consideration as far as reasonable and practicable.

Reg. 17(2)

8.2 *Cleaning of sludge tanks and discharge of residues*

8.2.1 To assist Administrations in determining the adequacy of the design and construction of sludge tanks to facilitate their cleaning and the discharge of residues to reception facilities, the following guidance is provided, having effect on ships the keel of which is laid or which is at a similar stage of construction on or after 31 December 1990:

.1 sufficient man-holes should be provided such that, taking into consideration the internal structure of the sludge tanks, all parts of the tank can be reached to facilitate cleaning;

.2 sludge tanks in ships operating with heavy oil, that needs to be purified for use, should be fitted with adequate heating arrangements or other suitable means to facilitate the pumpability and discharge of the tank content;

.3 there should be no interconnections between the sludge tank discharge piping and bilge-water piping other than possible common piping leading to the standard discharge connection referred to in regulation 19. However, arrangements may be made for draining of settled water from the sludge tanks by means of manually operated self-closing valves or equivalent arrangements; and

.4 the sludge tank should be provided with a designated pump for the discharge of the tank content to reception facilities. The pump should be of a suitable type, capacity and discharge head, having regard to the characteristics of the liquid being pumped and the size and position of tank(s) and the overall discharge time.

Reg. 17(3)

8.3 *Overboard connection of sludge tanks*

8.3.1 Ships with existing installations having piping to and from sludge tanks to overboard discharge outlets, other than the standard discharge connection referred to in regulation 19, may comply with regulation 17(3) by the installation of blanks in this piping.

9 Pumping and piping arrangements

Reg. 18(2) as amended

9.1 *Piping arrangements for discharge above the waterline*

9.1.1 Under regulation 18(2), pipelines for discharge to the sea above the waterline must be led either:

.1 to a ship's discharge outlet located above the waterline in the deepest ballast condition; or

.2 to a midship discharge manifold or, where fitted, a stern or bow loading/discharge facility above the upper deck.

9.1.2 The ship's side discharge outlet referred to in 9.1.1.1 should be so located that its lower edge will not be submerged when the ship carries the maximum quantity of ballast during its ballast voyages, having regard to the type and trade of the ship. The discharge outlet located above the waterline in the following ballast condition will be accepted as complying with this requirement:

.1 on oil tankers not provided with SBT or CBT, the ballast condition when the ship carries both normal departure ballast and normal clean ballast simultaneously;

.2 on oil tankers provided with SBT or CBT, the ballast condition when the ship carries ballast water in segregated or dedicated clean ballast tanks, together with additional ballast in cargo oil tanks in compliance with regulation 13(3).

9.1.3 The Administration may accept piping arrangements which are led to the ship's side discharge outlet located above the departure ballast waterline but not above the waterline in the deepest ballast condition, if such arrangements have been fitted before 1 January 1981.

9.1.4 Although regulation 18(2) does not preclude the use of the facility referred to in 9.1.1.2 for the discharge of ballast water, it is recognized that the use of this facility is not desirable, and it is strongly recommended that ships be provided with either the side discharge outlets referred to in 9.1.1.1 or the part flow arrangements referred to in regulation 18(6)(e).

Reg. 18(4)(b) as amended

9.2 *Small diameter line*

9.2.1 For the purpose of application of regulation 18(4)(b), the cross-sectional area of the small diameter line should not exceed:

.1 10% of that of a main cargo discharge line for new oil tankers or existing oil tankers not already fitted with a small diameter line; or

.2 25% of that of a main cargo discharge line for existing oil tankers already fitted with such a line.

(See paragraph 4.4.5 of the revised COW Specifications contained in resolution A.446(XI)).*

Reg. 18(4)(b)

9.3 *Connection of small diameter line to the manifold valve*

9.3.1 The phrase "connected outboard of" with respect to the small diameter line for discharge ashore should be interpreted to mean a connection on the downstream side of the tanker's deck manifold valves, both port and starboard, when the cargo is being discharged.

This arrangement would permit drainage back from the tanker's cargo lines to be pumped ashore with the tanker's manifold valves

* See IMO sales publication IMO-617E.

closed through the same connections as for main cargo lines (see the sketch shown in appendix 4).*

Reg. 18(6)(e)(ii) as amended

9.4 *Part flow system specifications*

9.4.1 The Specifications for the Design, Installation and Operation of a Part Flow System for Control of Overboard Discharges referred to in regulation 18(6)(e)(ii) is set out in appendix 5.†

10 Requirements for drilling rigs and other platforms

Reg. 21
Art. 2(3)(b)(ii)

10.1 *Application of MARPOL 73/78*

10.1.1 There are four categories of discharges associated with the operation of offshore platforms when engaged in the exploration and exploitation of mineral resources, i.e.:

.1 machinery space drainage;

.2 offshore processing drainage;

.3 production water discharge; and

.4 displacement water discharge.

Only the discharge of machinery space drainage should be subject to MARPOL 73/78 (see the diagram shown in appendix 6).‡

10.1.2 When an oil tanker is used as a floating storage unit (FSU) or floating production storage and offloading facility (FPSO) referred to in Unified Interpretation 4.6.1 it is to be regarded as an "other platform" for the purpose of the discharge requirements of regulation 21.

11 Tank size limitation and damage stability

Reg. 22(1)(b)

11.1 *Bottom damage assumptions*

11.1.1 When applying the figures for bottom damage within the forward part of the ship as specified in regulation 22(1)(b) for the purpose of calculating both oil outflow and damage stability, 0.3*L* from the forward perpendicular should be the aftermost point of the extent of damage.

Reg. 23

11.2 *Hypothetical oil outflow for combination carriers*

11.2.1 For the purpose of calculation of the hypothetical oil outflow for combination carriers:

.1 the volume of a cargo tank should include the volume of the hatchway up to the top of the hatchway coamings, regardless of the construction of the hatch, but may not include the volume of any hatch cover; and

* See appendix 4 to Unified Interpretations.
† See appendix 5 to Unified Interpretations.
‡ See appendix 6 to Unified Interpretations.

.2 for the measurement of the volume to moulded lines, no deduction should be made for the volume of internal structures.

Reg. 23(1)(b)

11.3 *Calculation of hypothetical oil outflow*

11.3.1 In a case where the width b_i is not constant along the length of a particular wing tank, the smallest b_i value in the tank should be used for the purposes of assessing the hypothetical outflows of oil O_c and O_s.

Reg. 25(1)

11.4 *Operating draught*

11.4.1 With regard to the term "any operating draught reflecting actual partial or full load conditions", the information required should enable the damage stability to be assessed under conditions the same as or similar to those under which the ship is expected to operate.

Reg. 25(2)

11.5 *Suction wells*

11.5.1 For the purpose of determining the extent of assumed damage under regulation 25(2), suction wells may be neglected, provided such wells are not excessive in area and extend below the tank for a minimum distance and in no case more than half the height of the double bottom.

Reg. 25A(2)

11A Intact stability

11A.1 The vessel should be loaded with all cargo tanks filled to a level corresponding to the maximum combined total of vertical moment of volume plus free surface inertia moment at 0° heel, for each individual tank. Cargo density should correspond to the available cargo deadweight at the displacement at which transverse KM reaches a minimum value, assuming full departure consumables and 1% of the total water ballast capacity. The maximum free surface moment should be assumed in all ballast tanks. For the purpose of calculating GM_o, liquid free surface corrections should be based on the appropriate upright free surface inertia moment. The righting lever curve may be corrected on the basis of liquid transfer moments.

12 Shipboard oil pollution emergency plan

Reg. 26(1)

12.1 *Definition of new ships*

12.1.1 The phrase "ships built" referred to in the last sentence of regulation 26(1) should be taken to mean "ships delivered".

12.2 *Equivalent provision for application of requirement for oil pollution emergency plans*

12.2.1 Any fixed or floating drilling rig or other offshore installation when engaged in the exploration, exploitation or associated offshore processing of sea-bed mineral resources, which has an oil pollution emergency plan co-ordinated with, and approved in accordance with procedures established by, the coastal State, should be regarded as complying with regulation 26.

Appendices to Unified Interpretations of Annex I

Appendix 1

Guidance to Administrations concerning draughts recommended for segregated ballast tankers below 150 m in length

Introduction

1 Three formulations are set forth as guidance to Administrations concerning minimum draught requirements for segregated ballast tankers below 150 m in length.

2 The formulations are based both on the theoretical research and surveys of actual practice on tankers of differing configuration reflecting varying degrees of concern with propeller emergence, vibration, slamming, speed loss, rolling, docking and other matters. In addition, certain information concerning assumed sea conditions is included.

3 Recognizing the nature of the underlying work, the widely varying arrangement of smaller tankers and each vessel's unique sensitivity to wind and sea conditions, no basis for recommending a single formulation is found.

Caution

4 It must be cautioned that the information presented should be used as general guidance for Administrations. With regard to the unique operating requirements of a particular vessel, the Administration should be satisfied that the tanker has sufficient ballast capacity for safe operation. In any case the stability should be examined independently.

5 *Formulation A*

.1 mean draught (m) = $0.200 + 0.032L$

.2 maximum trim = $(0.024 - 6 \times 10^{-5}L)L$

6 These expressions were derived from a study of 26 tankers ranging in length from 50 to 150 m. The draughts, in some cases, were abstracted from ship's trim and stability books and represent departure ballast conditions. The ballast conditions represent sailing conditions in weather up to and including Beaufort 5.

7 *Formulation B*

.1 minimum draught at bow (m) = $0.700 + 0.0170L$

.2 minimum draught at stern (m) = $2.300 + 0.030L$

or

.3 minimum mean draught (m) = $1.550 + 0.023L$

.4 maximum trim = $1.600 + 0.013L$

8 These expressions resulted from investigations based on theoretical research, model and full scale tests. These formulae are based on a Sea 6 (International Sea Scale).

9 *Formulation C*

.1 minimum draught aft (m) = $2.0000 + 0.0275L$

.2 minimum draught forward (m) = $0.5000 + 0.0225L$

10 These expressions provide for certain increased draughts to aid in the prevention of propeller emergence and slamming in higher length ships.

Appendix 2

Interim recommendation for a unified interpretation of regulation 13E

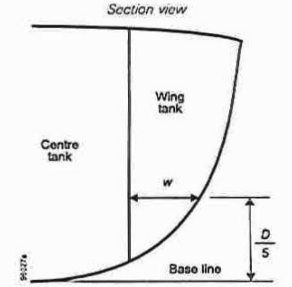
1 Regulation 13E(4) of Annex I of MARPOL 73/78 relating to the measurement of the 2 m minimum width of wing tanks and the measurement of the minimum vertical depth of double bottom tanks of 2 m or $B/15$ in respect of tanks at the ends of the ship where no identifiable bilge area exists should be interpreted as given hereunder. No difficulty exists in the measurement of the tanks in the parallel middle body of the ship where the bilge area is clearly identified. The regulation does not explain how the measurements should be taken.

2 The minimum width of wing tanks should be measured at a height of $D/5$ above the base line providing a reasonable level above which the 2 m width of collision protection should apply, under the assumption that in all cases $D/5$ is above the upper turn of bilge amidships (see figure 1). The minimum height of double bottom tanks should be measured at a vertical plane measured $D/5$ inboard from the intersection of the shell with a horizontal line $D/5$ above the base line (see figure 2).

3 The PA_c value for a wing tank which does not have a minimum width of 2 m throughout its length would be zero; no credit should be given for that part of the tank in which the minimum width is in excess of 2 m. No credit should be given in the assessment of PA_s to any double bottom tank, part of which does not meet the minimum depth requirements anywhere within its length. If, however, the projected dimensions of the bottom of the cargo tank above the double bottom fall entirely within the area of the double bottom tank or space which meets the minimum height requirement and provided the side bulkheads bounding the cargo tank above are vertical or have a slope of not more than 45° from the vertical, credit may be given to the part of the double bottom tank defined by the projection of the cargo tank bottom. For similar cases where the wing tanks above the double bottom are segregated ballast tanks or void spaces, such credit may also be given. This would not, however, preclude in the above cases credit being given to a PA_s value in the first case and to a PA_c value in the second case where the respective vertical or horizontal protection complies with the minimum distances prescribed in regulation 13E(4).

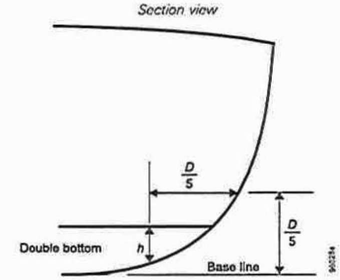
4 Projected dimensions should be used as shown in examples of figures 3 to 8. Figures 7 and 8 represent measurement of the height for the calculation of PA_c for double bottom tanks with sloping tank top. Figures 9 and 10 represent the cases where credit is given in calculation of PA_s to part or the whole of a double bottom tank.

Figure 1 – Measurement of minimum width of wing ballast tank at ends of ship



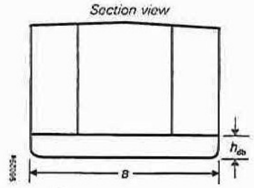
w must be at least 2 metres along the entire length of the tank for the tank to be used in the calculation of PA_c

Figure 2 – Measurement of minimum height of double bottom tank at ends of ship



h must be at least 2 metres or $\frac{B}{15}$, whichever is less, along the entire length of the tank for the tank to be used in the calculation of PA_s

Figure 3 – Calculation of PA_c and PA_s for double bottom tank amidships



If h_{db} is at least 2 metres or $\frac{B}{15}$, whichever is less, along entire tank length,

$PA_c = h_{db} \times$ double bottom tank length $\times$ 2

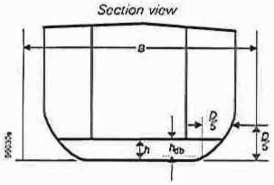
$PA_s = B \times$ double bottom tank length

If h_{db} is less than 2 metres or $\frac{B}{15}$, whichever is less,

$PA_c = h_{db} \times$ double bottom tank length $\times$ 2

$PA_s = 0$

Figure 4 – Calculation of PA_c and PA_s for double bottom tank at ends of ship



If h_{db} is at least 2 metres or $\frac{B}{15}$, whichever is less, along entire tank length,

$PA_c = h \times$ double bottom tank length $\times$ 2

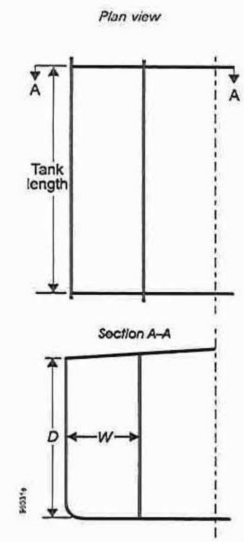
$PA_s = B \times$ double bottom tank length

If h_{db} is less than 2 metres or $\frac{B}{15}$, whichever is less,

$PA_c = h \times$ double bottom tank length $\times$ 2

$PA_s = 0$

Figure 5 – Calculation of PA_c and PA_s for wing tank amidships



If W is 2 metres or more,

$PA_c = D \times$ tank length $\times$ 2*

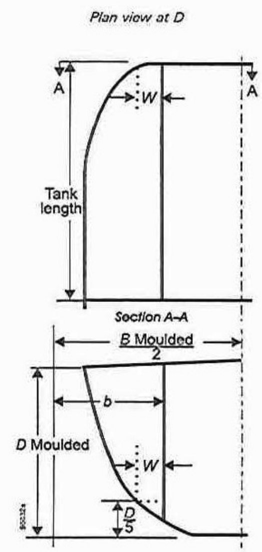
$PA_s = W \times$ tank length $\times$ 2*

If W is less than 2 metres,

$PA_c = 0$

$PA_s = W \times$ tank length $\times$ 2*

Figure 6 – Calculation of PA_c and PA_s for wing tank at end of ship



If W is 2 metres or more,

$PA_c = D \times$ tank length $\times$ 2*

$PA_s = b \times$ tank length $\times$ 2*

If W is less than 2 metres,

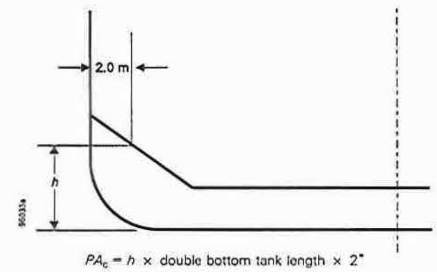
$PA_c = 0$

$PA_s = b \times$ tank length $\times$ 2*

* To include port and starboard.

Figure 7 – Measurement of *h* for calculation of PA_c for double bottom tanks with sloping tank tops (1)

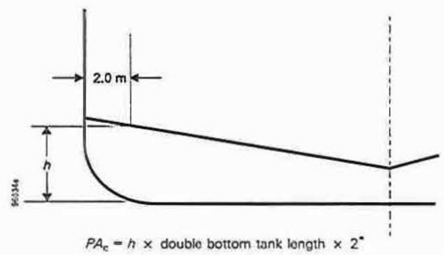
Section view



$PA_c = h \times$ double bottom tank length $\times$ 2*

Figure 8 – Measurement of *h* for calculation of PA_c for double bottom tanks with sloping tank tops (2)

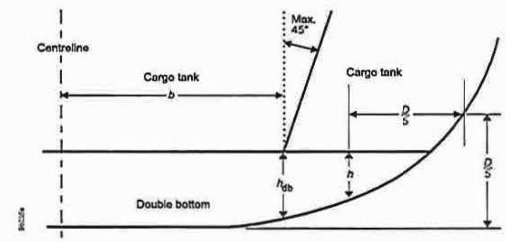
Section view



$PA_c = h \times$ double bottom tank length $\times$ 2*

* To include port and starboard.

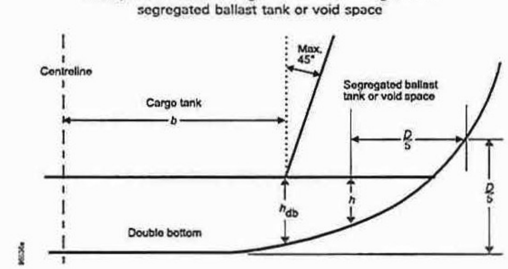
Figure 9 – Calculation of PA_s for double bottom tank without clearly defined turn of bilge area – when wing tank is cargo tank



If *h* is less than 2 metres or $\frac{B}{15}$, whichever is less, anywhere along the tank length, but h_{db} is at least 2 metres or $\frac{B}{15}$, whichever is less, along the entire tank length within the width of 2*b*, then:

$PA_s = 2b \times$ cargo tank length

Figure 10 – Calculation of PA_s for double bottom tank without clearly defined turn of bilge area – when wing tank is segregated ballast tank or void space



If *h* is less than 2 metres or $\frac{B}{15}$, whichever is less, anywhere along the tank length, but h_{db} is at least 2 metres or $\frac{B}{15}$, whichever is less, along the entire tank length within the width of 2*b*, then:

$PA_s = B \times$ cargo tank length

Appendix 3

Equivalent provisions for the carriage of oil by a chemical tanker*

1 By implication, regulation 1(4) of Annex I of MARPOL 73/78 prescribes that where a cargo subject to the provisions of Annex I of MARPOL 73/78 is carried in a cargo space of a chemical tanker, the appropriate requirements of Annex I of MARPOL 73/78 shall apply. For the purposes of application of such requirements, a chemical tanker when carrying oil, if it is impracticable to comply with the requirements of regulation 15(2) and 15(3)(b), shall comply with the following equivalent provisions in accordance with regulation 3 of Annex I.

2 A chemical tanker shall hold a valid Certificate of Fitness issued under the provision of the Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk.

3 A chemical tanker shall be fitted within the cargo tank area with the following equipment:

.1 oily-water separating equipment capable of producing effluent with oil content of less than 100 ppm, complying with the requirements of regulation 16(6) which has been demonstrated to be suitable for the full range of Annex I products and with a minimum capacity as shown in the table below:

Deadweight tons	Capacity of separating equipment (m^3/h)
Less than 2,000	5
2,000 and above but less than 5,000	7.5
5,000 and above but less than 10,000	10
10,000 and above	deadweight/1000

.2 permanently installed transfer pump for overboard discharge of effluent containing oil through the oily-water separating equipment, with a capacity not exceeding the capacity of the separating equipment;

.3 holding tank of sufficient capacity for the separated oil and with the means for discharge of such oil to reception facilities. The holding tank capacity shall be at least equal to the total quantity of residues remaining in the cargo tanks after unloading as determined by the methods prescribed in appendix A of the Standards for Procedures and Arrangements for the Discharge of Noxious Liquid Substances; and

.4 a collecting tank for collecting tank washings. Any cargo tank may be designated as a collecting tank.

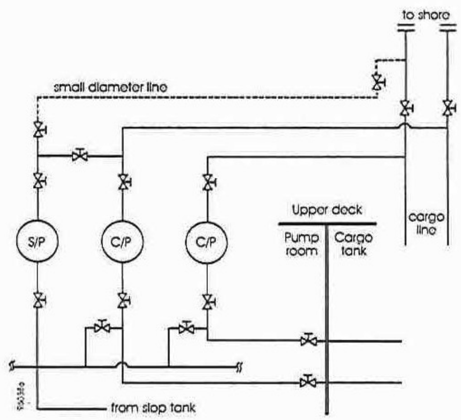
* The 1992 amendments to regulation 16, adopted by the Marine Environment Protection Committee by resolution MEPC.51(32), have effectively made some contents of paragraphs 3 and 4 of this appendix invalid. In accordance with regulation 16(6), 100 ppm equipment was only allowed until 6 July 1998. Therefore, this appendix is subject to future amendment by the MEPC.

4 The equipment referred to in paragraph 3.1 shall be of the type approved under the terms of resolution A.393(X).

5 The outlet for the overboard discharge of the effluent from the oily-water separating equipment shall be located above the waterline in the deepest loaded conditions.

Appendix 4

Connection of small diameter line to the manifold valve



Appendix 5

Specifications for the design, installation and operation of a part flow system for control of overboard discharges

1 *Purpose*

1.1 The purpose of these Specifications is to provide specific design criteria and installation and operational requirements for the part flow system referred to in regulation 18(6)(e) of Annex I of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (MARPOL 73/78).

2 *Application*

2.1 Existing oil tankers may, in accordance with regulation 18(6)(e) of Annex I of MARPOL 73/78, discharge dirty ballast water and oil-contaminated water from cargo tank areas below the waterline, provided that a part of the flow is led through permanent piping to a readily accessible location on the upper deck or above where it may be visually observed during the discharge operation and provided that the arrangements comply with the requirements established by the Administration which shall at least contain all the provisions of these Specifications.

2.2 The part flow concept is based on the principle that the observation of a representative part flow of the overboard effluent is equivalent to observing the entire effluent stream. These specifications provide the details of the design, installation and operation of a part flow system.

3 *General provisions*

3.1 The part flow system shall be so fitted that it can effectively provide a representative sample of the overboard effluent for visual display under all normal operating conditions.

3.2 The part flow system is in many respects similar to the sampling system for an oil discharge monitoring and control system but shall have pumping and piping arrangements separate from such a system, or combined equivalent arrangements acceptable to the Administration.

3.3 The display of the part flow shall be arranged in a sheltered and readily accessible location on the upper deck or above, approved by the Administration (e.g. the entrance to the pump-room). Regard should be given to effective communication between the location of the part flow display and the discharge control position.

3.4 Samples shall be taken from relevant sections of the overboard discharge piping and be passed to the display arrangement through a permanent piping system.

3.5 The part flow system shall include the following components:

.1 sampling probes;

.2 sample water piping system;

.3 sample feed pump(s);

.4 display arrangements;

.5 sample discharge arrangements; and, subject to the diameter of the sample piping,

.6 flushing arrangement.

3.6 The part flow system shall comply with the applicable safety requirements.

4 System arrangement

4.1 Sampling points

4.1.1 Sampling point location:

.1 Sampling points shall be so located that relevant samples can be obtained of the effluent being discharged through outlets below the waterline which are used for operational discharges.

.2 Sampling points shall as far as practicable be located in pipe sections where a turbulent flow is normally encountered.

.3 Sampling points shall as far as practicable be arranged in accessible locations in vertical sections of the discharge piping.

4.1.2 Sampling probes:

.1 Sampling probes shall be arranged to protrude into the pipe a distance of about one fourth of the pipe diameter.

.2 Sampling probes shall be arranged for easy withdrawal for cleaning.

.3 The part flow system shall have a stop valve fitted adjacent to each probe, except that where the probe is mounted in a cargo line, two stop valves shall be fitted in series, in the sample line.

.4 Sampling probes should be of corrosion-resistant and oil-resistant material, of adequate strength, properly jointed and supported.

.5 Sampling probes shall have shape that is not prone to becoming clogged by particle contaminants and should not generate high hydrodynamic pressures at the sampling probe tip. Figure 1 is an example of one suitable shape of a sampling probe.

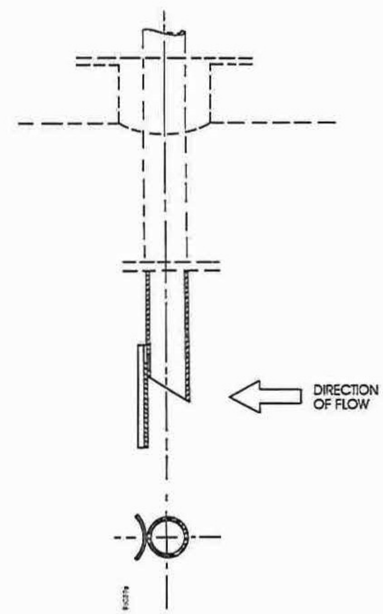
.6 Sampling probes shall have the same nominal bore as the sample piping.

4.2 Sample piping

.1 The sample piping shall be arranged as straight as possible between the sampling points and the display arrangement. Sharp bends and pockets where settled oil or sediment may accumulate should be avoided.

.2 The sample piping shall be so arranged that sample water is conveyed to the display arrangement within 20 s. The flow velocity in the piping should not be less than 2 m/s.

Figure 1 – Sampling probe for a part flow display system



.3 The diameter of the piping shall not be less than 40 mm if no fixed flushing arrangement is provided and shall not be less than 25 mm if a pressurized flushing arrangement as detailed in paragraph 4.4 is installed.

.4 The sample piping should be of corrosion-resistant and oil-resistant material, of adequate strength, properly jointed and supported.

.5 Where several sampling points are installed, the piping shall be connected to a valve chest at the suction side of the sample feed pump.

4.3 **Sample feed pump**

.1 The sample feed pump capacity shall be suitable to allow the flow rate of the sample water to comply with 4.2.2.

4.4 Flushing arrangement

.1 If the diameter of sample piping is less than 40 mm, a fixed connection from a pressurized sea or fresh water piping system shall be installed for flushing of the sample piping system.

4.5 Display arrangement

.1 The display arrangement shall consist of a display chamber provided with a sight glass. The chamber should be of a size that will allow a free fall stream of the sample water to be clearly visible over a length of at least 200 mm. The Administration may approve equivalent arrangements.

.2 The display arrangement shall incorporate valves and piping in order to allow part of the sample flow to bypass the display chamber to obtain a laminar flow for display in the chamber.

.3 The display arrangement shall be designed to be easily opened and cleaned.

.4 The interior of the display chamber shall be white except for the background wall which shall be so coloured as to facilitate the observation of any change in the quality of the sample water.

.5 The lower part of the display chamber shall be shaped like a funnel for collection of the sample water.

.6 A test cock for taking a grab sample shall be provided in order that a sample of the water can be examined independent of that in the display chamber.

.7 The display arrangement shall be adequately lighted to facilitate visual observation of the sample water.

4.6 Sample discharge arrangement

.1 The sample water leaving the display chamber shall be routed to the sea or to a slop tank through fixed piping of adequate diameter.

5 *Operation*

5.1 When a discharge of dirty ballast water or other oil-contaminated water from the cargo tank area is taking place through an outlet below the waterline, the part flow system shall provide sample water from the relevant discharge outlet at all times.

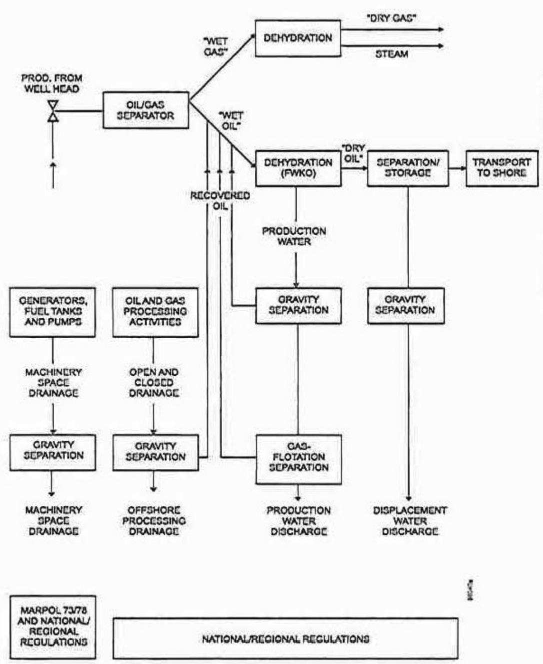
5.2 The sample water should be observed particularly during those phases of the discharge operation when the greatest possibility of oil contamination occurs. The discharge shall be stopped whenever any traces of oil are visible in the flow and when the oil content meter reading indicates that the oil content exceeds permissible limits.

5.3 On those systems that are fitted with flushing arrangements, the sample piping should be flushed after contamination has been observed and, additionally, it is recommended that the sample piping be flushed after each period of usage.

5.4 The ship's cargo and ballast handling manuals and, where applicable, those manuals required for crude oil washing systems or dedicated clean ballast tanks operation shall clearly describe the use of the part flow system in conjunction with the ballast discharge and the slop tank decanting procedures.

Appendix 6

Offshore platform discharges



Appendix 7

Interim guidelines for the approval of alternative methods of design and construction of oil tankers under regulation 13F(5) of Annex I of MARPOL 73/78

Preamble

1 The purpose of these Interim Guidelines, hereunder referred to as "the Guidelines", is to provide an international standard for the evaluation and approval of alternative methods of design and construction of oil tankers under regulation 13F(5) of Annex I of MARPOL 73/78.

2 The basic philosophy of the Guidelines is to compare the oil outflow performance in case of collision or stranding of an alternative tanker design to that of reference double-hull designs complying with regulation 13F(3) on the basis of a calculated pollution-prevention index.

3 The oil outflow performance of double-hull tankers which comply with regulation 13F(3) may be different. The longitudinal subdivision of the cargo tanks has a major influence on the oil outflow in case of inner hull penetration. The selected reference double-hull designs exhibit a favourable oil outflow performance.

4 The calculation of oil outflow is based on the probabilistic methodology and best available tanker accident damage statistics. Reappraisal of the Guidelines may be appropriate when more information on tanker accident damage has become available and more experience with the application of these Guidelines has been gained.

5 Falling tides will have an adverse effect on oil outflow from a stranded tanker and the Guidelines take account of this. The tide values specified in section 5 represent realistic average tidal changes which have been chosen to identify the influence of tidal changes on the oil outflow in case of stranding.

1 *General*

1.1 Regulation 13F of Annex I of MARPOL 73/78 specifies structural requirements for new tankers of 600 tdw and above, contracted on or after 6 July 1993. Paragraph (3) of the regulation requires tankers of 5,000 tdw and above to be equipped with double hulls. Various detailed requirements and permissible exceptions are given in the regulation.

Paragraph (5) of the regulation specifies that other designs may be accepted as alternatives to double hull, provided they give at least the same level of protection against oil pollution in the event of collision or stranding and are approved in principle by the MEPC based on Guidelines developed by the Organization.

1.2 These Guidelines should be used to assess the acceptability of alternative oil tanker designs of 5,000 tdw and above with regard to the prevention of oil outflow in the event of collision or stranding as specified in paragraph (5) of regulation 13F of Annex I of MARPOL 73/78.

1.3 For any alternative design of an oil tanker not satisfying regulation 13F(3) or (4), a study of the cargo oil outflow performance should be carried out as specified in sections 4 through 6 of these Guidelines.

1.4 This study should cover the full range of ship sizes with a minimum of four different ship sizes, unless the approval is requested for only a limited range of vessel sizes. Data for four reference double-hull designs are given in section 7.

1.5 Evaluation of the cargo oil outflow performance of the proposed alternative design should be made by calculating the pollution-prevention index E as outlined in section 4 of these Guidelines.

1.6 The probabilistic methodology for the calculation of oil outflow according to these Guidelines is based on available tanker casualty statistics. With the collection of additional statistical material, the damage density distribution functions specified in 5.2 should be periodically reviewed.

1.7 In principle, and as far as applicable, the requirements of paragraphs (3)(d)–(f), (6) and (8) of regulation 13F apply also to alternative designs. The requirements of paragraph (9) of regulation 13F also apply to alternative designs. In addition, it should be demonstrated by means of a risk analysis that the new design under consideration provides an adequate safety level. Such analysis should address any specific risks associated with the alternative design, and if there are any, it should be demonstrated that safe solutions exist to cope with them.

2 *Applicability*

2.1 These Guidelines apply to the assessment of alternative designs of oil tankers to be constructed of steel or other equivalent material as required by regulation 42 of chapter II-2 of the 1974 SOLAS Convention as amended. Designs for tankers intended to be constructed of other materials or incorporating novel features (e.g. non-metallic materials) or designs which use impact-absorbing devices should be specially considered.

2.2 The approval procedure of these Guidelines applies to oil tankers of sizes up to 350,000 tdw. For larger sizes the approval procedure should be specially considered.

3 *Approval procedure for alternative tanker designs*

3.1 An Administration of a Party to MARPOL 73/78 which receives a request for approval of an alternative tanker design for the purpose of complying with regulation 13F should first evaluate the proposed design and satisfy itself that the design complies with these Guidelines and other applicable regulations of Annex I of MARPOL 73/78. That Administration should then submit the proposal and the supporting documentation, together with its own evaluation report, to the Organization for evaluation and approval of the design concept by the Marine Environment Protection Committee (MEPC) as an alternative to the requirements of regulation 13F(3). Only design concepts which have been approved in principle by the MEPC are allowed for the construction of tankers to which regulation 13F(5) applies.

3.2 The submission to the Administration and the Organization should at least include the following items:

.1 Detailed specification of the alternative design concept.

.2 Drawings showing the basic design of the tank system and, where necessary, of the entire ship.

.3 Study of the oil outflow performance as outlined in paragraphs 1.3 to 1.5.

.4 Risk analysis as outlined in paragraph 1.7.

.5 Details of the calculation procedure or computer program used for the probabilistic oil outflow analysis to satisfy the Administration that the calculation procedure used gives satisfactory results. For verification of the computer program see paragraph 6.2.

Any additional information may be required to be submitted if deemed necessary.

3.3 In addition to the approval procedure for the design concept specified in 3.1 and 3.2 above, the final shipyard design should be approved by the Flag State Administration for compliance with these Guidelines and all other applicable regulations of Annex I of MARPOL 73/78. This should include survivability considerations as referred to in 5.1.5.10.

3.4 Any approved design concept will require reconsideration if the Guidelines have been amended.

4 *Oil outflow analysis*

4.1 General

4.1.1 The oil pollution prevention performance of a tanker design is expressed by a non-dimensional oil pollution prevention index *E* which is a function of the three oil outflow parameters: "probability of zero oil outflow", "mean oil outflow" and "extreme oil outflow". The oil outflow parameters should be calculated for all conceivable damage cases within the entire envelope of damage conditions as detailed in section 5.

4.1.2 The three oil outflow parameters are defined as follows:

Probability of zero oil outflow. This parameter represents the probability that no cargo oil will escape from the tanker in case of collision or stranding. If, e.g., the parameter equals 0.6, in 60% of all collision or stranding accidents no oil outflow is expected to occur.

Mean oil outflow parameter. The mean oil outflow represents the sum of all outflow volumes multiplied by their respective probabilities. The mean oil outflow parameter is expressed as a fraction of the total cargo oil capacity at 98% tank filling.

Extreme oil outflow parameter. The extreme oil outflow is calculated – after the volumes of all outflow cases have been arranged in ascending order – as the sum of the outflow volumes between 0.9 and 1.0 cumulative probability, multiplied by their respective probabilities. The value so derived is multiplied by 10. The extreme oil outflow parameter is expressed as a fraction of the total cargo oil capacity at 98% tank filling.

4.1.3 In general, consideration of ship's survivability will not be required for the conceptual approval of an alternative design. This may, however, be required in special cases, depending on special features of the design.

4.2 Pollution-prevention index

The level of protection against oil pollution in the event of collision or stranding as compared to the reference double-hull designs should be determined by calculation of the pollution-prevention index E as follows:

$$E = k_1 \frac{P_0}{P_{0R}} + k_2 \frac{0.01 + O_{MR}}{0.01 + O_M} + k_3 \frac{0.025 + O_{ER}}{0.025 + O_E} \geq 1.0$$

where:

k_1, k_2 and k_3 are weighting factors having the values:

k_1 = 0.5

k_2 = 0.4

k_3 = 0.1

P_0 = probability of zero oil outflow for the alternative design

O_M = mean oil outflow parameter for the alternative design

O_E = extreme oil outflow parameter for the alternative design

P_{0R}, O_{MR} and O_{ER} are the corresponding parameters for the reference double-hull design of the same cargo oil capacity as specified in section 7.

4.3 Calculation of oil outflow parameters

The oil outflow parameters P_0, O_M and O_E should be calculated as follows:

Probability of zero oil outflow, P_0:

$$P_0 = \sum_{i=1}^{n} P_i \cdot K_i$$

where:

i represents each compartment or group of compartments under consideration, running from $i = 1$ to $i = n$

P_i accounts for the probability that only the compartment or group of compartments under consideration are breached

K_i equals 0 if there is oil outflow from any of the breached cargo spaces in i. If there is no outflow, K_i equals 1.

Mean oil outflow parameter, O_M:

$$O_M = \sum_{i=1}^{n} \frac{P_i \cdot O_i}{C}$$

Annex I

Unified Interpretations

where:

O_i = combined oil outflow (m^3) from all cargo spaces breached in i

C = total cargo oil capacity at 98% tank filling (m^3)

Extreme oil outflow parameter, O_E:

$$O_E = 10\left(\sum \frac{P_{ie} \cdot O_{ie}}{C}\right)$$

where the index "*ie*" represents the extreme outflow cases, which are the damage cases falling within the cumulative probability range between 0.9 and 1.0 after they have been arranged as specified in 6.1.

5 *Assumptions for calculating oil outflow parameters*

5.1 General

5.1.1 The assumptions specified in this section should be used when calculating the oil outflow parameters.

5.1.2 Outflow parameters should be calculated independently for collisions and strandings and then combined as follows:

0.4 of the computed value for collisions plus

0.6 of the computed value for strandings.

5.1.3 For strandings, independent calculations should be done for 0 m, 2 m and 6 m tides. The tide, however, need not be taken greater than 50% of the ship's maximum draught. Outflow parameters for the stranded conditions should be a weighted average, calculated as follows:

0.4 for 0 m tide condition

0.5 for minus 2 m tide condition

0.1 for minus 6 m tide condition.

5.1.4 The damage cases and the associated probability factor P_i for each damage case should be determined based on the damage density distribution functions as specified in paragraph 5.2.

5.1.5 The following general assumptions apply for the calculation of outflow parameters:

.1 The ship should be assumed to be loaded to the maximum assigned load line with zero trim and heel and with a cargo having a density allowing all cargo tanks to be filled to 98%.

.2 For all cases of collision damage, the entire contents of all damaged cargo oil tanks should be assumed to be spilled into the sea, unless proven otherwise.

.3 For all stranded conditions, the ship should be assumed aground on a shelf. Assumed stranded draughts prior to tidal change should be equal to the initial intact draughts. Should the ship trim or float free due to the outflow of oil, this should be accounted for in the calculations for the final shipyard design.

.4 In general, an inert gas overpressure of 0.05 bar gauge should be assumed.

.5 For the calculation of oil outflow in case of stranding, the principles of hydrostatic balance should apply, and the location of damage used for calculations of hydrostatic pressure balance and related oil outflow calculations should be the lowest point in the cargo tank.

.6 For cargo tanks bounded by the bottom shell, unless proven otherwise, oil outflow equal to 1% of the volume of the damaged tank should be assumed to account for initial exchange losses and dynamic effects due to current and waves.

.7 For breached non-cargo spaces located wholly or in part below breached cargo oil tanks, the flooded volume of these spaces at equilibrium should be assumed to contain 50% oil and 50% seawater by volume, unless proven otherwise.

.8 If deemed necessary, model tests may be required to determine the influence of tidal, current and swell effects on the oil outflow performance.

.9 For ship designs which incorporate cargo transfer systems for reducing oil outflow, calculations should be provided illustrating the effectiveness of such devices. For these calculations, damage openings consistent with the damage density distribution functions defined in 5.2 should be assumed.

.10 Where, for the final shipyard design referred to in 3.3 and in the special cases referred to in 4.1.3, damage stability calculations are required, the following should apply:

A damage stability calculation should be performed for each damage case. The stability in the final stage of flooding should be regarded as sufficient if the requirements of regulation 25(3) of Annex I of MARPOL 73/78 are complied with.

Should the ship fail to meet the survivability criteria as defined in regulation 25(3), 100% oil outflow from all cargo tanks should be assumed for that damage case.

5.2 Damage assumptions

5.2.1 *General, definitions*

The damage assumptions for the probabilistic oil outflow analysis are given in terms of the damage density distribution functions specified in subparagraphs 5.2.2 and 5.2.3. These functions are so scaled that the total probability for each damage parameter equals 100%, i.e. the area under each curve equals 1.0.

The location of a damage refers always to the centre of a damage. Damage location and extent to an inner horizontal bottom or vertical bulkhead should be assumed to be the same as the statistically derived damage to the outer hull.

The location and extent of damage to compartment boundaries should be assumed to be of rectangular shape, following the hull surface in the extents defined in subparagraphs 5.2.2 and 5.2.3.

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Unified Interpretations

The following definitions apply for the purpose of subparagraphs 5.2.2 and 5.2.3.

x	=	dimensionless distance from A.P. relative to the ship's length between perpendiculars
y	=	dimensionless longitudinal extent of damage relative to the ship's length between perpendiculars
z_t	=	dimensionless transverse penetration extent relative to the ship's breadth
z_v	=	dimensionless vertical penetration extent relative to the ship's depth
z_l	=	dimensionless vertical distance between the baseline and the centre of the vertical extent z_v relative to the distance between baseline and deck level (normally the ship's depth)
b	=	dimensionless transverse extent of bottom damage relative to the ship's breadth
b_l	=	dimensionless transverse location of bottom damage relative to the ship's breadth.

5.2.2 *Side damage due to collision*

Function for longitudinal location:

$f_{s1} = 1.0$ for $0 \leqslant x \leqslant 1.0$;

function for longitudinal extent:

$f_{s2} = 11.95 - 84.5y$	for $y \leqslant 0.1$
$f_{s2} = 6.65 - 31.5y$	for $0.1 < y \leqslant 0.2$
$f_{s2} = 0.35$	for $0.2 < y \leqslant 0.3$;

function for transverse penetration:

$f_{s3} = 24.96 - 399.2z_t$	for $z_t \leqslant 0.05$
$f_{s3} = 9.44 - 88.8z_t$	for $0.05 < z_t \leqslant 0.1$
$f_{s3} = 0.56$	for $0.1 < z_t \leqslant 0.3$;

function for vertical extent:

$f_{s4} = 3.83 - 11.1z_v$	for $z_v \leqslant 0.3$
$f_{s4} = 0.5$	for $z_v > 0.3$;

function for vertical location:

$f_{s5} = z_l$	for $z_l \leqslant 0.25$
$f_{s5} = 5z_l - 1.0$	for $0.25 < z_l \leqslant 0.50$
$f_{s5} = 1.50$	for $0.50 < z_l \leqslant 1.00$.

Graphs of the functions f_{s1}, f_{s2}, f_{s3}, f_{s4} and f_{s5} are shown in figures 1 and 2.

5.2.3 *Bottom damage due to stranding*

Function for longitudinal location:

$f_{b1} = 0.2 + 0.8x$ for $x \leqslant 0.5$

$f_{b1} = 4x - 1.4$ for $0.5 < x \leqslant 1.0$;

function for longitudinal extent:

$f_{b2} = 4.5 - 13.33y$ for $y \leqslant 0.3$

$f_{b2} = 0.5$ for $0.3 < y \leqslant 0.8$;

function for vertical penetration:

$f_{b3} = 14.5 - 134z_v$ for $z_v \leqslant 0.1$

$f_{b3} = 1.1$ for $0.1 < z_v \leqslant 0.3$;

function for transverse extent:

$f_{b4} = 4.0 - 12b$ for $b \leqslant 0.3$

$f_{b4} = 0.4$ for $0.3 < b \leqslant 0.9$

$f_{b4} = 12b - 10.4$ for $b > 0.9$;

function for transverse location:

$f_{b5} = 1.0$ for $0 \leqslant b_l \leqslant 1.0$.

Graphs of the functions f_{b1}, f_{b2}, f_{b3}, f_{b4} and f_{b5} are shown in figures 3 and 4.

6 *Probabilistic methodology for calculating oil outflow*

6.1 Damage cases

6.1.1 Using the damage probability distribution functions specified in paragraph 5.2, all damage cases n as per paragraph 4.3 should be evaluated and placed in ascending order of oil outflow. The cumulative probability for all damage cases should be computed, being the running sum of probabilities beginning at the minimum outflow damage case and proceeding to the maximum outflow damage case. The cumulative probability for all damage cases should be 1.0.

6.1.2 For each damage case the damage consequences in terms of penetrations (breaching) of cargo tank boundaries should be evaluated and the related oil outflow calculated. A cargo tank should be considered as being breached in a damage case under consideration if the applied damage envelope reaches any part of the cargo tank boundaries.

6.1.3 When determining the damage cases, it should be assumed for the purpose of these calculations that the location, extent and penetration of damages are independent of each other.

6.2 Oil outflow calculations

6.2.1 The probabilistic oil outflow calculations may be done as outlined by the "Example for the Application of the Interim Guidelines" given in the appendix to these

Guidelines. Other calculation procedures may be accepted, provided they show acceptable accuracy.

6.2.2 The computer program used for the oil outflow analysis should be verified against the data for oil outflow parameters for the reference double-hull designs given in section 7.

6.2.3 After the final waterline has been determined, the oil outflow from each damaged cargo tank should be computed for each damage case under the assumptions specified in 5.1.5.

7 *Reference double-hull designs*

Data for four reference double-hull designs of 5,000 tdw, 60,000 tdw, 150,000 tdw and 283,000 tdw are summarized in tables 7.1 and 7.2 and are illustrated in figures 5 to 8.

Table 7.1 contains the data for the oil outflow parameters P_{OR}, O_{MR} and O_{ER} to be used for the concept approval (ship survivability not considered). Table 7.2 contains the corresponding data to be used for the shipyard design approval (ship survivability considered).

Table 7.1 – Oil outflow parameters (ship survivability not considered)

Reference design number	Deadweight (t)	Oil outflow parameters (ship survivability not considered)		
		P_{OR}	O_{MR}	O_{ER}
1	5,000	0.81	0.017	0.127
2	60,000	0.81	0.014	0.104
3	150,000	0.79	0.016	0.113
4	283,000	0.77	0.013	0.085

Table 7.2 – Oil outflow parameters (ship survivability considered)

Reference design number	Deadweight (t)	Oil outflow parameters (ship survivability considered)		
		P_{OR}	O_{MR}	O_{ER}
1	5,000	0.72	0.113	0.469
2	60,000	0.81	0.021	0.173
3	150,000	0.79	0.017	0.124
4	283,000	0.77	0.015	0.098

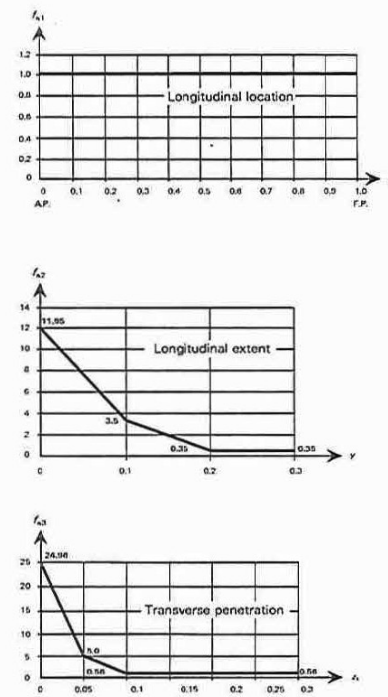


Figure 1 – Side damage due to collision: density distribution functions f_{s1}, f_{s2}, f_{s3}

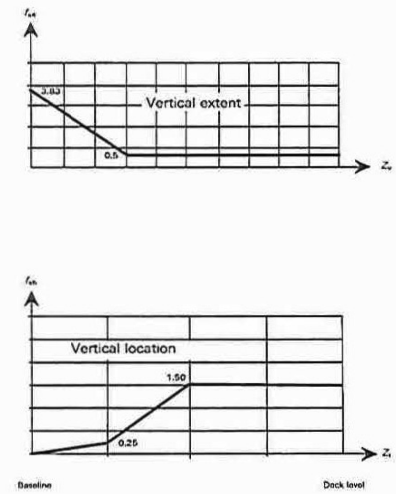


Figure 2 – Side damage due to collision: density distribution functions f_{s4} and f_{s5}

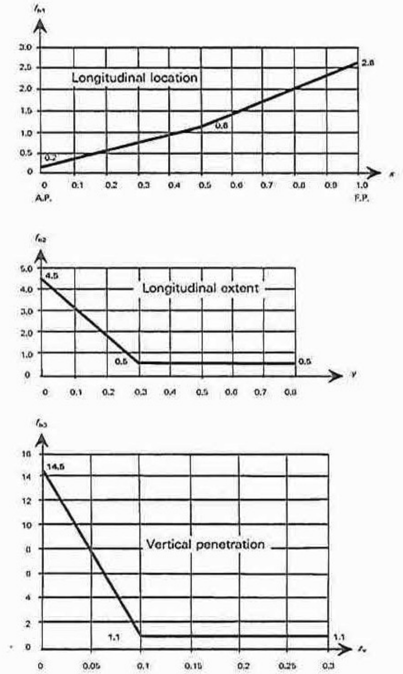


Figure 3 – Bottom damage due to stranding: density distribution functions f_{b1}, f_{b2}, f_{b3}

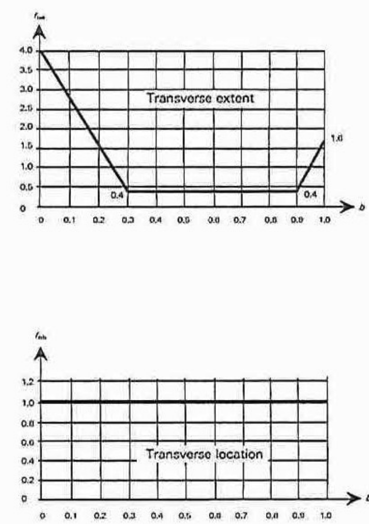


Figure 4 – Bottom damage due to stranding: density distribution functions f_{b4} and f_{b5}

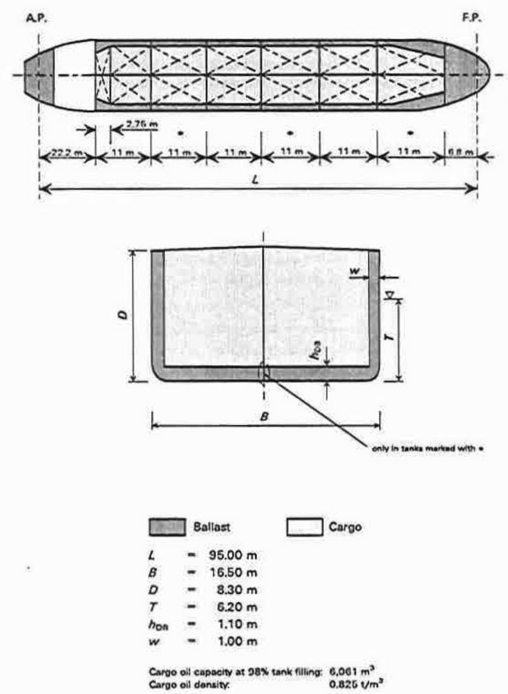


Figure 5 – Reference double-hull design no. 1
Deadweight: 5,000 tdw

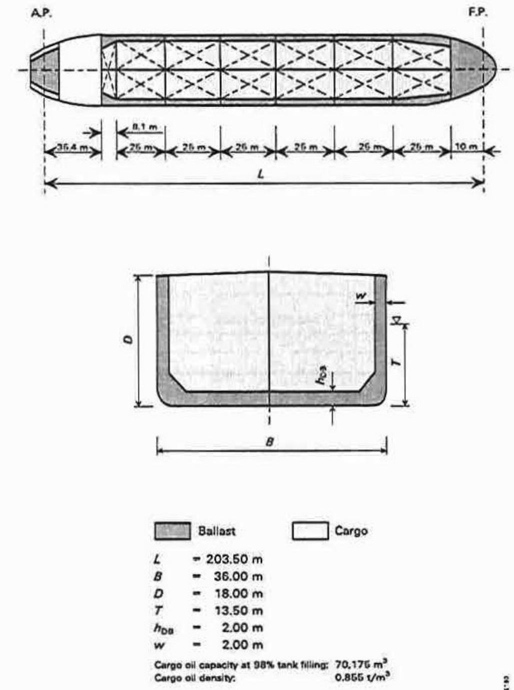
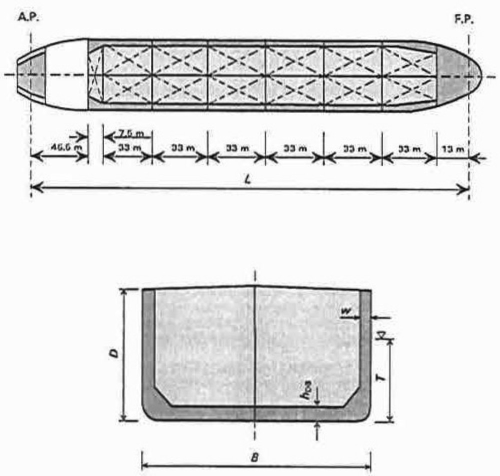


Figure 6 – Reference double-hull design no. 2
Deadweight: 60,000 tdw

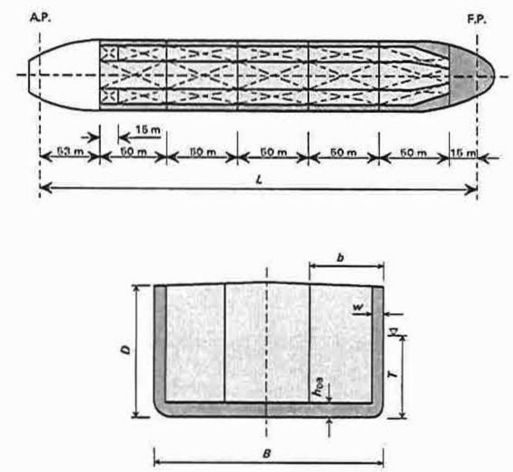


Ballast   Cargo

L	= 264.00 m
B	= 48.00 m
D	= 24.00 m
T	= 16.80 m
h_{DB}	= 2.32 m
w	= 2.00 m

Cargo oil capacity at 98% tank filling: 175,430 m^3
Cargo oil density: 0.855 t/m^3

Figure 7 – Reference double-hull design no. 3
Deadweight: 150,000 tdw



Ballast   Cargo

L	= 318.00 m
B	= 57.00 m
D	= 31.00 m
T	= 22.00 m
b	= 18.00 m
h_{DB}	= 4.20 m
w	= 2.00 m

Cargo oil capacity at 98% tank filling: 330,994 m^3
Cargo oil density: 0.855 t/m^3

Figure 8 – Reference double-hull design no. 4
Deadweight: 283,000 tdw

Appendix

Example for the application of the "Interim Guidelines"

1 *General*

The application of the Interim Guidelines, hereunder referred to as "the Guidelines", is shown in the following worked example illustrating the calculation procedure of the oil outflow parameters for a tank barge. For presentation purposes, a simplified hull form and level of compartmentation have been assumed. The procedures described herein are readily adaptable as a computer application, which will be necessary as more complicated arrangements are evaluated. This example is evaluated in accordance with the requirements for "concept approval". Additional requirements for a shipyard design approval are noted where applicable.

An application of the Guidelines will typically follow these seven basic steps:

1) ***Vessel design***: In accordance with paragraph 3.1 of the Guidelines, the vessel is designed to meet all applicable regulations of Annex I of MARPOL 73/78.

2) ***Establishing of the full load condition***: In accordance with paragraph 5.1.5 of the Guidelines, a full load condition is developed.

3) ***Assembling of the damage cases***: By applying the damage density distribution functions provided in the Guidelines, determine each unique grouping of damaged compartments and the probability associated with that damage condition. Independent sets of damage cases are derived for side (collision) and bottom (stranding) damage.

4) ***Computation of the equilibrium condition for each damage case***: Compute the final equilibrium condition for all side and bottom damage conditions. This step is only required for the final shipyard design, in accordance with paragraph 5.1.5.10 of the Guidelines.

5) ***Computation of the oil outflow for each damage case***: Calculate the oil outflow for each damage case. Separate calculations are done for side damage, and for bottom damage at the 0.0 m, 2.0 m and 6.0 m tide conditions. For side damage, all oil is assumed to escape from damaged tanks. For bottom damage, a hydrostatic balance method is applied. For the final shipyard design, survivability is evaluated in accordance with the requirements of regulation 25(3) of Annex I of MARPOL 73/78.

6) ***Computation of the oil outflow parameters***: The cumulative probability of occurrence of each level of oil outflow is developed. This is done for the side damage and for each bottom damage tide condition. The associated oil outflow parameters are then computed. The bottom damage tidal parameters are combined in accordance with paragraph 5.1.3 and the side and bottom

damage parameters are then combined in accordance with paragraph 5.1.2 of the Guidelines.

7) ***Computation of the Pollution Prevention Index E***: The new design has satisfactory characteristics if E as defined in paragraph 4.2 of the Guidelines is greater than or equal to 1.0.

2 *Analysis procedure*

The basic steps Nos. 1 through 6 are described in this section.

2.1 Step 1: Vessel design

The arrangement and dimensions of the example barge are as shown in figure A1 (Barge arrangement). For clarity purposes, a simple arrangement has been selected which does not meet all MARPOL 73/78 requirements. However, for actual designs submitted for approval as an alternative to double hull, the vessel must meet all applicable regulations of Annex I of MARPOL 73/78.

2.2 Step 2: Establishing of the full load condition

An intact load condition shall be developed with the vessel at its maximum assigned load line with zero trim and heel. Departure quantities of constants and consumables (fuel oil, diesel oil, fresh water, lube oil, etc.) should be assumed. Capacities of cargo oil tanks should be based on actual permeabilities for these compartments. All cargo oil tanks shall be assumed to be filled to 98% of their capacities. All cargo oil shall be taken at a homogeneous density.

For this example, it is assumed that the permeability of the cargo oil tanks is 0.99 and 0.95 for the double bottom/wing tank ballast spaces. The 100% capacity of the cargo oil tanks CO1 and CO2 is:

CO1:	9,623 m^3
CO2:	28,868 m^3
Total:	38,491 m^3.

Cargo tank capacity at 98% filling: $C = 0.98 \times 38{,}491 = 37{,}721\ m^3$.

For this barge, for simplicity reasons, zero weight for the constants and consumables has been assumed. At the 9.0 m assigned load line the following values for the cargo oil mass (W) and density (ρ_c) are obtained:

W = displacement − light barge weight = 33,949 t

ρ_c = 33,949 t/C = 0.90 t/m^3.

2.3 Step 3: Assembling of the damage cases

In this step the damage cases have to be developed. This involves applying the probability density distribution functions for side damage (figures 1 and 2) and the probability density distribution functions for bottom damage (figures 3 and 4). Each unique grouping of damaged compartments is determined together with its associated probability. The sum of the probabilities should equal 1.0 for both the side and the bottom damage evaluations.

There are different methods available for developing the compartment groupings and probabilities, each of which should converge on the same results.

In this example, the compartment groupings and the use of the probability density functions is shown by a "step-wise" evaluation method. This method involves stepping through each damage location and extent at a sufficiently fine increment. For instance, it is assumed (for the side damage) to step through the functions as follows: longitudinal location = 100 steps, longitudinal extent = 100 steps, transverse penetration = 100 steps, vertical location = 10 steps, and vertical extent = 100 steps. You will then be developing 10^9 damage incidents. The probability of each step is equal to the area under the probability density distribution curve over that increment. The probability for each damage incident is the product of the probabilities of the five functions. There are many redundant incidents which damage identical compartments. These are combined by summing their probabilities. For a typical double-hull tanker, the 10^9 damage incidents reduce down to 100 to 400 unique groupings of compartments.

2.3.1 *Side damage evaluation*

The damage density distribution functions provide independent statistics for location, length, and penetration. For side damage, the probability of a given damage longitudinal location, longitudinal extent, transverse penetration, vertical location and vertical extent is the product of the probabilities of these five damage characteristics.

To maintain the example at a manageable size, fairly coarse increments have been assumed:

Longitudinal location at 10 steps	$= L/10$	$= 0.10L$ per step
Longitudinal extent at 3 steps	$= 0.3L/3$	$= 0.10L$ per step
Transverse penetration at 6 steps	$= 0.3B/6$	$= 0.05B$ per step.

To further simplify the evaluation, each damage is assumed to extend vertically without limit. Therefore, the probabilities of vertical location and vertical extent are taken as 1.0 for each damage case. This is a reasonable assumption as the double bottom height is only 10% of the depth. Taking the area under the density distribution function for vertical location up to $0.1D$ (see figure 2, function f_{v5}) yields a value of 0.005. This means that the probability of the centre of damage location falling within the double bottom region is 1/200.

Figure A2 (Side damage definition) shows the steps for longitudinal location, longitudinal extent and transverse penetration in relation to the barge. Table A1 (Increments for step-wise side damage evaluation) gives the range for each step, the mean or average value over the step, and the probability of occurrence of that particular step. For instance, Z_1 covers the range of transverse penetration beginning at the side shell and extending inboard 5% of the breadth. The average penetration is $0.025B$ or 2.5% of the breadth. The probability of occurrence is the likelihood that the penetration will fall within the range of 0% to 5% of the breadth. The probability equals 0.749, which is the area under the density distribution function for transverse penetration (figure 1, function f_{s3}) between $0.0B$ and $0.05B$. The area under each probability density function is 1.0, and therefore the sum of the probabilities for all increments for each function is 1.0.

A total of ten longitudinal locations, three longitudinal extents and six transverse penetrations will be evaluated. All combinations of damages must be considered for a total of $(10) \times (3) \times (6) = 180$ separate incidents. The damaged compartments are found by overlaying each combination of location/extent/penetration onto the barge. These damage boundaries define a rectangular box. Any compartment which extends into this damage zone is considered damaged. Each of the 180 incidents results in damage to one or more compartments. Incidents with identical damaged compartments are collected into a single damage case by summing the probabilities of the individual damage incidents.

Let us begin at the aft end of the barge and proceed forward. The first damage location X_1 is centred $0.05L$ forward of the transom. The first damage extent Y_1 has an average length of $0.05L$. The average value for the first transverse penetration Z_1 is $0.025B$. The resulting damage box lies entirely within the WB1 compartment and therefore damages that compartment only. The probability of this incident is:

$$P_{111}(X_1Y_1Z_1) = (0.1000) \times (0.7725) \times (0.7490) = 0.05786$$

If we step through the transverse penetrations Z_2 through Z_6, we find that only the WB1 compartment is damaged for each of these cases. The probabilities for these cases are 0.01074, 0.00216, 0.00216, 0.00216, 0.00216, and 0.00216 respectively. The combined probability for the six cases at longitudinal damage location X_1 is:

$$P_{111\text{-}6}(X_1Y_1Z_{1\text{-}6}) = 0.05786 + 0.01074 + 0.00216 + 0.00216 + 0.00216 + 0.00216 = 0.07725$$

Next, we move to damage extent Y_2. The damage box $X_1Y_2Z_1$ once again falls within the WB1 compartment. Likewise, transverse penetrations Z_2 through Z_6 fall within this compartment. We compute the probability for these cases and find that $P_{121\text{-}6}(X_1Y_2Z_{1\text{-}6}) = 0.01925$.

Similarly, the damage boxes defined by $X_1Y_3Z_{1\text{-}6}$ lie within the WB1 compartment and have a combined probability $P_{131\text{-}6}(X_1Y_3Z_{1\text{-}6}) = 0.00350$.

We now move to the next longitudinal location, X_2. With longitudinal extent Y_1, the damage stays within the WB1 compartment. The combined probability is $P_{211\text{-}6}(X_2Y_1Z_{1\text{-}6}) = 0.07725$.

The forward bound of the damage box $X_2Y_2Z_1$ extends forward of the transverse bulkhead located 20.0 m from the transom, damaging compartments both fore and aft of this bulkhead. Transverse penetration Z_1 extends to a point just outboard of the longitudinal bulkhead. Therefore, this combination damages both the WB1 and WB2S compartments. The probability is $P_{221}(X_2Y_2Z_1) = 0.01442$.

We find that the damage box $X_2Y_2Z_2$ extends inboard of the longitudinal bulkhead, damaging compartments WB1, WB2S and CO1. A cargo oil tank has been damaged and oil outflow will occur. Similarly, damage penetrations Z_3 through Z_6 result in breaching of the three compartments. The combined probability for these five incidents is:

$$P_{222\text{-}6}(X_2Y_2Z_{2\text{-}6}) = 0.00268 + 0.00054 + 0.00054 + 0.00054 + 0.00054 = 0.00483$$

By stepping through the barge for all 180 incidents and combining unique damage compartment groupings, we obtain the compartment grouping and probability values shown in table A2 (Probability values for side damage). Each compartment group represents a unique set of compartments. The associated probability is the probability that each particular group of compartments will be damaged in a collision which breaches the hull. For instance, the probability of damaging the WB1 compartment is 0.17725. This means there is approximately a 17.7% likelihood that only this compartment will be damaged. Likewise, the probability of concurrently damaging the WB1 and WB2S compartments is 0.03408 or about 3.4%. Note that the cumulative probability of occurrence for all groups equals 1.0.

2.3.2 *Bottom damage evaluation*

For bottom damage, the probability of a given damage longitudinal location, longitudinal extent, vertical penetration, transverse location and transverse extent is, analogously to the side damage evaluation, the product of the probabilities of these five damage characteristics.

The following increments are assumed for the bottom damage evaluation:

Longitudinal location at 10 steps	$= L/10$	$= 0.10L$ per step
Longitudinal extent at 8 steps	$= 0.8L/8$	$= 0.10L$ per step
Vertical penetration at 6 steps	$= 0.3D/6$	$= 0.05D$ per step.

To further simplify the evaluation, all damage is assumed to extend transversely without limit. Therefore, the probabilities of transverse extent and transverse location are taken as 1.0 for each damage case.

Compartment groupings are developed using the same process as previously described for side damage.

Analogously, a total of ten longitudinal locations, eight longitudinal extents and six vertical penetrations need to be evaluated. The damage incidents to be taken into account for groundings sum up to a total of $(10) \times (8) \times (6) = 480$ separate incidents.

Figure A3 (Bottom damage definition) shows the steps for longitudinal location, longitudinal extent and vertical penetration in relation to the barge. Table A3 (Increments for step-wise bottom damage definition) gives the range for each step, the mean or average value over the step, and the probability of occurrence of that particular step.

Again, putting the aftmost compartment WB1 together in terms of damage increments, the following probabilities have to be summed up:

$$P_{111\text{-}6}(X_1Y_1Z_{1\text{-}6}) = (0.0240) \times (0.38333) \times (1.0) = 0.00920$$

$$P_{121\text{-}6}(X_1Y_2Z_{1\text{-}6}) = (0.0240) \times (0.2500) \times (1.0) = 0.00600$$

$$P_{131\text{-}6}(X_1Y_3Z_{1\text{-}6}) = (0.0240) \times (0.11677) \times (1.0) = 0.00280$$

$$P_{211\text{-}6}(X_2Y_1Z_{1\text{-}6}) = (0.0320) \times (0.38333) \times (1.0) = 0.01227.$$

Therefore the likelihood of damaging the WB1 compartment sums up to:

$$P_{WB1} = P_{11} + P_{12} + P_{13} + P_{21} = 0.03027.$$

By addressing each of the 480 incidents to the relevant compartment (or groups of compartments) the likelihood of a damage to these resulting from a grounding is obtained. This is shown in table A4 (Probability values for bottom damage).

2.4 Step 4: Computation of the equilibrium condition for each damage case

This example describes the concept analysis only. Damage stability analyses to determine the equilibrium conditions are only required for the final shipyard design, in accordance with paragraph 5.1.5.10 of the Guidelines.

2.5 Step 5: Computation of the oil outflow for each damage case

In this step the oil outflow associated with each of the compartment groupings is calculated for side and bottom damage as outlined below.

2.5.1 *Side damage evaluation*

For side damage, 100% of the oil in a damaged cargo oil tank is assumed to outflow into the sea. If we review the eleven compartment groupings for side damage, we find that oil tank damage occurs in three combinations: CO1 only, CO2 only, and concurrent damage to CO1 and CO2. The oil outflow for these tanks is as follows:

CO1 (98% full volume)	=	9,430 m^3
CO2 (98% full volume)	=	28,291 m^3
CO1 + CO2 (98% full volume)	=	37,721 m^3.

2.5.2 *Bottom damage evaluation*

For bottom damage, a pressure balance calculation must be carried out. The vessel is assumed to remain stranded on a shelf at its original intact draught. For the concept analysis, zero trim and zero heel are assumed. An inert gas overpressure of 0.05 bar gauge is assumed in accordance with paragraph 5.1.5.4 of the Guidelines. The double bottom spaces located below the cargo oil tanks "capture" some portion of the oil outflow. In accordance with paragraph 5.1.5.7 of the Guidelines, the flooded volume of such spaces should be assumed to contain 50% oil and 50% seawater by volume at equilibrium. When calculating the oil volume captured in these spaces, no assumptions are made on how the oil and seawater is distributed in these spaces.

The calculations are generally carried out for three tidal conditions: 0.0 m tide, with a 2.0 m tidal drop, and with a 6.0 m tidal drop. In accordance with paragraph 5.1.3 of the Guidelines, the tidal drop need not be taken greater than 50% of the ship's maximum draught. For this example, the appropriate tidal conditions are therefore 0.0 m, 2.0 m and 4.5 m.

The actual oil volume lost from a cargo tank is calculated for each of the three tidal conditions, assuming hydrostatic balance as follows:

$$z_c \cdot \rho_c \cdot g + 100\Delta p = z_s \cdot \rho_s \cdot g$$

where:

z_c = height of remaining oil in the damaged tank (m)

ρ_c = cargo oil density (0.9 t/m^3)

g = gravitational acceleration (9.81 m/s^2)

Δp = set pressure of cargo tank pressure/vacuum valves (0.05 bar gauge)

z_s = external seawater head above inner bottom (m)

z_s = $T - 2 = 7.00$ m

ρ_s = seawater density (1.025 t/m^3)

See also figure A4.

From the above equation one obtains for the height of remaining oil z_c for the zero-tide condition:

z_c = 7.40 m.

Thus, the height of lost oil ($h_l = 0.98h_c - z_c$) is:

h_l = 17.64 - 7.40 = 10.24 m.

The volume of lost oil (V_l) of cargo tank CO1 is:

$V_l = 10.24 \times 36 \times 15 \times 0.99 = 5{,}474$ m^3.

In this case the total volume (V_{wo}) of oil and water in the water ballast tanks is:

$V_{wo} = 2 \times [20 \times 2 + z_{wo} \times 2] \times 60 \times 0.95 = 6{,}202$ m^3

where:

$z_{wo} = 0.5(z_c + z_s) = 7.20$ m.

If one assumes that 50% of V_{wo} is occupied by captured oil, one obtains for the total oil outflow ($V_{outflow}$) of cargo tank CO1:

$V_{outflow} = V_l - 0.5V_{wo} = 2{,}373$ m^3.

The oil outflow of cargo tank CO2 is:

$V_{outflow} = 10.24 \times 36 \times 45 \times 0.99 - 0.5 \times 6{,}202 = 13{,}322$ m^3

and the total oil outflow of cargo tanks CO1 and CO2 is:

$V_{outflow} = 10.24 \times 36 \times 60 \times 0.99 - 0.5 \times 6{,}202 = 18{,}796$ m^3.

Step-wise application of the damage extents and assumed increments results in fourteen compartment groupings for bottom damage. Oil tank and double bottom damage occurs in three combinations. The oil outflows for these tanks at 0.0 m, 2.0 m and 4.5 m tide are summarized in the table below:

Tank combination	Oil outflow (m^3) at		
	0.0 m tide	2.0 m tide	4.5 m tide
WB2S+WB2P+CO1	2,373	3,832	5,658
WB2S+WB2P+CO2	13,322	17,210	22,081
WB2S+WB2P+CO1+CO2	18,796	23,898	30,292

Annex I

Unified Interpretations

2.6 **Step 6: Computation of the oil outflow parameters**

In this step the oil outflow parameters are computed in accordance with paragraph 4.3 of the Guidelines. To facilitate calculation of these parameters, place the damage groupings in a table in ascending order as a function of oil outflow. A running sum of probabilities is computed, beginning at the minimum outflow damage case and proceeding to the maximum outflow damage case. Tables A5 and A6 (Cumulative probability and oil outflow values) contain the outflow values for the side damage and bottom damage for the three tide conditions.

Probability of zero oil outflow, P_0: This parameter equals the cumulative probability for all damage cases for which there is no oil outflow. From table A5, we see that the probability of zero outflow for the side damage condition is 0.83798, and the probability of zero outflow for the bottom damage (0.0 m tide) condition is 0.84313.

Mean oil outflow parameter, O_M: This is the weighted average of all cases, and is obtained by summing the products of each damage case probability and the computed outflow for that damage case.

Extreme oil outflow parameter, O_E: This represents the weighted average of the damage cases falling within the cumulative probability range between 0.9 and 1.0. It equals the sum of the products of each damage case probability with a cumulative probability between 0.90 and 1.0 and its corresponding oil outflow, with the result multiplied by 10.

For this example, the computed outflow values are as shown in tables A5 and A6. In accordance with paragraph 5.1.3 of the Guidelines, the bottom damage outflow parameters for the 0.0 m, 2.0 m and 4.5 m tides are combined in a ratio of 0.4 : 0.5 : 0.1 respectively. In accordance with paragraph 5.1.2, the collision (side damage) and stranding (bottom damage) parameters are then combined in a ratio of 0.4 : 0.6 respectively. In table A7 (Summary of oil outflow parameters) the oil outflow parameters P_0, O_M and O_E for the example tank barge are listed.

Table A1 – Increments for step-wise side damage evaluation

Longitudinal location (step = 0.1L)

	range of increments			
	minimum	maximum	midpoint	probability
X_1	0.0L	0.1L	0.05L	0.1000
X_2	0.1L	0.2L	0.15L	0.1000
X_3	0.2L	0.3L	0.25L	0.1000
X_4	0.3L	0.4L	0.35L	0.1000
X_5	0.4L	0.5L	0.45L	0.1000
X_6	0.5L	0.6L	0.55L	0.1000
X_7	0.6L	0.7L	0.65L	0.1000
X_8	0.7L	0.8L	0.75L	0.1000
X_9	0.8L	0.9L	0.85L	0.1000
X_{10}	0.9L	1.0L	0.95L	0.1000
				1.0000

Longitudinal extent (step = 0.1L)

	range of extents			
	minimum	maximum	average	probability
Y_1	0.0L	0.1L	0.05L	0.7725
Y_2	0.1L	0.2L	0.15L	0.1925
Y_3	0.2L	0.3L	0.25L	0.0350
				1.0000

Transverse penetration (step = 0.05B)

	range of penetration			
	minimum	maximum	average	probability
Z_1	0.0B	0.05B	0.025B	0.7490
Z_2	0.05B	0.10B	0.075B	0.1390
Z_3	0.10B	0.15B	0.125B	0.0280
Z_4	0.15B	0.20B	0.175B	0.0280
Z_5	0.20B	0.25B	0.225B	0.0280
Z_6	0.25B	0.30B	0.275B	0.0280
				1.0000

Table A2 – Probability values for side damage

	Unique compartment groupings	Damage extents and probabilities							Group probability
1	WB1	$X_1Y_1Z_{1\text{-}6}$ 0.07725	$X_1Y_2Z_{1\text{-}6}$ 0.01925	$X_1Y_3Z_{1\text{-}6}$ 0.00350	$X_2Y_1Z_{1\text{-}6}$ 0.07725				0.17725
2	WB1 + WB2S	$X_2Y_2Z_1$ 0.01442	$X_2Y_3Z_1$ 0.00262	$X_3Y_3Z_1$ 0.00262	$X_3Y_2Z_1$ 0.01442				0.03408
3	WB1 + WB2S + CO1	$X_2Y_2Z_{2\text{-}6}$ 0.00483	$X_2Y_3Z_{2\text{-}6}$ 0.00088	$X_3Y_2Z_{2\text{-}6}$ 0.00483					0.01054
4	WB2S	$X_3Y_1Z_1$ 0.05786	$X_4Y_1Z_1$ 0.05786	$X_4Y_2Z_1$ 0.01442	$X_4Y_3Z_1$ 0.00262	$X_5Y_1Z_1$ 0.05786	$X_5Y_2Z_1$ 0.01442	$X_5Y_3Z_1$ 0.00262	0.41532
		$X_6Y_1Z_1$ 0.05786	$X_6Y_2Z_1$ 0.01442	$X_6Y_3Z_1$ 0.00262	$X_7Y_1Z_1$ 0.05786	$X_7Y_2Z_1$ 0.01442	$X_7Y_3Z_1$ 0.00262	$X_8Y_1Z_1$ 0.05786	
5	WB2S + CO1	$X_3Y_1Z_{2\text{-}6}$ 0.01939							0.01939
6	WB2S + CO1 + CO2	$X_4Y_1Z_{2\text{-}6}$ 0.01939	$X_4Y_2Z_{2\text{-}6}$ 0.00483	$X_4Y_3Z_{2\text{-}6}$ 0.00088	$X_5Y_3Z_{2\text{-}6}$ 0.00088				0.02598
7	WB1 + WB2S + CO1 + CO2	$X_3Y_3Z_{2\text{-}6}$ 0.00088							0.00088
8	WB2S + CO2	$X_5Y_1Z_{2\text{-}6}$ 0.01939	$X_5Y_2Z_{2\text{-}6}$ 0.00483	$X_6Y_1Z_{2\text{-}6}$ 0.01939	$X_6Y_2Z_{2\text{-}6}$ 0.00483	$X_6Y_3Z_{2\text{-}6}$ 0.00088	$X_7Y_1Z_{2\text{-}6}$ 0.01939	$X_7Y_2Z_{2\text{-}6}$ 0.00483	0.09381
		$X_7Y_3Z_{2\text{-}6}$ 0.00088	$X_8Y_1Z_{2\text{-}6}$ 0.01939						
9	WB2S + WB3	$X_8Y_2Z_1$ 0.01442	$X_8Y_3Z_1$ 0.00262	$X_9Y_2Z_1$ 0.01442	$X_9Y_3Z_1$ 0.00262				0.03408
10	WB2S + CO2 + WB3	$X_8Y_2Z_{2\text{-}6}$ 0.00483	$X_8Y_3Z_{2\text{-}6}$ 0.00088	$X_9Y_2Z_{2\text{-}6}$ 0.00483	$X_9Y_3Z_{2\text{-}6}$ 0.00088				0.01142
11	WB3	$X_9Y_1Z_{1\text{-}6}$ 0.07725	$X_{10}Y_1Z_{1\text{-}6}$ 0.07725	$X_{10}Y_2Z_{1\text{-}6}$ 0.01925	$X_{10}Y_3Z_{1\text{-}6}$ 0.00350				0.17725
									1.00000

Table A3 – Increments for step-wise bottom damage definition

Longitudinal location (step = 0.1*L*)

	range of increments			
	minimum	maximum	midpoint	probability
X_1	0.0*L*	0.1*L*	0.05*L*	0.0240
X_2	0.1*L*	0.2*L*	0.15*L*	0.0320
X_3	0.2*L*	0.3*L*	0.25*L*	0.0400
X_4	0.3*L*	0.4*L*	0.35*L*	0.0480
X_5	0.4*L*	0.5*L*	0.45*L*	0.0560
X_6	0.5*L*	0.6*L*	0.55*L*	0.0800
X_7	0.6*L*	0.7*L*	0.65*L*	0.1200
X_8	0.7*L*	0.8*L*	0.75*L*	0.1600
X_9	0.8*L*	0.9*L*	0.85*L*	0.2000
X_{10}	0.9*L*	1.0*L*	0.95*L*	0.2400
				1.0000

Longitudinal extent (step = 0.1*L*)

	range of extents			
	minimum	maximum	average	probability
Y_1	0.0*L*	0.1*L*	0.05*L*	0.3833
Y_2	0.1*L*	0.2*L*	0.15*L*	0.2500
Y_3	0.2*L*	0.3*L*	0.25*L*	0.1167
Y_4	0.3*L*	0.4*L*	0.35*L*	0.0500
Y_5	0.4*L*	0.5*L*	0.45*L*	0.0500
Y_6	0.5*L*	0.6*L*	0.55*L*	0.0500
Y_7	0.6*L*	0.7*L*	0.65*L*	0.0500
Y_8	0.7*L*	0.8*L*	0.75*L*	0.0500
				1.0000

Vertical penetration (step = 0.05*D*)

	range of penetration			
	minimum	maximum	average	probability
Z_1	0.0*D*	0.05*D*	0.025*D*	0.5575
Z_2	0.05*D*	0.10*D*	0.075*D*	0.2225
Z_3	0.10*D*	0.15*D*	0.125*D*	0.0550
Z_4	0.15*D*	0.20*D*	0.175*D*	0.0550
Z_5	0.20*D*	0.25*D*	0.225*D*	0.0550
Z_6	0.25*D*	0.30*D*	0.275*D*	0.0550
				1.0000

Table A4 – Probability values for bottom damage

	Unique compartment groupings	Damage extents and probabilities								Group probability
1	WB1	$X_{1-2}Y_1Z_{1-5}$ 0.02147	$X_1Y_2Z_{1-5}$ 0.006	$X_1Y_3Z_{1-5}$ 0.0028						0.03027
2	WB1 + WB2S + WB2P		$X_{2-3}Y_2Z_{1-2}$ 0.01404	$X_{2-3}Y_3Z_{1-2}$ 0.00655	$X_{1-4}Y_4Z_{1-2}$ 0.00562	$X_{1-4}Y_5Z_{1-2}$ 0.00562	$X_{1-5}Y_6Z_{1-2}$ 0.0078	$X_{1-5}Y_7Z_{1-2}$ 0.0078	$X_{1-4}Y_8Z_{1-2}$ 0.00562	0.05305
3	WB2S + WB2P + WB3		$X_{8-9}Y_2Z_{1-2}$ 0.0702	$X_{8-9}Y_3Z_{1-2}$ 0.03276	$X_{7-10}Y_4Z_{1-2}$ 0.02808	$X_{7-10}Y_5Z_{1-2}$ 0.02808	$X_{6-10}Y_6Z_{1-2}$ 0.0312	$X_{6-10}Y_7Z_{1-2}$ 0.0312	$X_{7-10}Y_8Z_{1-2}$ 0.02808	0.24960
4	WB1 + WB2S + WB2P + WB3								$X_{5-6}Y_8Z_{1-2}$ 0.00530	0.00530
5	WB2S + WB2P	$X_{3-8}Y_1Z_{1-2}$ 0.1507	$X_{4-7}Y_2Z_{1-2}$ 0.05928	$X_{4-7}Y_3Z_{1-2}$ 0.02766	$X_{5-6}Y_4Z_{1-2}$ 0.0053	$X_{5-6}Y_5Z_{1-2}$ 0.0053				0.24824
6	WB3	$X_{9-10}Y_1Z_{1-5}$ 0.16867	$X_{10}Y_2Z_{1-5}$ 0.06	$X_{10}Y_3Z_{1-5}$ 0.028						0.25667
7	WB1 + WB2S + WB2P + CO1		$X_{2-3}Y_2Z_{3-5}$ 0.00396	$X_2Y_3Z_{3-5}$ 0.00082	$X_{1-2}Y_4Z_{3-5}$ 0.00062	$X_1Y_5Z_{3-5}$ 0.00026	$X_1Y_6Z_{3-5}$ 0.00026			0.00592
8	WB2S + WB2P + CO1	$X_3Y_1Z_{3-5}$ 0.00337								0.00337
9	WB2S + WB2P + CO2	$X_{4-8}Y_1Z_{3-5}$ 0.03508	$X_{5-7}Y_2Z_{3-5}$ 0.01408	$X_{6-7}Y_3Z_{3-5}$ 0.00513	$X_6Y_4Z_{3-5}$ 0.00088					0.05517
10	WB2S + WB2P + WB3 + CO2		$X_{8-9}Y_2Z_{3-5}$ 0.0198	$X_{8-9}Y_3Z_{3-5}$ 0.00924	$X_{7-10}Y_4Z_{3-5}$ 0.00792	$X_{7-10}Y_5Z_{3-5}$ 0.00792	$X_{7-10}Y_6Z_{3-5}$ 0.00792	$X_{8-10}Y_7Z_{3-5}$ 0.0066	$X_{8-10}Y_8Z_{3-5}$ 0.0066	0.06600
11	WB1 + WB2S + WB2P + CO1 + CO2			$X_3Y_3Z_{3-5}$ 0.00098	$X_{3-4}Y_4Z_{3-5}$ 0.00098	$X_{2-4}Y_5Z_{3-5}$ 0.00132	$X_{2-5}Y_6Z_{3-5}$ 0.00194	$X_{1-5}Y_7Z_{3-5}$ 0.0022	$X_{1-4}Y_8Z_{3-5}$ 0.00158	0.00903
12	WB2S + WB2P + WB3 + CO1 + CO2						$X_6Y_6Z_{3-5}$ 0.00088	$X_{6-7}Y_7Z_{3-5}$ 0.0022	$X_7Y_8Z_{3-5}$ 0.00132	0.00440
13	WB1 + WB2S + WB2P + WB3 + CO1 + CO2								$X_{5-6}Y_8Z_{3-5}$ 0.0015	0.00150
14	WB2S + WB2P + CO1 + CO2	$X_4Y_1Z_{3-5}$ 0.00405	$X_4Y_2Z_{3-5}$ 0.00264	$X_{4-5}Y_3Z_{3-5}$ 0.00267	$X_5Y_4Z_{3-5}$ 0.00062	$X_{5-6}Y_5Z_{3-5}$ 0.00015				0.01148
										1.00000

Table A5 – Cumulative probability and oil outflow values *(continued)*

Bottom damage (0.0 metre tide)

Compartment groupings	Oil outflow O_i (m^3)	Probability P_i	Cumulative probability [sum of P_i]	Mean oil outflow $P_i \times O_i$ (m^3)	Probability P_n	Extreme outflow $O_n \times P_n \times 10$ (m^3)
WB1	0.00	0.03027	0.03027	0.00		
WB1 + WB2S + WB2P	0.00	0.05304	0.08331	0.00		
WB1 + WB2S + WB2P + WB3	0.00	0.00530	0.08861	0.00		
WB2S + WB2P	0.00	0.24825	0.33686	0.00		
WB2S + WB2P + WB3	0.00	0.24960	0.58646	0.00		
WB3	0.00	0.25667	0.84313	0.00		
WB1 + WB2S + WB2P + CO1	2373.00	0.00592	0.84905	14.05		
WB2S + WB2P + CO1	2373.00	0.00337	0.85242	8.00		
WB2S + WB2P + CO2	13322.00	0.05518	0.90760	735.11	0.00760	1012.4720
WB2S + WB2P + WB3 + CO2	13322.00	0.06600	0.97360	879.25	0.06600	8792.5200
WB1 + WB2S + WB2P + CO1 + CO2	18796.00	0.00903	0.98263	169.73	0.00903	1697.2788
WB3 + WB2S + WB2P + CO1 + CO2	18796.00	0.00150	0.98413	28.19	0.00150	281.9400
WB1 + WB2S + WB2P + WB3 + CO1 + CO2	18796.00	0.00440	0.98853	82.70	0.00440	827.0240
WB2S + WB2P + CO1 + CO2	18796.00	0.01147	1.00000	215.59	0.01147	2155.9012
				2132.62	0.10000	14767.1360

Table A5 – Cumulative probability and oil outflow values

Side damage

Compartment groupings	Oil outflow O_i (m^3)	Probability P_i	Cumulative probability [sum of P_i]	Mean oil outflow $P_i \times O_i$ (m^3)	Probability P_n	Extreme outflow $O_n \times P_n \times 10$ (m^3)
WB1	0.00	0.17725	0.17725	0.00		
WB1 + WB2S	0.00	0.03408	0.21133	0.00		
WB2S	0.00	0.41532	0.62665	0.00		
WB2S + WB3	0.00	0.03408	0.66073	0.00		
WB3	0.00	0.17725	0.83798	0.00		
WB1 + WB2S + CO1	9430.00	0.01054	0.84852	99.39		
WB2S + CO1	9430.00	0.01939	0.86791	182.85		
WB2S + CO2	28291.00	0.09381	0.96172	2653.98	0.06172	17461.2052
WB2S + CO2 + WB3	28291.00	0.01142	0.97314	323.08	0.01142	3230.8322
WB1 + WB2S + CO1 + CO2	37721.00	0.00088	0.97402	33.19	0.00088	331.9448
WB2S + CO1 + CO2	37721.00	0.02598	1.00000	979.99	0.02598	9799.9158
				4272.48	0.10000	30823.898

Table A6 – Cumulative probability and oil outflow values

Bottom damage (2.0 metre tide)

Compartment groupings	Oil outflow O_i (m^3)	Probability P_i	Cumulative probability [sum of P_i]	Mean oil outflow $P_i \times O_i$ (m^3)	Probability P_n	Extreme outflow $O_n \times P_n \times 10$ (m^3)
WB1	0.00	0.03027	0.03027	0.00		
WB1 + WB2S + WB2P	0.00	0.05304	0.08331	0.00		
WB1 + WB2S + WB2P + WB3	0.00	0.00530	0.08861	0.00		
WB2S + WB2P	0.00	0.24825	0.33686	0.00		
WB2S + WB2P + WB3	0.00	0.24960	0.58646	0.00		
WB3	0.00	0.25667	0.84313	0.00		
WB1 + WB2S + WB2P + CO1	3832.00	0.00592	0.84905	22.69		
WB2S + WB2P + CO1	3832.00	0.00337	0.85242	12.91		
WB2S + WB2P + CO2	17210.00	0.05518	0.90760	949.65	0.00760	1307.9600
WB2S + WB2P + WB3 + CO2	17210.00	0.06600	0.97360	1135.86	0.06600	11358.6000
WB1 + WB2S + WB2P + CO1 + CO2	23898.00	0.00903	0.98263	215.80	0.00903	2157.9894
WB3 + WB2S + WB2P + CO1 + CO2	23898.00	0.00150	0.98413	35.85	0.00150	358.4700
WB1 + WB2S + WB2P + WB3 + CO1 + CO2	23898.00	0.00440	0.98853	105.15	0.00440	1051.5120
WB2S + WB2P + CO1 + CO2	23898.00	0.01147	1.00000	274.11	0.01147	2741.1006
				2762.02	0.10000	18975.6320

Table A6 – Cumulative probability and oil outflow values *(continued)*

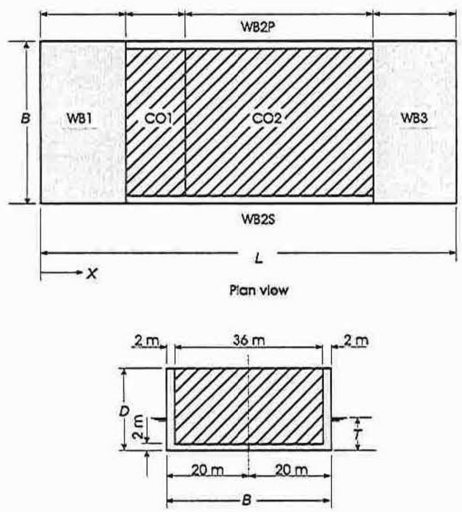
Bottom damage (4.5 metre tide)

Compartment groupings	Oil outflow O_i (m^3)	Probability P_i	Cumulative probability [sum of P_i]	Mean oil outflow $P_i \times O_i$ (m^3)	Probability P_n	Extreme outflow $O_n \times P_n \times 10$ (m^3)
WB1	0.00	0.03027	0.03027	0.00		
WB1 + WB2S + WB2P	0.00	0.05304	0.08331	0.00		
WB1 + WB2S + WB2P + WB3	0.00	0.00530	0.08861	0.00		
WB2S + WB2P	0.00	0.24825	0.33686	0.00		
WB2S + WB2P + WB3	0.00	0.24960	0.58646	0.00		
WB3	0.00	0.25667	0.84313	0.00		
WB1 + WB2S + WB2P + CO1	5658.00	0.00592	0.84905	33.50		
WB2S + WB2P + CO1	5658.00	0.00337	0.85242	19.07		
WB2S + WB2P + CO2	22081.00	0.05518	0.90760	1218.43	0.00760	1678.1560
WB2S + WB2P + WB3 + CO2	22081.00	0.06600	0.97360	1457.35	0.06600	14573.4600
WB1 + WB2S + WB2P + CO1 + CO2	30292.00	0.00903	0.98263	273.54	0.00903	2735.3676
WB3 + WB2S + WB2P + CO1 + CO2	30292.00	0.00150	0.98413	45.44	0.00150	454.3800
WB1 + WB2S + WB2P + WB3 + CO1 + CO2	30292.00	0.00440	0.98853	133.28	0.00440	1332.8480
WB2S + WB2P + CO1 + CO2	30292.00	0.01147	1.00000	347.45	0.01147	3474.4924
				3528.05	0.10000	24248.7040

Table A7 – Summary of oil outflow parameters

Bottom damage	(40%) 0.0 m tide	(50%) 2.0 m tide	(10%) 4.5 m tide	Combined
Probability of zero outflow P_0	0.8431	0.8431	0.8431	0.8431
Mean outflow (m^3)	2133	2752	3528	2582
Extreme outflow (m^3)	14767	18976	24249	17820

Combined side and bottom damage	(40%) Side damage	(60%) Bottom damage	Combined
Probability of zero outflow P_0	0.8380	0.8431	0.8411
Mean outflow (m^3)	4272	2582	3258
Extreme outflow (m^3)	30824	17820	23021
Mean outflow parameter O_M			0.0864
Extreme outflow parameter O_E			0.6103



Barge particulars

L = ________ 100 m
B = ________ 40 m
D = ________ 20 m
T = ________ 9 m
displacement = ________ 36,900 t
light barge weight = ________ 2,951 t
CO1, CO2 = ________ cargo oil tanks
WB1, WB2, WB3 = water ballast tanks

Figure A1 – Barge arrangement

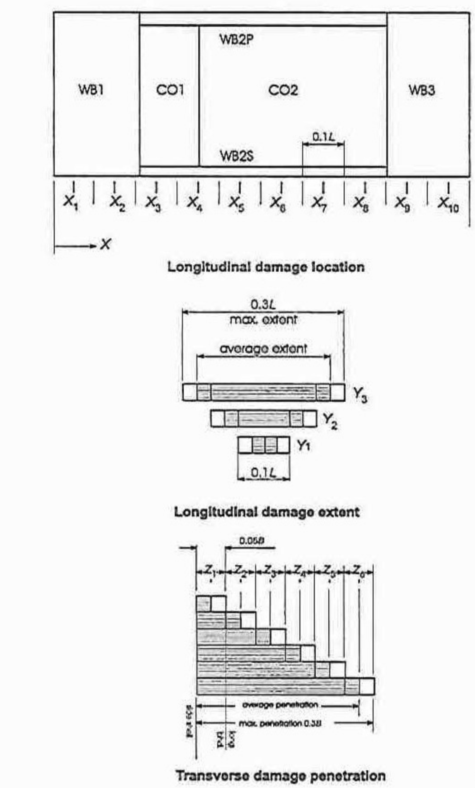


Figure A2 – Side damage definition

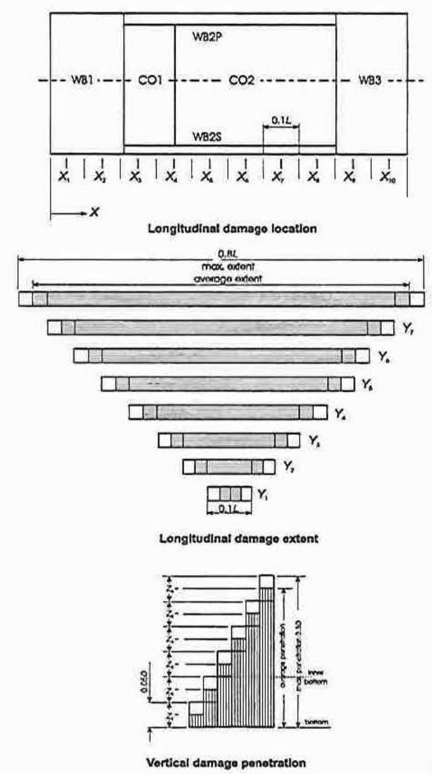


Figure A3 – Bottom damage definition

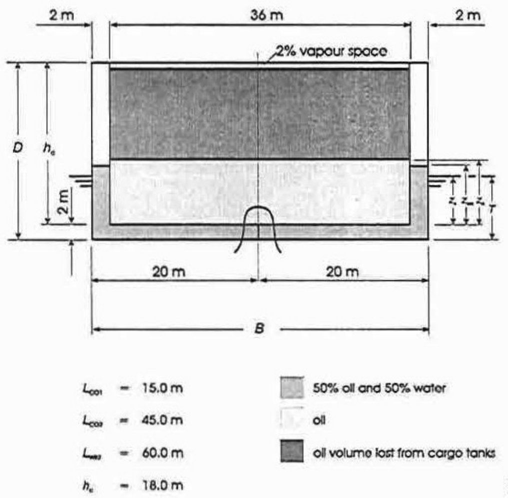


Figure A4 – Oil outflow scheme for bottom damage

Appendix 8

Guidelines for approval of alternative structural or operational arrangements as called for in MARPOL 73/78, Annex I, regulation 13G(7)*

Background

1 Regulation 13G(4) of Annex I of MARPOL 73/78 specifies the requirements applicable to existing crude oil tankers of 20,000 tons deadweight and above and product carriers of 30,000 tons deadweight and above to reduce the accidental outflow of oil in the event of a collision or stranding. Regulation 13G(7) permits other structural or operational arrangements to be accepted as alternatives, provided that such alternatives provide at least the same level of protection against oil pollution in the event of collision or stranding, and are approved by the Administration based on guidelines developed by the Organization.

The guidelines contained herein specify the criteria by which the acceptability of alternative arrangements should be determined. Methods approved by the MEPC at the time of development of the guidelines are detailed in the appendix.

Other alternative arrangements may be approved by the MEPC after considering their pollution-prevention and safety characteristics. A proposal for approval of a new or revised arrangement should be submitted by an Administration and contain technical and operational specifications and evaluation of any safety aspects.

Applicability

2 These guidelines apply to crude oil tankers of 20,000 tons deadweight and above and product carriers of 30,000 tons deadweight and above which are not required to comply with regulation 13F and do not satisfy the requirements of regulation 13G(1)(c).

Performance requirements

3 The required minimum protection against accidental oil outflow is governed by regulation 13G(4), which stipulates that tankers to which regulation 13G applies shall have wing tanks or double-bottom spaces, not used for the carriage of oil and meeting the width and height requirements of regulation 13E(4), covering at least 30% of L_t for the full depth of the ship on each side or at least 30% of the projected bottom shell area within the length L_t, where L_t is as defined in regulation 13E(2). Equivalent structural or operational arrangements, as permitted by regulation 13G(7), should ensure at least the same degree of protection against oil pollution in the event of collision or stranding. The equivalency should be determined by calculations in accordance with paragraphs 4 and 5 below.

* An interpretation (IACS Unified Interpretation MPC 7) of sections of these guidelines has been circulated as MEPC/Circ. 365. It is included as appendix 9 of these Interpretations.

Damage and outflow criteria

4 The oil outflow should be calculated for the damage cases identified in subparagraph 5.1 of these guidelines. The hypothetical outflow should be calculated for the conditions specified in subparagraphs 4.1, 4.2 and 4.3 below and in accordance with the procedures defined in subparagraphs 5.2, 5.3 and 5.4. The hypothetical outflows so calculated, divided by the volume of the cargo being carried by the ship in its original configuration, and expressed as a percentage, constitute the equivalent oil spill number (the EOS number) for the ship under each of the conditions detailed in subparagraphs 4.1, 4.2 and 4.3.

4.1 The EOS number should be calculated for the existing ship, with the ship loaded to the maximum assigned load line with zero trim and with cargo having a uniform density, allowing all cargo tanks to be loaded to 98% full. This calculation establishes the base EOS number and also the nominal cargo oil density, which should be applied in the calculations required by subparagraphs 4.2 and 4.3.

4.2 A second EOS number should be calculated for the ship arranged with non-cargo side tanks as referred to in regulation 13G(4).

4.3 A third EOS number should be calculated for the selected alternative method and should not exceed the EOS number as calculated according to subparagraph 4.2, and should furthermore not be greater than 85% of the EOS number calculated according to subparagraph 4.1.

4.4 Fuel oil tanks located within the cargo tank length should be considered as cargo oil tanks for the purpose of calculating the EOS numbers.

Methodology for calculation of the hypothetical oil outflow

5 The methodology detailed in this paragraph should be used for calculating the EOS number as required by paragraph 4.

5.1 Damage assumptions

The damage assumptions identified below should be applied to all oil tanks when calculating the EOS number.

5.1.1 *Side damage*

Longitudinal extent	l_c =	$\frac{1}{3}L^{2/3}$ or 14.5 m whichever is less
Transverse extent	t_c =	$B/5$ or 11.5 m whichever is less
Vertical extent	v_c =	from the baseline upwards without limit

5.1.2 *Bottom damage*

Longitudinal extent	l_s =	$0.2L$
Transverse extent	b_s =	$B/6$ or 10 m whichever is less, but not less than 5 m
Vertical extent from the baseline	v_s =	$B/15$

5.2 Calculation of outflow in case of side damage

Calculation of the outflow from a side damage should be done as follows:

Length between the forward and after extremities of the cargo tanks	= L_t	(m)
Length of tank number i	= l_i	(m)
Distance from hull plating to the tank boundary	= s_i	(m)
Cargo volume in tank number i	= V_i	(m^3)
Length of side damage according to subparagraph 5.1.1	= l_c	(m)
Transverse extent of damage according to subparagraph 5.1.1	= t_c	(m)

Even longitudinal distribution of damage location is assumed

Probability factor for breaching tank number i due to side damage

$$q_{ci} = (1 - s_i/t_c)\frac{(l_i + l_c)}{(L_t + l_c)}$$

$(1 - s_i/t_c)$ to be ≥ 0

Total hypothetical outflow in case of a side damage

$$O_c = \sum q_{ci} \cdot V_i$$

This calculation method gives appropriate credit for any number and size of side ballast tanks. It also takes into account the effect of the cargo tank size. The risk of breaching a longitudinal bulkhead and outflow from centre tanks is also taken into account.

5.3 Calculation of outflow in case of bottom damage

Calculation of the outflow from bottom damages should be done as follows:

Length between the forward and after extremities of the cargo tanks	= L_t	(m)
Width of the cargo tank area	= B_t	(m)
Length of tank number i	= l_i	(m)
Width of tank number i	= b_i	(m)
Height of a double bottom	= h_i	(m)
Cargo volume in tank number i	= V_i	(m^3)
Length of a bottom damage according to subparagraph 5.1.2	= l_s	(m)
Width of a bottom damage according to subparagraph 5.1.2	= b_s	(m)
Vertical extent of a bottom damage according to subparagraph 5.1.2	= v_s	(m)

Probability factor for breaching tank number i due to bottom damage

$$q_{si} = (1 - h_i/v_s)\frac{(l_i + l_s)(b_i + b_s)}{(L_t + l_s)(B_t + b_s)}$$

$(1 - h_i/v_s)$ to be ≥ 0

Nominal density of the cargo according to paragraph 4		=	ρ_c (t/m^3)
Density of the seawater (normally 1.025)		=	ρ_s (t/m^3)
Loaded condition draught		=	d (m)
Height of cargo column above the cargo tank bottom		=	h_c (m)
Highest normal overpressure in the inert gas system (normally 0.05 bar)		=	Δp (bar)
Margin for average transient loss, swell and tide effects		=	1.1
Standard acceleration of gravity	g	=	9.81 m/s^2

Outflow factor due to hydrostatic overpressure in tank number i

$$q_{hi} = 1 - \frac{(\rho_s(d - h_i)g - 100\Delta p)}{1.1\rho_c \cdot h_c \cdot g}$$

q_{hi} to be ≥ 0

Outflow from tank number i

$$O_{si} = q_{si} \cdot q_{hi} \cdot V_i$$

Total hypothetical outflow in case of a bottom damage

$$O_s = \sum q_{si} \cdot q_{hi} \cdot V_i$$

In case the ship is equipped with a double bottom, the calculated outflow from tanks located above such double bottom may be assumed to be reduced by 50% of the total capacity of the affected double bottom tanks but in no case by more than 50% of the calculated outflow from each tank.

5.4 **Calculation of total outflow in case of a side or bottom damage**

The outflow calculated under subparagraphs 5.2 and 5.3 above should be combined to the total hypothetical outflow as follows:

$$O_{tot} = 0.4O_c + 0.6O_s$$

Outflow-reducing arrangements

6 Alternative outflow-reducing methods as permitted under regulation 13G(7) may include a single method or a combination of methods giving protection in case of collision or stranding or both. Methods that have been approved by the MEPC are identified in the appendix.

Other methods may be accepted by the Organization. Such methods should, in addition to meeting the outflow criteria given in paragraphs 4 and 5, be evaluated in each individual case for acceptability from general operational and safety points of view. In particular any such method:

should not expose the tanker to an unacceptable stress level in intact condition and should not cause the accidental hull damage to be exacerbated;

should not create an unacceptable additional fire or explosion hazard.

Operations Manual

7 The master should be supplied with operational instructions, approved by the Administration, in which the operational conditions required for compliance with these guidelines should be clearly described. These instructions may be contained in a separate manual or be incorporated into existing shipboard manuals. These instructions should identify approved loading conditions, including part load conditions and including any ballasting used for obtaining these conditions. It should also contain information on the use of inert gas system and relevant trim, stress and stability information.

Endorsement of the IOPP Certificate/Supplement

8 The IOPP Certificate/Supplement should be endorsed to identify the structural or operational measures approved in accordance with regulation 13(G)(7) as well as the approved operations instructions.

Appendix

Arrangements acceptable as alternatives under regulation 13G(7) of Annex I of MARPOL 73/78

This appendix contains detailed requirements on arrangements accepted by the MEPC as alternatives under the provisions of regulation 13G(7) of Annex I of MARPOL 73/78. At the time of development this appendix contains only one approved alternative method.

Requirements for application of hydrostatic balance loading in cargo tanks

Hydrostatic balance loading is based on the principle that the hydrostatic pressure at the cargo tank bottom of the cargo oil column plus the ullage space inert gas overpressure remains equal to or less than the hydrostatic pressure of the outside water column, thereby mitigating the outflow of oil in case of bottom damage.

The maximum cargo level in each tank being loaded under this criterion should therefore satisfy the following equation:

$$h_c \cdot \rho_c \cdot g + 100\Delta p \leq (d - h_i) \cdot \rho_s \cdot g$$

where:

- h_c is the maximum acceptable cargo level in each tank, measured from the cargo tank bottom (m),
- ρ_c is the density of the current cargo (t/m^3),
- d is the corresponding draught of the vessel (m),
- h_i is the height of the tank bottom above the keel (m),
- Δp is the highest normal overpressure in the inert gas system, expressed in bar (normally 0.05 bar) (bar),
- ρ_s is the density of the seawater (t/m^3),
- g is the standard acceleration of gravity (g = 9.81 m/s^2).

Ballast may be carried in segregated ballast tanks to increase draught to a larger value. This may be used to allow more cargo to be taken into cargo tanks within the hydrostatic equilibrium criterion and within the limits of the assigned load line.

The arrangements and procedures for operation with the hydrostatic balance method should be approved by the Administration. The approval should be based on a system specification and documentation, incorporating also:

.1 calculations made to confirm whether or not resonance can occur between the natural period of longitudinal cargo liquid motion and the natural period of pitching of the ship, and also between the natural period of transverse cargo liquid motion and the natural period of rolling of the ship under approved cargo loading conditions and in any cargo tanks. In this context 'resonance can occur' means that the natural period of longitudinal motion of cargo oil is within the range from 60% to 130% of the natural period of pitching of the ship and/or the natural period of transverse motion of cargo is within the range from 80% to 120% of the natural period of rolling of the ship. When resonance can occur between ship's motion and cargo liquid motion, the sloshing pressure caused by such resonance should be estimated, and it should be confirmed that the existing structure has sufficient strength to withstand the estimated sloshing pressure; and

.2 calculations of intact and damage stability, including the effects of free surface. Damage stability calculations are, however, only required for ships defined in regulation 1(6).

When the accidental outflow reduction requirement can be met by applying hydrostatic loading to a limited number of tanks, wing tanks should have priority, thereby ensuring some reduction also in outflow from a side damage and minimizing sloshing in part-loaded centre tanks.

When operating in a multiport loading or unloading mode using the hydrostatic balance loading method, tanks covering at least 30% of the side of the length of the cargo section should be kept empty until the last loading location or should be unloaded at the first unloading location.

Copies of certified ullage measurement reports should be kept on board, clearly identified, for at least three years.

Appendix 9

Interpretation of requirements for application of hydrostatic balance loading in cargo tanks (resolution MEPC.64(36))*

1 The Marine Environment Protection Committee, at its forty-first session (30 March to 3 April 1998), noted that a large number of tankers of 25 years of age and over would potentially use the hydrostatic balance loading operational alternative which is permitted by MARPOL regulation I/13G(7), in order to continue to trade for another five years, and recognized that there was a need to develop a unified interpretation with the purpose of avoiding any potential problems which might arise with the hydrostatic balance loading.

2 Subsequently, the Committee, at its forty-second session (2 to 6 November 1998), having considered the recommendation made by the Sub-Committee on Bulk Liquids and Gases, at its third session, regarding IACS Unified Interpretation MPC 7 "Hydrostatic Balance Loading", agreed to circulate this Unified Interpretation to Member Governments, as set out in the annex, subject to the following clarifications:

.1 all ballast tanks should be assumed empty when calculating EOS1 and EOS2, whereas ballast water allocation may be considered when calculating EOS3; and

.2 it is understood that ballast water may be taken on board during the voyage in order to maintain the draughts necessary for compliance and to satisfy trim, stability, strength and other requirements.

3 At its forty-third session (28 June to 2 July 1999), the Committee approved an IACS proposal to make a number of minor corrections to the original interpretations.

4 As a result, this Circular includes these corrections and replaces MEPC/Circ.347.

5 Member Governments are invited to use the annexed Interpretation together with the above clarifications when applying the provisions of the Guidelines for approval of alternative structural or operational arrangements, as called for in regulation 13G(7) of Annex I of MARPOL 73/78 (resolution MEPC.64(36)), to tankers of 25 years of age and over referred to in regulation 13G(4) of Annex I to MARPOL 73/78.

* This is MEPC Circular 365 of 26 July 1999.

APPENDIX 5.2

ANNEX III: REGULATIONS FOR THE PREVENTION OF POLLUTION BY HARMFUL SUBSTANCES CARRIED BY SEA IN PACKAGED FORM

Annex III of MARPOL 73/78: ***Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form***

Annex III of MARPOL 73/78
(including amendments)

Regulations for the Prevention of Pollution by Harmful Substances Carried by Sea in Packaged Form

Regulation 1
Application

(1) Unless expressly provided otherwise, the regulations of this Annex apply to all ships carrying harmful substances in packaged form.

(1.1) For the purpose of this Annex, "harmful substances" are those substances which are identified as marine pollutants in the International Maritime Dangerous Goods Code (IMDG Code).*

(1.2) Guidelines for the identification of harmful substances in packaged form are given in the appendix to this Annex.

(1.3) For the purposes of this Annex, "packaged form" is defined as the forms of containment specified for harmful substances in the IMDG Code.

(2) The carriage of harmful substances is prohibited, except in accordance with the provisions of this Annex.

(3) To supplement the provisions of this Annex, the Government of each Party to the Convention shall issue, or cause to be issued, detailed requirements on packing, marking, labelling, documentation, stowage, quantity limitations and exceptions for preventing or minimizing pollution of the marine environment by harmful substances.*

* Refer to the IMDG Code adopted by the Organization by resolution A.716(17), as it has been or may be amended by the Maritime Safety Committee; see IMO sales publications IMO-200E and IMO-210E.

(4) For the purposes of this Annex, empty packagings which have been used previously for the carriage of harmful substances shall themselves be treated as harmful substances unless adequate precautions have been taken to ensure that they contain no residue that is harmful to the marine environment.

(5) The requirements of this Annex do not apply to ship's stores and equipment.

Regulation 2
Packing

Packages shall be adequate to minimize the hazard to the marine environment, having regard to their specific contents.

Regulation 3
Marking and labelling

(1) Packages containing a harmful substance shall be durably marked with the correct technical name (trade names alone shall not be used) and, further, shall be durably marked or labelled to indicate that the substance is a marine pollutant. Such identification shall be supplemented where possible by any other means, for example, by use of the relevant United Nations number.

(2) The method of marking the correct technical name and of affixing labels on packages containing a harmful substance shall be such that this information will still be identifiable on packages surviving at least three months' immersion in the sea. In considering suitable marking and labelling, account shall be taken of the durability of the materials used and of the surface of the package.

(3) Packages containing small quantities of harmful substances may be exempted from the marking requirements.*

Regulation 4†
Documentation

(1) In all documents relating to the carriage of harmful substances by sea where such substances are named, the correct technical name of each such substance shall be used (trade names alone shall not be used) and

* Refer to the specific exemptions provided for in the IMDG Code; see IMO sales publications IMO-200E and IMO-210E.

† Reference to "documents" in this regulation does not preclude the use of electronic data processing (EDP) and electronic data interchange (EDI) transmission techniques as an aid to paper documentation.

the substance further identified by the addition of the words "MARINE POLLUTANT".

(2) The shipping documents supplied by the shipper shall include, or be accompanied by, a signed certificate or declaration that the shipment offered for carriage is properly packaged and marked, labelled or placarded as appropriate and in proper condition for carriage to minimize the hazard to the marine environment.

(3) Each ship carrying harmful substances shall have a special list or manifest setting forth the harmful substances on board and the location thereof. A detailed stowage plan which sets out the location of the harmful substances on board may be used in place of such special list or manifest. Copies of such documents shall also be retained on shore by the owner of the ship or his representative until the harmful substances are unloaded. A copy of one of these documents shall be made available before departure to the person or organization designated by the port State authority.

SEE INTERPRETATION 1.0

(4) When the ship carries a special list or manifest or a detailed stowage plan, required for the carriage of dangerous goods by the International Convention for the Safety of Life at Sea, 1974, as amended, the documents required by this regulation may be combined with those for dangerous goods. Where documents are combined, a clear distinction shall be made between dangerous goods and harmful substances covered by this Annex.

Regulation 5
Stowage

Harmful substances shall be properly stowed and secured so as to minimize the hazards to the marine environment without impairing the safety of the ship and persons on board.

Regulation 6
Quantity limitations

Certain harmful substances may, for sound scientific and technical reasons, need to be prohibited for carriage or be limited as to the quantity which may be carried aboard any one ship. In limiting the quantity, due consideration shall be given to size, construction and equipment of the ship, as well as the packaging and the inherent nature of the substances.

Regulation 7
Exceptions

(1) Jettisoning of harmful substances carried in packaged form shall be prohibited, except where necessary for the purpose of securing the safety of the ship or saving life at sea.

(2) Subject to the provisions of the present Convention, appropriate measures based on the physical, chemical and biological properties of harmful substances shall be taken to regulate the washing of leakages overboard, provided that compliance with such measures would not impair the safety of the ship and persons on board.

Regulation 8
*Port State control on operational requirements**

(1) A ship when in a port of another Party is subject to inspection by officers duly authorized by such Party concerning operational requirements under this Annex, where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by harmful substances.

(2) In the circumstances given in paragraph (1) of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex.

(3) Procedures relating to the port State control prescribed in article 5 of the present Convention shall apply to this regulation.

(4) Nothing in this regulation shall be construed to limit the rights and obligations of a Party carrying out control over operational requirements specifically provided for in the present Convention.

* Refer to the Procedures for port State control adopted by the Organization by resolution A.787(19) and amended by A.882(21); see IMO sales publication IMO-650E.

Appendix to Annex III

Guidelines for the identification of harmful substances in packaged form

For the purposes of this Annex, substances identified by any one of the following criteria are harmful substances:

- bioaccumulated to a significant extent and known to produce a hazard to aquatic life or to human health (Hazard Rating "+" in column A*); or
- bioaccumulated with attendant risk to aquatic organisms or to human health with a short retention of the order of one week or less (Hazard Rating "Z" in column A*); or
- highly toxic to aquatic life, defined by a LC_{50}/96 hour† less than 1 ppm (Hazard Rating "4" in column B*).

* Refer to the Composite List of Hazard Profiles prepared by the IMO/FAO/UNESCO/WMO/WHO/IAEA/UN/UNEP Joint Group of Experts on the Scientific Aspects of Marine Pollution (GESAMP), which is circulated annually by the Organization by means of BLG circulars to all IMO Member States.

† The concentration of a substance which will, within the specified time (generally 96 hours), kill 50% of the exposed group of test organisms. Also referred to as "96 h LC_{50}". LC_{50} is often specified in milligrams per litre (mg/l) or parts per million (ppm).

Unified Interpretation of Annex III

Reg. 4(3)

1.0 At any stopover, where any loading or unloading operations, even partial, are carried out, a revision of the documents listing the harmful substances taken on board, indicating their location on board or showing a detailed stowage plan, shall be made available before departure to the person or organization designated by the port State authority.

APPENDIX 5.3

ANNEX IV: REGULATIONS FOR THE PREVENTION OF POLLUTION BY SEWAGE

<u>Annex IV of MARPOL 73/78</u>: *Regulations for the Prevention of Pollution by Sewage from Ships*

Annex IV of MARPOL 73/78*

Regulations for the Prevention of Pollution by Sewage from Ships

Regulation 1
Definitions

For the purposes of the present Annex:

(1) *New ship* means a ship:

(a) for which the building contract is placed, or in the absence of a building contract, the keel of which is laid, or which is at a similar stage of construction, on or after the date of entry into force of this Annex; or

(b) the delivery of which is three years or more after the date of entry into force of this Annex.

(2) *Existing ship* means a ship which is not a new ship.

(3) *Sewage* means:

(a) drainage and other wastes from any form of toilets, urinals, and WC scuppers;

(b) drainage from medical premises (dispensary, sick bay, etc.) via wash basins, wash tubs and scuppers located in such premises;

(c) drainage from spaces containing living animals; or

(d) other waste waters when mixed with the drainages defined above.

(4) *Holding tank* means a tank used for the collection and storage of sewage.

(5) *Nearest land*. The term "from the nearest land" means from the baseline from which the territorial sea of the territory in question is established in accordance with international law except that, for the purposes of the present Convention, "from the nearest land" off the

Annex IV

* On the publication date of the 2002 Consolidated Edition, Annex IV had not met the conditions of entry into force. This Annex has been revised by the Marine Environment Protection Committee of the Organization. The revised text and resolution MEPC.88(44) are included in the Additional Information at the end of this publication.

north-eastern coast of Australia shall mean from a line drawn from a point on the coast of Australia in

latitude 11°00′ S, longitude 142°08′ E
to a point in latitude 10°35′ S, longitude 141°55′ E
thence to a point latitude 10°00′ S, longitude 142°00′ E
thence to a point latitude 9°10′ S, longitude 143°52′ E
thence to a point latitude 9°00′ S, longitude 144°30′ E
thence to a point latitude 13°00′ S, longitude 144°00′ E
thence to a point latitude 15°00′ S, longitude 146°00′ E
thence to a point latitude 18°00′ S, longitude 147°00′ E
thence to a point latitude 21°00′ S, longitude 153°00′ E
thence to a point on the coast of Australia in
latitude 24°42′ S, longitude 153°15′ E.

Regulation 2
Application

The provisions of this Annex shall apply to:

(a) (i) new ships of 200 tons gross tonnage and above;

(ii) new ships of less than 200 tons gross tonnage which are certified to carry more than 10 persons;

(iii) new ships which do not have a measured gross tonnage and are certified to carry more than 10 persons; and

(b) (i) existing ships of 200 tons gross tonnage and above, 10 years after the date of entry into force of this Annex;

(ii) existing ships of less than 200 tons gross tonnage which are certified to carry more than 10 persons, 10 years after the date of entry into force of this Annex; and

(iii) existing ships which do not have a measured gross tonnage and are certified to carry more than 10 persons, 10 years after the date of entry into force of this Annex.

Regulation 3
Surveys

(1) Every ship which is required to comply with the provisions of this Annex and which is engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention shall be subject to the surveys specified below:

(a) An initial survey before the ship is put in service or before the certificate required under regulation 4 of this Annex is issued for the first time, which shall include a survey of the ship which shall be such as to ensure:

(i) when the ship is fitted with a sewage treatment plant the plant shall meet operational requirements based on standards and the test methods developed by the Organization;*

(ii) when the ship is fitted with a system to comminute and disinfect the sewage, such a system shall be of a type approved by the Administration;

(iii) when the ship is equipped with a holding tank the capacity of such tank shall be to the satisfaction of the Administration for the retention of all sewage having regard to the operation of the ship, the number of persons on board and other relevant factors. The holding tank shall have a means to indicate visually the amount of its contents; and

(iv) that the ship is equipped with a pipeline leading to the exterior convenient for the discharge of sewage to a reception facility and that such a pipeline is fitted with a standard shore connection in compliance with regulation 11 of this Annex.

This survey shall be such as to ensure that the equipment, fittings, arrangements and material fully comply with the applicable requirements of this Annex.

(b) Periodical surveys at intervals specified by the Administration but not exceeding five years which shall be such as to ensure that the equipment, fittings, arrangements and material fully comply with the applicable requirements of this Annex. However, where the duration of the International Sewage Pollution Prevention Certificate (1973) is extended as specified in regulation 7(2) or (4) of this Annex, the interval of the periodical survey may be extended correspondingly.

(2) The Administration shall establish appropriate measures for ships which are not subject to the provisions of paragraph (1) of this regulation in order to ensure that the provisions of this Annex are complied with.

(3) Surveys of the ship as regards enforcement of the provisions of this Annex shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it. In every case the Administration concerned fully guarantees the completeness and efficiency of the surveys.

* Refer to the Recommendation on international effluent standards and guidelines for performance tests for sewage treatment plants adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.2(VI); see IMO sales publication IMO-592E.

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(4) After any survey of the ship under this regulation has been completed, no significant change shall be made in the equipment, fittings, arrangements, or material covered by the survey without the approval of the Administration, except the direct replacement of such equipment or fittings.

Regulation 4
Issue of Certificate

(1) An International Sewage Pollution Prevention Certificate (1973) shall be issued, after survey in accordance with the provisions of regulation 3 of this Annex, to any ship which is engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention.

(2) Such Certificate shall be issued either by the Administration or by any persons or organization duly authorized by it. In every case the Administration assumes full responsibility for the Certificate.

Regulation 5
Issue of a Certificate by another Government

(1) The Government of a Party to the Convention may, at the request of the Administration, cause a ship to be surveyed and, if satisfied that the provisions of this Annex are complied with, shall issue or authorize the issue of an International Sewage Pollution Prevention Certificate (1973) to the ship in accordance with this Annex.

(2) A copy of the Certificate and a copy of the survey report shall be transmitted as early as possible to the Administration requesting the survey.

(3) A Certificate so issued shall contain a statement to the effect that it has been issued at the request of the Administration and it shall have the same force and receive the same recognition as the Certificate issued under regulation 4 of this Annex.

(4) No International Sewage Pollution Prevention Certificate (1973) shall be issued to a ship which is entitled to fly the flag of a State which is not a Party.

Regulation 6
Form of Certificate

The International Sewage Pollution Prevention Certificate (1973) shall be drawn up in an official language of the issuing country in the form corresponding to the model given in the appendix to this Annex. If the

language used is neither English nor French, the text shall include a translation into one of these languages.

Regulation 7
Duration of Certificate

(1) The International Sewage Pollution Prevention Certificate (1973) shall be issued for a period specified by the Administration, which shall not exceed five years from the date of issue, except as provided in paragraphs (2), (3) and (4) of this regulation.

(2) If a ship at the time when the Certificate expires is not in a port or offshore terminal under the jurisdiction of the Party to the Convention whose flag the ship is entitled to fly, the Certificate may be extended by the Administration, but such extension shall be granted only for the purpose of allowing the ship to complete its voyage to the State whose flag the ship is entitled to fly or in which it is to be surveyed and then only in cases where it appears proper and reasonable to do so.

(3) No Certificate shall be thus extended for a period longer than five months and a ship to which such extension is granted shall not on its arrival in the State whose flag it is entitled to fly or the port in which it is to be surveyed, be entitled by virtue of such extension to leave that port or State without having obtained a new certificate.

(4) A Certificate which has not been extended under the provisions of paragraph (2) of this regulation may be extended by the Administration for a period of grace of up to one month from the date of expiry stated on it.

(5) A Certificate shall cease to be valid if significant alterations have taken place in the equipment, fittings, arrangement or material required without the approval of the Administration, except the direct replacement of such equipment or fittings.

(6) A Certificate issued to a ship shall cease to be valid upon transfer of such a ship to the flag of another State, except as provided in paragraph (7) of this regulation.

(7) Upon transfer of a ship to the flag of another Party, the Certificate shall remain in force for a period not exceeding five months provided that it would not have expired before the end of that period, or until the Administration issues a replacement Certificate, whichever is earlier. As soon as possible after the transfer has taken place the Government of the Party whose flag the ship was formerly entitled to fly shall transmit to the Administration a copy of the Certificate carried by the ship before the transfer and, if available, a copy of the relevant survey report.

Annex IV

Regulation 8
Discharge of sewage

(1) Subject to the provisions of regulation 9 of this Annex, the discharge of sewage into the sea is prohibited, except when:

(a) the ship is discharging comminuted and disinfected sewage using a system approved by the Administration in accordance with regulation 3(1)(a) at a distance of more than 4 nautical miles from the nearest land, or sewage which is not comminuted or disinfected at a distance of more than 12 nautical miles from the nearest land, provided that in any case, the sewage that has been stored in holding tanks shall not be discharged instantaneously but at a moderate rate when the ship is *en route* and proceeding at not less than 4 knots; the rate of discharge shall be approved by the Administration based upon standards developed by the Organization; or

(b) the ship has in operation an approved sewage treatment plant which has been certified by the Administration to meet the operational requirements referred to in regulation 3(1)(a)(i) of this Annex, and

(i) the test results of the plant are laid down in the ship's International Sewage Pollution Prevention Certificate (1973);

(ii) additionally, the effluent shall not produce visible floating solids in, nor cause discoloration of, the surrounding water; or

(c) the ship is situated in the waters under the jurisdiction of a State and is discharging sewage in accordance with such less stringent requirements as may be imposed by such State.

(2) When the sewage is mixed with wastes or waste water having different discharge requirements, the more stringent requirements shall apply.

Regulation 9
Exceptions

Regulation 8 of this Annex shall not apply to:

(a) the discharge of sewage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or

(b) the discharge of sewage resulting from damage to a ship or its equipment if all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimizing the discharge.

Regulation 10
Reception facilities

(1) The Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of sewage, without causing undue delay to ships, adequate to meet the needs of the ships using them.

(2) The Government of each Party shall notify the Organization for transmission to the Contracting Governments concerned of all cases where the facilities provided under this regulation are alleged to be inadequate.

Regulation 11
Standard discharge connections

To enable pipes of reception facilities to be connected with the ship's discharge pipeline, both lines shall be fitted with a standard discharge connection in accordance with the following table:

Standard dimensions of flanges for discharge connections

Description	*Dimension*
Outside diameter	210 mm
Inner diameter	According to pipe outside diameter
Bolt circle diameter	170 mm
Slots in flange	4 holes 18 mm in diameter equidistantly placed on a bolt circle of the above diameter, slotted to the flange periphery. The slot width to be 18 mm
Flange thickness	16 mm
Bolts and nuts: quantity and diameter	4, each of 16 mm in diameter and of suitable length
The flange is designed to accept pipes up to a maximum internal diameter of 100 mm and shall be of steel or other equivalent material having a flat face. This flange, together with a suitable gasket, shall be suitable for a service pressure of 6 kg/cm^2	

For ships having a moulded depth of 5 m and less, the inner diameter of the discharge connection may be 38 mm.

Annex IV

Appendix to Annex IV

Form of Sewage Certificate

INTERNATIONAL SEWAGE POLLUTION PREVENTION CERTIFICATE (1973)

Issued under the Provisions of the International Convention for the Prevention of Pollution from Ships, 1973, under the authority of the Government of

....

(full designation of the country)

by...

(full designation of the competent person or organization authorized under the provisions of the International Convention for the Prevention of Pollution from Ships, 1973)

Name of ship	Distinctive number or letters	Port of registry	Gross tonnage	Number of persons which the ship is certified to carry

New/existing ship*

Date of building contract.................................

Date on which keel was laid or ship was at a similar stage of construction........................

Date of delivery.......................................

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* Delete as appropriate.

THIS IS TO CERTIFY:

(1) The ship is equipped with a sewage treatment plant/comminuter/holding tank* and a discharge pipeline in compliance with regulation 3(1)(a)(i) to (iv) of Annex IV of the Convention as follows:

- *(a) Description of the sewage treatment plant:
  Type of sewage treatment plant........................
  Name of manufacturer..............................
  The sewage treatment plant is certified by the Administration to meet the following effluent standards† ....
- *(b) Description of comminuter:
  Type of comminuter................................
  Name of manufacturer..............................
  Standard of sewage after disinfection....................
- *(c) Description of holding tank equipment:
  Total capacity of the holding tank..................... m^3
  Location..
- (d) A pipeline for the discharge of sewage to a reception facility, fitted with a standard shore connection.

(2) The ship has been surveyed in accordance with regulation 3 of Annex IV of the International Convention for the Prevention of Pollution from Ships, 1973, concerning the prevention of pollution by sewage and the survey showed that the equipment of the ship and the condition thereof are in all respects satisfactory and the ship complies with the applicable requirements of Annex IV of the Convention.

This certificate is valid until.....................................

Issued at..

(place of issue of certificate)

....

(Date of issue) *(Signature of official issuing the certificate)*

(Seal or stamp of the issuing authority, as appropriate)

Under the provisions of regulation 7(2) and (4) of Annex IV of the Convention the validity of this certificate is extended until

....

Signed..........................
(Signature of duly authorized official)
Place...........................
Date............................

(Seal or stamp of the authority, as appropriate)

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* Delete as appropriate.
† Parameters should be incorporated.

APPENDIX 5.4

ANNEX V: REGULATIONS FOR THE PREVENTION OF POLLUTION BY GARBAGE FROM SHIPS

Annex V of MARPOL 73/78: *Regulations for the Prevention of Pollution by Garbage from Ships*

Annex V of MARPOL 73/78
(including amendments)

Regulations for the Prevention of Pollution by Garbage from Ships

Regulation 1
Definitions

For the purposes of this Annex:

(1) *Garbage* means all kinds of victual, domestic and operational waste - excluding fresh fish and parts thereof, generated during the normal operation of the ship and liable to be disposed of continuously or periodically except those substances which are defined or listed in other Annexes to the present Convention.

(2) *Nearest land.* The term "from the nearest land" means from the baseline from which the territorial sea of the territory in question is established in accordance with international law, except that, for the purposes of the present Convention, "from the nearest land" off the north-eastern coast of Australia shall mean from a line drawn from a point on the coast of Australia in

latitude 11°00′ S, longitude 142°08′ E
to a point in latitude 10°35′ S, longitude 141°55′ E,
thence to a point latitude 10°00′ S, longitude 142°00′ E,
thence to a point latitude 09°10′ S, longitude 143°52′ E,
thence to a point latitude 09°00′ S, longitude 144°30′ E,
thence to a point latitude 10°41′ S, longitude 145°00′ E,
thence to a point latitude 13°00′ S, longitude 145°00′ E,
thence to a point latitude 15°00′ S, longitude 146°00′ E,
thence to a point latitude 17°30′ S, longitude 147°00′ E,
thence to a point latitude 21°00′ S, longitude 152°55′ E,
thence to a point latitude 24°30′ S, longitude 154°00′ E,
thence to a point on the coast of Australia in
latitude 24°42′ S, longitude 153°15′ E.

(3) *Special area* means a sea area where for recognized technical reasons in relation to its oceanographical and ecological condition and to the particular character of its traffic the adoption of special mandatory methods for the prevention of sea pollution by garbage is required. Special areas shall include those listed in regulation 5 of this Annex.

Regulation 2
Application

Unless expressly provided otherwise, the provisions of this Annex shall apply to all ships.

Regulation 3
Disposal of garbage outside special areas

(1) Subject to the provisions of regulations 4, 5 and 6 of this Annex:

(a) the disposal into the sea of all plastics, including but not limited to synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products which may contain toxic or heavy metal residues, is prohibited;

(b) the disposal into the sea of the following garbage shall be made as far as practicable from the nearest land but in any case is prohibited if the distance from the nearest land is less than:

(i) 25 nautical miles for dunnage, lining and packing materials which will float;

(ii) 12 nautical miles for food wastes and all other garbage including paper products, rags, glass, metal, bottles, crockery and similar refuse;

(c) disposal into the sea of garbage specified in subparagraph(b)(ii) of this regulation may be permitted when it has passed through a comminuter or grinder and made as far as practicable from the nearest land but in any case is prohibited if the distance from the nearest land is less than 3 nautical miles. Such comminuted or ground garbage shall be capable of passing through a screen with openings no greater than 25 mm.

(2) When the garbage is mixed with other discharges having different disposal or discharge requirements the more stringent requirements shall apply.

Regulation 4
Special requirements for disposal of garbage

(1) Subject to the provisions of paragraph (2) of this regulation, the disposal of any materials regulated by this Annex is prohibited from fixed or floating platforms engaged in the exploration, exploitation and associated offshore processing of sea-bed mineral resources, and from all other ships when alongside or within 500 m of such platforms.

(2) The disposal into the sea of food wastes may be permitted when they have been passed through a comminuter or grinder from such fixed or floating platforms located more than 12 nautical miles from land and all other ships when alongside or within 500 m of such platforms. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm.

Regulation 5
Disposal of garbage within special areas

(1) For the purposes of this Annex the special areas are the Mediterranean Sea area, the Baltic Sea area, the Black Sea area, the Red Sea area, the "Gulfs area", the North Sea area, the Antarctic area and the Wider Caribbean Region, including the Gulf of Mexico and the Caribbean Sea, which are defined as follows:

(a) The *Mediterranean Sea area* means the Mediterranean Sea proper including the gulfs and seas therein with the boundary between the Mediterranean and the Black Sea constituted by the 41° N parallel and bounded to the west by the Straits of Gibraltar at the meridian 5°36′ W.

(b) The *Baltic Sea area* means the Baltic Sea proper with the Gulf of Bothnia and the Gulf of Finland and the entrance to the Baltic Sea bounded by the parallel of the Skaw in the Skagerrak at 57°44.8′ N.

(c) The *Black Sea area* means the Black Sea proper with the boundary between the Mediterranean and the Black Sea constituted by the parallel 41° N.

(d) The *Red Sea area* means the Red Sea proper including the Gulfs of Suez and Aqaba bounded at the south by the rhumb line between Ras si Ane (12°28.5′ N, 43°19.6′ E) and Husn Murad (12°40.4′ N, 43°30.2′ E).

(e) The *Gulfs area* means the sea area located north-west of the rhumb line between Ras al Hadd (22°30′ N, 59°48′ E) and Ras al Fasteh (25°04′ N, 61°25′ E).

(f) The *North Sea area* means the North Sea proper including seas therein with the boundary between:

(i) the North Sea southwards of latitude 62° N and eastwards of longitude 4° W;

(ii) the Skagerrak, the southern limit of which is determined east of the Skaw by latitude 57°44.8′ N; and

(iii) the English Channel and its approaches eastwards of longitude 5° W and northwards of latitude 48°30′ N.

(g) The *Antarctic area* means the sea area south of latitude 60° S.

(h) The *Wider Caribbean Region*, as defined in article 2, paragraph 1 of the Convention for the Protection and Development of the Marine Environment of the Wider Caribbean Region (Cartagena de Indias, 1983), means the Gulf of Mexico and Caribbean Sea proper including the bays and seas therein and that portion of the Atlantic Ocean within the boundary constituted by the 30° N parallel from Florida eastward to 77°30' W meridian, thence a rhumb line to the intersection of 20° N parallel and 59° W meridian, thence a rhumb line to the intersection of 7°20' N parallel and 50° W meridian, thence a rhumb line drawn south-westerly to the eastern boundary of French Guiana.

(2) Subject to the provisions of regulation 6 of this Annex:

(a) disposal into the sea of the following is prohibited:

(i) all plastics, including but not limited to synthetic ropes, synthetic fishing nets, plastic garbage bags and incinerator ashes from plastic products which may contain toxic or heavy metal residues; and

(ii) all other garbage, including paper products, rags, glass, metal, bottles, crockery, dunnage, lining and packing materials;

(b) except as provided in subparagraph (c) of this paragraph, disposal into the sea of food wastes shall be made as far as practicable from land, but in any case not less than 12 nautical miles from the nearest land;

(c) disposal into the Wider Caribbean Region of food wastes which have been passed through a comminuter or grinder shall be made as far as practicable from land, but in any case not less than 3 nautical miles from the nearest land. Such comminuted or ground food wastes shall be capable of passing through a screen with openings no greater than 25 mm.

(3) When the garbage is mixed with other discharges having different disposal or discharge requirements the more stringent requirements shall apply.

(4) Reception facilities within special areas:

(a) The Government of each Party to the Convention, the coastline of which borders a special area, undertakes to ensure that as soon as possible in all ports within a special area adequate reception facilities are provided in accordance with regulation 7 of this Annex, taking into account the special needs of ships operating in these areas.

(b) The Government of each Party concerned shall notify the Organization of the measures taken pursuant to subparagraph (a) of this regulation. Upon receipt of sufficient notifications the Organization shall establish a date from which the requirements of this regulation in respect of the area in question shall take effect. The Organization shall notify all Parties of the date so established no less than twelve months in advance of that date.

(c) After the date so established, ships calling also at ports in these special areas where such facilities are not yet available, shall fully comply with the requirements of this regulation.

(5) Notwithstanding paragraph 4 of this regulation, the following rules apply to the Antarctic area:

(a) The Government of each Party to the Convention at whose ports ships depart *en route* to or arrive from the Antarctic area undertakes to ensure that as soon as practicable adequate facilities are provided for the reception of all garbage from all ships, without causing undue delay, and according to the needs of the ships using them.

(b) The Government of each Party to the Convention shall ensure that all ships entitled to fly its flag, before entering the Antarctic area, have sufficient capacity on board for the retention of all garbage while operating in the area and have concluded arrangements to discharge such garbage at a reception facility after leaving the area.

Regulation 6
Exceptions

Regulations 3, 4 and 5 of this Annex shall not apply to:

(a) the disposal of garbage from a ship necessary for the purpose of securing the safety of a ship and those on board or saving life at sea; or

(b) the escape of garbage resulting from damage to a ship or its equipment provided all reasonable precautions have been taken before and after the occurrence of the damage, for the purpose of preventing or minimizing the escape; or

(c) the accidental loss of synthetic fishing nets, provided that all reasonable precautions have been taken to prevent such loss.

Regulation 7
Reception facilities

(1) The Government of each Party to the Convention undertakes to ensure the provision of facilities at ports and terminals for the reception of garbage, without causing undue delay to ships, and according to the needs of the ships using them.

(2) The Government of each Party shall notify the Organization for transmission to the Parties concerned of all cases where the facilities provided under this regulation are alleged to be inadequate.

Regulation 8
*Port State control on operational requirements**

(1) A ship when in a port of another Party is subject to inspection by officers duly authorized by such Party concerning operational requirements under this Annex, where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of pollution by garbage.

(2) In the circumstances given in paragraph (1) of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex.

(3) Procedures relating to the port State control prescribed in article 5 of the present Convention shall apply to this regulation.

(4) Nothing in this regulation shall be construed to limit the rights and obligations of a Party carrying out control over operational requirements specifically provided for in the present Convention.

Regulation 9
Placards, garbage management plans and garbage record-keeping

(1) (a) Every ship of 12 m or more in length overall shall display placards which notify the crew and passengers of the disposal requirements of regulations 3 and 5 of this Annex, as applicable.

(b) The placards shall be written in the working language of the ship's personnel and, for ships engaged in voyages to ports or

* Refer to the Procedures for port State control adopted by the Organization by resolution A.787(19) and amended by A.882(21); see IMO sales publication IMO-650E.

Annex V

offshore terminals under the jurisdiction of other Parties to the Convention, shall also be in English, French or Spanish.

(2) Every ship of 400 tons gross tonnage and above, and every ship which is certified to carry 15 persons or more, shall carry a garbage management plan which the crew shall follow. This plan shall provide written procedures for collecting, storing, processing and disposing of garbage, including the use of the equipment on board. It shall also designate the person in charge of carrying out the plan. Such a plan shall be in accordance with the guidelines developed by the Organization* and written in the working language of the crew.

(3) Every ship of 400 tons gross tonnage and above and every ship which is certified to carry 15 persons or more engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties to the Convention and every fixed and floating platform engaged in exploration and exploitation of the sea-bed shall be provided with a Garbage Record Book. The Garbage Record Book, whether as a part of the ship's official log-book or otherwise, shall be in the form specified in the appendix to this Annex;

(a) each discharge operation, or completed incineration, shall be recorded in the Garbage Record Book and signed for on the date of the incineration or discharge by the officer in charge. Each completed page of the Garbage Record Book shall be signed by the master of the ship. The entries in the Garbage Record Book shall be at least in English, French or Spanish. Where the entries are also made in an official language of the State whose flag the ship is entitled to fly, these entries shall prevail in case of a dispute or discrepancy;

(b) the entry for each incineration or discharge shall include date and time, position of the ship, description of the garbage and the estimated amount incinerated or discharged;

(c) the Garbage Record Book shall be kept on board the ship and in such a place as to be available for inspection in a reasonable time. This document shall be preserved for a period of two years after the last entry is made on the record;

(d) in the event of discharge, escape or accidental loss referred to in regulation 6 of this Annex an entry shall be made in the Garbage Record Book of the circumstances of, and the reasons for, the loss.

* Refer to the Guidelines for the development of garbage management plans adopted by the Marine Environment Protection Committee of the Organization by resolution MEPC.71(38); see MEPC/Circ.317 and IMO sales publication IMO-656E.

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(4) The Administration may waive the requirements for Garbage Record Books for:

(a) any ship engaged on voyages of 1 hour or less in duration which is certified to carry 15 persons or more; or

(b) fixed or floating platforms while engaged in exploration and exploitation of the sea-bed.

(5) The competent authority of the Government of a Party to the Convention may inspect the Garbage Record Book on board any ship to which this regulation applies while the ship is in its ports or offshore terminals and may make a copy of any entry in that book, and may require the master of the ship to certify that the copy is a true copy of such an entry. Any copy so made, which has been certified by the master of the ship as a true copy of an entry in the ship's Garbage Record Book, shall be admissible in any judicial proceedings as evidence of the facts stated in the entry. The inspection of a Garbage Record Book and the taking of a certified copy by the competent authority under this paragraph shall be performed as expeditiously as possible without causing the ship to be unduly delayed.

(6) In the case of ships built before 1 July 1997, this regulation shall apply as from 1 July 1998.

Appendix to Annex V

Form of Garbage Record Book

GARBAGE RECORD BOOK

Name of ship: ____________________

Distinctive number or letters: ____________________

IMO No.: ____________________

Period: ____________ From: ____________ To: ____________

1 Introduction

In accordance with regulation 9 of Annex V of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 (MARPOL 73/78), a record is to be kept of each discharge operation or completed incineration. This includes discharges at sea, to reception facilities, or to other ships.

2 Garbage and garbage management

Garbage includes all kinds of food, domestic and operational waste excluding fresh fish and parts thereof, generated during the normal operation of the vessel and liable to be disposed of continuously or periodically except those substances which are defined or listed in other annexes to MARPOL 73/78 (such as oil, sewage or noxious liquid substances).

The Guidelines for the Implementation of Annex V of MARPOL 73/78* should also be referred to for relevant information.

3 Description of the garbage

The garbage is to be grouped into categories for the purposes of this record book as follows:

1 Plastics

2 Floating dunnage, lining, or packing material

3 Ground-down paper products, rags, glass, metal, bottles, crockery, etc.

4 Paper products, rags, glass, metal, bottles, crockery, etc.

* Refer to the Guidelines for the Implementation of Annex V of MARPOL 73/78; see IMO sales publication IMO-656E.

5 Food waste

6 Incinerator ash.

4 Entries in the Garbage Record Book

4.1 Entries in the Garbage Record Book shall be made on each of the following occasions:

(a) When garbage is discharged into the sea:
- (i) Date and time of discharge
- (ii) Position of the ship (latitude and longitude)
- (iii) Category of garbage discharged
- (iv) Estimated amount discharged for each category in cubic metres
- (v) Signature of the officer in charge of the operation.

(b) When garbage is discharged to reception facilities ashore or to other ships:
- (i) Date and time of discharge
- (ii) Port or facility, or name of ship
- (iii) Category of garbage discharged
- (iv) Estimated amount discharged for each category in cubic metres
- (v) Signature of officer in charge of the operation.

(c) When garbage is incinerated:
- (i) Date and time of start and stop of incineration
- (ii) Position of the ship (latitude and longitude)
- (iii) Estimated amount incinerated in cubic metres
- (iv) Signature of the officer in charge of the operation.

(d) Accidental or other exceptional discharges of garbage
- (i) Time of occurrence
- (ii) Port or position of the ship at time of occurrence
- (iii) Estimated amount and category of garbage
- (iv) Circumstances of disposal, escape or loss, the reason therefor and general remarks.

4.2 Receipts

The master should obtain from the operator of port reception facilities, or from the master of the ship receiving the garbage, a receipt or certificate specifying the estimated amount of garbage transferred. The receipts or certificates must be kept on board the ship with the Garbage Record Book for two years.

4.3 Amount of garbage

The amount of garbage on board should be estimated in cubic metres, if possible separately according to category. The Garbage Record Book contains many references to estimated amount of garbage. It is recognized that the accuracy of estimating amounts of garbage is left to interpretation. Volume estimates will differ before and after processing. Some processing procedures may not allow for a usable estimate of volume, e.g. the continuous processing of food waste. Such factors should be taken into consideration when making and interpreting entries made in a record.

Annex V

RECORD OF GARBAGE DISCHARGES

Ship's name ____________ Distinctive No., or letters ____________ IMO No: ________

Garbage categories:

1: Plastic
2: Floating dunnage, lining, or packing materials
3: Ground paper products, rags, glass, metal, bottles, crockery, etc
4: Paper products, rags, glass, metal, bottles, crockery, etc
5: Food waste
6: Incinerator ash except from plastic products which may contain toxic or heavy metal residues

NOTE: THE DISCHARGE OF ANY GARBAGE OTHER THAN FOOD WASTE IS PROHIBITED IN SPECIAL AREAS. ONLY GARBAGE DISCHARGED INTO THE SEA MUST BE CATEGORIZED. GARBAGE OTHER THAN CATEGORY 1 DISCHARGED TO RECEPTION FACILITIES NEED ONLY BE LISTED AS A TOTAL ESTIMATED AMOUNT.

Date/time	Position of the ship	Estimated amount discharged into sea (m^3)					Estimated amount discharged to reception facilities or to other ship (m^3)		Estimated amount incinerated (m^3)	Certification/ Signature
		Cat. 2	Cat. 3	Cat. 4	Cat. 5	Cat. 6	Cat. 1	Other		

Master's signature: ____________ Date: ________

APPENDIX 5.5

ANNEX VI: REGULATIONS FOR THE PREVENTION OF AIR POLLUTION FROM SHIPS

Annex VI of MARPOL 73/78: ***Regulations for the Prevention of Air Pollution from Ships***

Annex VI of MARPOL 73/78

Regulations for the Prevention of Air Pollution from Ships

Chapter I – General

Regulation 1
Application

The provisions of this Annex shall apply to all ships, except where expressly provided otherwise in regulations 3, 5, 6, 13, 15, 18 and 19 of this Annex.

Regulation 2
Definitions

For the purpose of this Annex:

(1) *A similar stage of construction* means the stage at which:

(a) construction identifiable with a specific ship begins; and

(b) assembly of that ship has commenced comprising at least 50 tonnes or one per cent of the estimated mass of all structural material, whichever is less.

(2) *Continuous feeding* is defined as the process whereby waste is fed into a combustion chamber without human assistance while the incinerator is in normal operating conditions with the combustion chamber operative temperature between 850°C and 1200°C.

(3) *Emission* means any release of substances subject to control by this Annex from ships into the atmosphere or sea.

(4) *New installations*, in relation to regulation 12 of this Annex, means the installation of systems, equipment, including new portable fire-extinguishing units, insulation, or other material on a ship after the date on which this Annex enters into force, but excludes repair or recharge of previously installed systems, equipment, insulation, or other material, or recharge of portable fire-extinguishing units.

(5) *NO_x Technical Code* means the Technical Code on Control of Emission of Nitrogen Oxides from Marine Diesel Engines adopted by Conference resolution 2, as may be amended by the Organization,

provided that such amendments are adopted and brought into force in accordance with the provisions of article 16 of the present Convention concerning amendment procedures applicable to an appendix to an Annex.

(6) *Ozone-depleting substances* means controlled substances defined in paragraph 4 of article 1 of the Montreal Protocol on Substances that Deplete the Ozone Layer, 1987, listed in Annexes A, B, C or E to the said Protocol in force at the time of application or interpretation of this Annex.

Ozone-depleting substances that may be found on board ship include, but are not limited to:

Halon 1211	Bromochlorodifluoromethane
Halon 1301	Bromotrifluoromethane
Halon 2402	1,2-Dibromo-1,1,2,2-tetrafluoroethane (also known as Halon 114B2)
CFC-11	Trichlorofluoromethane
CFC-12	Dichlorodifluoromethane
CFC-113	1,1,2-Trichloro-1,2,2-trifluoroethane
CFC-114	1,2-Dichloro-1,1,2,2-tetrafluoroethane
CFC-115	Chloropentafluoroethane

(7) *Sludge oil* means sludge from the fuel or lubricating oil separators, waste lubricating oil from main or auxiliary machinery, or waste oil from bilge water separators, oil filtering equipment or drip trays.

(8) *Shipboard incineration* means the incineration of wastes or other matter on board a ship, if such wastes or other matter were generated during the normal operation of that ship.

(9) *Shipboard incinerator* means a shipboard facility designed for the primary purpose of incineration.

(10) *Ships constructed* means ships the keels of which are laid or which are at a similar stage of construction.

(11) *SO_x emission control area* means an area where the adoption of special mandatory measures for SO_x emissions from ships is required to prevent, reduce and control air pollution from SO_x and its attendant adverse impacts on land and sea areas. SO_x emission control areas shall include those listed in regulation 14 of this Annex.

(12) *Tanker* means an oil tanker as defined in regulation 1(4) of Annex I or a chemical tanker as defined in regulation 1(1) of Annex II of the present Convention.

(13) *The Protocol of 1997* means the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as amended by the Protocol of 1978 relating thereto.

Regulation 3
General exceptions

Regulations of this Annex shall not apply to:

(a) any emission necessary for the purpose of securing the safety of a ship or saving life at sea; or

(b) any emission resulting from damage to a ship or its equipment:

(i) provided that all reasonable precautions have been taken after the occurrence of the damage or discovery of the emission for the purpose of preventing or minimizing the emission; and

(ii) except if the owner or the master acted either with intent to cause damage, or recklessly and with knowledge that damage would probably result.

Regulation 4
Equivalents

(1) The Administration may allow any fitting, material, appliance or apparatus to be fitted in a ship as an alternative to that required by this Annex if such fitting, material, appliance or apparatus is at least as effective as that required by this Annex.

(2) The Administration which allows a fitting, material, appliance or apparatus as an alternative to that required by this Annex shall communicate to the Organization for circulation to the Parties to the present Convention particulars thereof, for their information and appropriate action, if any.

Chapter II – Survey, certification and means of control

Regulation 5

Surveys and inspections

(1) Every ship of 400 gross tonnage or above and every fixed and floating drilling rig and other platforms shall be subject to the surveys specified below:

(a) an initial survey before the ship is put into service or before the certificate required under regulation 6 of this Annex is issued for the first time. This survey shall be such as to ensure that the equipment, systems, fittings, arrangements and material fully comply with the applicable requirements of this Annex;

(b) periodical surveys at intervals specified by the Administration, but not exceeding five years, which shall be such as to ensure that the equipment, systems, fittings, arrangements and material fully comply with the requirements of this Annex; and

(c) a minimum of one intermediate survey during the period of validity of the certificate which shall be such as to ensure that the equipment and arrangements fully comply with the requirements of this Annex and are in good working order. In cases where only one such intermediate survey is carried out in a single certificate validity period, and where the period of the certificate exceeds 2½ years, it shall be held within six months before or after the halfway date of the certificate's period of validity. Such intermediate surveys shall be endorsed on the certificate issued under regulation 6 of this Annex.

(2) In the case of ships of less than 400 gross tonnage, the Administration may establish appropriate measures in order to ensure that the applicable provisions of this Annex are complied with.

(3) Surveys of ships as regards the enforcement of the provisions of this Annex shall be carried out by officers of the Administration. The Administration may, however, entrust the surveys either to surveyors nominated for the purpose or to organizations recognized by it. Such organizations shall comply with the guidelines adopted by the Organization.* In every case the Administration concerned shall fully guarantee the completeness and efficiency of the survey.

(4) The survey of engines and equipment for compliance with regulation 13 of this Annex shall be conducted in accordance with the NO_x Technical Code.

* Refer to the Guidelines for the authorization of organizations acting on behalf of the Administration, adopted by the Organization by resolution A.739(18), and the Specifications on the survey and certification functions of recognized organizations acting on behalf of the Administration, adopted by the Organization by resolution A.789(19).

(5) The Administration shall institute arrangements for unscheduled inspections to be carried out during the period of validity of the certificate. Such inspections shall ensure that the equipment remains in all respects satisfactory for the service for which the equipment is intended. These inspections may be carried out by their own inspection service, nominated surveyors, recognized organizations, or by other Parties upon request of the Administration. Where the Administration, under the provisions of paragraph (1) of this regulation, establishes mandatory annual surveys, the above unscheduled inspections shall not be obligatory.

(6) When a nominated surveyor or recognized organization determines that the condition of the equipment does not correspond substantially with the particulars of the certificate, they shall ensure that corrective action is taken and shall in due course notify the Administration. If such corrective action is not taken, the certificate should be withdrawn by the Administration. If the ship is in a port of another Party, the appropriate authorities of the port State shall also be notified immediately. When an officer of the Administration, a nominated surveyor or recognized organization has notified the appropriate authorities of the port State, the Government of the port State concerned shall give such officer, surveyor or organization any necessary assistance to carry out their obligations under this regulation.

(7) The equipment shall be maintained to conform with the provisions of this Annex and no changes shall be made in the equipment, systems, fittings, arrangements, or material covered by the survey, without the express approval of the Administration. The direct replacement of such equipment and fittings with equipment and fittings that conform with the provisions of this Annex is permitted.

(8) Whenever an accident occurs to a ship or a defect is discovered, which substantially affects the efficiency or completeness of its equipment covered by this Annex, the master or owner of the ship shall report at the earliest opportunity to the Administration, a nominated surveyor, or recognized organization responsible for issuing the relevant certificate.

Regulation 6

Issue of International Air Pollution Prevention Certificate

(1) An International Air Pollution Prevention Certificate shall be issued, after survey in accordance with the provisions of regulation 5 of this Annex, to:

(a) any ship of 400 gross tonnage or above engaged in voyages to ports or offshore terminals under the jurisdiction of other Parties; and

(b) platforms and drilling rigs engaged in voyages to waters under the sovereignty or jurisdiction of other Parties to the Protocol of 1997.

(2) Ships constructed before the date of entry into force of the Protocol of 1997 shall be issued with an International Air Pollution Prevention Certificate in accordance with paragraph (1) of this regulation no later than the first scheduled drydocking after entry into force of the Protocol of 1997, but in no case later than three years after entry into force of the Protocol of 1997.

(3) Such Certificate shall be issued either by the Administration or by any person or organization duly authorized by it. In every case the Administration assumes full responsibility for the Certificate.

Regulation 7
Issue of a Certificate by another Government

(1) The Government of a Party to the Protocol of 1997 may, at the request of the Administration, cause a ship to be surveyed and, if satisfied that the provisions of this Annex are complied with, issue or authorize the issuance of an International Air Pollution Prevention Certificate to the ship in accordance with this Annex.

(2) A copy of the Certificate and a copy of the survey report shall be transmitted as soon as possible to the requesting Administration.

(3) A Certificate so issued shall contain a statement to the effect that it has been issued at the request of the Administration and it shall have the same force and receive the same recognition as a Certificate issued under regulation 6 of this Annex.

(4) No International Air Pollution Prevention Certificate shall be issued to a ship which is entitled to fly the flag of a State which is not a Party to the Protocol of 1997.

Regulation 8
Form of Certificate

The International Air Pollution Prevention Certificate shall be drawn up in an official language of the issuing country in the form corresponding to the model given in appendix I to this Annex. If the language used is not English, French, or Spanish, the text shall include a translation into one of these languages.

Regulation 9
Duration and validity of Certificate

(1) An International Air Pollution Prevention Certificate shall be issued for a period specified by the Administration, which shall not exceed five years from the date of issue.

(2) No extension of the five-year period of validity of the International Air Pollution Prevention Certificate shall be permitted, except in accordance with paragraph (3).

(3) If the ship, at the time when the International Air Pollution Prevention Certificate expires, is not in a port of the State whose flag it is entitled to fly or in which it is to be surveyed, the Administration may extend the Certificate for a period of no more than five months. Such extension shall be granted only for the purpose of allowing the ship to complete its voyage to the State whose flag it is entitled to fly or in which it is to be surveyed, and then only in cases where it appears proper and reasonable to do so. After arrival in the State whose flag it is entitled to fly or in which it is to be surveyed, the ship shall not be entitled by virtue of such extension to leave the port or State without having obtained a new International Air Pollution Prevention Certificate.

(4) An International Air Pollution Prevention Certificate shall cease to be valid in any of the following circumstances:

(a) if the inspections and surveys are not carried out within the periods specified under regulation 5 of this Annex;

(b) if significant alterations have taken place to the equipment, systems, fittings, arrangements or material to which this Annex applies without the express approval of the Administration, except the direct replacement of such equipment or fittings with equipment or fittings that conform with the requirements of this Annex. For the purpose of regulation 13, significant alteration shall include any change or adjustment to the system, fittings, or arrangement of a diesel engine which results in the nitrogen oxide limits applied to that engine no longer being complied with; or

(c) upon transfer of the ship to the flag of another State. A new Certificate shall be issued only when the Government issuing the new Certificate is fully satisfied that the ship is in full compliance with the requirements of regulation 5 of this Annex. In the case of a transfer between Parties, if requested within three months after the transfer has taken place, the Government of the Party whose flag the ship was formerly entitled to fly shall, as soon as possible, transmit to the Administration of the other

Party a copy of the International Air Pollution Prevention Certificate carried by the ship before the transfer and, if available, copies of the relevant survey reports.

Regulation 10
Port State control on operational requirements

(1) A ship, when in a port or an offshore terminal under the jurisdiction of another Party to the Protocol of 1997, is subject to inspection by officers duly authorized by such Party concerning operational requirements under this Annex, where there are clear grounds for believing that the master or crew are not familiar with essential shipboard procedures relating to the prevention of air pollution from ships.

(2) In the circumstances given in paragraph (1) of this regulation, the Party shall take such steps as will ensure that the ship shall not sail until the situation has been brought to order in accordance with the requirements of this Annex.

(3) Procedures relating to the port State control prescribed in article 5 of the present Convention shall apply to this regulation.

(4) Nothing in this regulation shall be construed to limit the rights and obligations of a Party carrying out control over operational requirements specifically provided for in the present Convention.

Regulation 11
Detection of violations and enforcement

(1) Parties to this Annex shall co-operate in the detection of violations and the enforcement of the provisions of this Annex, using all appropriate and practicable measures of detection and environmental monitoring, adequate procedures for reporting and accumulation of evidence.

(2) A ship to which the present Annex applies may, in any port or offshore terminal of a Party, be subject to inspection by officers appointed or authorized by that Party for the purpose of verifying whether the ship has emitted any of the substances covered by this Annex in violation of the provision of this Annex. If an inspection indicates a violation of this Annex, a report shall be forwarded to the Administration for any appropriate action.

(3) Any Party shall furnish to the Administration evidence, if any, that the ship has emitted any of the substances covered by this Annex in violation of the provisions of this Annex. If it is practicable to do so,

the competent authority of the former Party shall notify the master of the ship of the alleged violation.

(4) Upon receiving such evidence, the Administration so informed shall investigate the matter, and may request the other Party to furnish further or better evidence of the alleged contravention. If the Administration is satisfied that sufficient evidence is available to enable proceedings to be brought in respect of the alleged violation, it shall cause such proceedings to be taken in accordance with its law as soon as possible. The Administration shall promptly inform the Party which has reported the alleged violation, as well as the Organization, of the action taken.

(5) A Party may also inspect a ship to which this Annex applies when it enters the ports or offshore terminals under its jurisdiction, if a request for an investigation is received from any Party together with sufficient evidence that the ship has emitted any of the substances covered by the Annex in any place in violation of this Annex. The report of such investigation shall be sent to the Party requesting it and to the Administration so that the appropriate action may be taken under the present Convention.

(6) The international law concerning the prevention, reduction, and control of pollution of the marine environment from ships, including that law relating to enforcement and safeguards, in force at the time of application or interpretation of this Annex, applies, *mutatis mutandis*, to the rules and standards set forth in this Annex.

Chapter III – Requirements for control of emissions from ships

Regulation 12
Ozone-depleting substances

(1) Subject to the provisions of regulation 3, any deliberate emissions of ozone-depleting substances shall be prohibited. Deliberate emissions include emissions occurring in the course of maintaining, servicing, repairing or disposing of systems or equipment, except that deliberate emissions do not include minimal releases associated with the recapture or recycling of an ozone-depleting substance. Emissions arising from leaks of an ozone-depleting substance, whether or not the leaks are deliberate, may be regulated by Parties to the Protocol of 1997.

(2) New installations which contain ozone-depleting substances shall be prohibited on all ships, except that new installations containing hydrochlorofluorocarbons (HCFCs) are permitted until 1 January 2020.

(3) The substances referred to in this regulation, and equipment containing such substances, shall be delivered to appropriate reception facilities when removed from ships.

Regulation 13
Nitrogen oxides (NO_x)

(1) (a) This regulation shall apply to:

(i) each diesel engine with a power output of more than 130 kW which is installed on a ship constructed on or after 1 January 2000; and

(ii) each diesel engine with a power output of more than 130 kW which undergoes a major conversion on or after 1 January 2000.

(b) This regulation does not apply to:

(i) emergency diesel engines, engines installed in lifeboats and any device or equipment intended to be used solely in case of emergency; and

(ii) engines installed on ships solely engaged in voyages within waters subject to the sovereignty or jurisdiction of the State the flag of which the ship is entitled to fly, provided that such engines are subject to an alternative NO_x control measure established by the Administration.

(c) Notwithstanding the provisions of sub-paragraph (a) of this paragraph, the Administration may allow exclusion from the application of this regulation to any diesel engine which is installed on a ship constructed, or on a ship which undergoes a major conversion, before the date of entry into force of the present Protocol, provided that the ship is solely engaged in voyages to ports or offshore terminals within the State the flag of which the ship is entitled to fly.

(2) (a) For the purpose of this regulation, *major conversion* means a modification of an engine where:

(i) the engine is replaced by a new engine built on or after 1 January 2000, or

(ii) any substantial modification, as defined in the NO_x Technical Code, is made to the engine, or

(iii) the maximum continuous rating of the engine is increased by more than 10%.

(b) The NO_x emission resulting from modifications referred to in the sub-paragraph (a) of this paragraph shall be documented in accordance with the NO_x Technical Code for approval by the Administration.

(3) (a) Subject to the provision of regulation 3 of this Annex, the operation of each diesel engine to which this regulation applies is prohibited, except when the emission of nitrogen oxides (calculated as the total weighted emission of NO_2) from the engine is within the following limits:

(i) 17.0 g/kW h when n is less than 130 rpm

(ii) $45.0 \times n^{-0.2}$ g/kW h when n is 130 or more but less than 2000 rpm

(iii) 9.8 g/kW h when n is 2000 rpm or more

where n = rated engine speed (crankshaft revolutions per minute).

When using fuel composed of blends from hydrocarbons derived from petroleum refining, test procedure and measurement methods shall be in accordance with the NO_x Technical Code, taking into consideration the test cycles and weighting factors outlined in appendix II to this Annex.

(b) Notwithstanding the provisions of sub-paragraph (a) of this paragraph, the operation of a diesel engine is permitted when:

(i) an exhaust gas cleaning system, approved by the Administration in accordance with the NO_x Technical Code, is applied to the engine to reduce onboard NO_x emissions at least to the limits specified in sub-paragraph (a), or

(ii) any other equivalent method, approved by the Administration taking into account relevant guidelines to be developed by the Organization, is applied to reduce onboard NO_x emissions at least to the limit specified in sub-paragraph (a) of this paragraph.

Regulation 14
Sulphur oxides (SO_x)

General requirements

(1) The sulphur content of any fuel oil used on board ships shall not exceed 4.5% m/m.

(2) The world-wide average sulphur content of residual fuel oil supplied for use on board ships shall be monitored taking into account guidelines to be developed by the Organization.*

Requirements within SO_x emission control areas

(3) For the purpose of this regulation, SO_x emission control areas shall include:

(a) the Baltic Sea area as defined in regulation 10(1)(b) of Annex I; and

(b) any other sea area, including port areas, designated by the Organization in accordance with criteria and procedures for designation of SO_x emission control areas with respect to the prevention of air pollution from ships contained in appendix III to this Annex.

(4) While ships are within SO_x emission control areas, at least one of the following conditions shall be fulfilled:

(a) the sulphur content of fuel oil used on board ships in a SO_x emission control area does not exceed 1.5% m/m;

(b) an exhaust gas cleaning system, approved by the Administration taking into account guidelines to be developed by the Organization, is applied to reduce the total emission of sulphur oxides from ships, including both auxiliary and main propulsion engines, to 6.0 g SO_x/kW h or less calculated as the total weight of sulphur dioxide emission. Waste streams from the use of such equipment shall not be discharged into enclosed ports, harbours and estuaries unless it can be thoroughly documented by the ship that such waste streams have no adverse impact on the ecosystems of such enclosed ports, harbours and estuaries, based upon criteria communicated by the authorities of the port State to the Organization. The Organization shall circulate the criteria to all Parties to the Convention; or

(c) any other technological method that is verifiable and enforceable to limit SO_x emissions to a level equivalent to that described in sub-paragraph (b) is applied. These methods shall be approved by the Administration taking into account guidelines to be developed by the Organization.

(5) The sulphur content of fuel oil referred to in paragraph (1) and paragraph (4)(a) of this regulation shall be documented by the supplier as required by regulation 18 of this Annex.

(6) Those ships using separate fuel oils to comply with paragraph (4)(a) of this regulation shall allow sufficient time for the fuel oil service system to be fully flushed of all fuels exceeding 1.5% m/m sulphur content prior to entry into a SO_x emission control area. The volume of low-sulphur fuel oils (less than or equal to 1.5% sulphur content) in each tank as well as the date, time, and position of the ship when any fuel-changeover operation is completed, shall be recorded in such log-book as prescribed by the Administration.

(7) During the first 12 months immediately following entry into force of the present Protocol, or of an amendment to the present Protocol designating a specific SO_x emission control area under paragraph (3)(b) of this regulation, ships entering a SO_x emission control area referred to in paragraph (3)(a) of this regulation or designated under paragraph (3)(b) of this regulation are exempted from the requirements in paragraphs (4) and (6) of this regulation and from the requirements of paragraph (5) of this regulation insofar as they relate to paragraph (4)(a) of this regulation.

Regulation 15
Volatile organic compounds

(1) If the emissions of volatile organic compounds (VOCs) from tankers are to be regulated in ports or terminals under the jurisdiction of a Party to the Protocol of 1997, they shall be regulated in accordance with the provisions of this regulation.

(2) A Party to the Protocol of 1997 which designates ports or terminals under its jurisdiction in which VOCs emissions are to be regulated shall submit a notification to the Organization. This notification shall include information on the size of tankers to be controlled, on cargoes requiring vapour emission control systems, and the effective date of such control. The notification shall be submitted at least six months before the effective date.

(3) The Government of each Party to the Protocol of 1997 which designates ports or terminals at which VOCs emissions from tankers

* Refer to resolution MEPC.82(43), Guidelines for monitoring the world-wide average sulphur content of residual fuel oils supplied for use on board ships; see item 9 of the additional information.

are to be regulated shall ensure that vapour emission control systems, approved by that Government taking into account the safety standards developed by the Organization,* are provided in ports and terminals designated, and are operated safely and in a manner so as to avoid undue delay to the ship.

(4) The Organization shall circulate a list of the ports and terminals designated by the Parties to the Protocol of 1997 to other Parties to the Protocol of 1997 and Member States of the Organization for their information.

(5) All tankers which are subject to vapour emission control in accordance with the provisions of paragraph (2) of this regulation shall be provided with a vapour collection system approved by the Administration taking into account the safety standards developed by the Organization,* and shall use such system during the loading of such cargoes. Terminals which have installed vapour emission control systems in accordance with this regulation may accept existing tankers which are not fitted with vapour collection systems for a period of three years after the effective date identified in paragraph (2).

(6) This regulation shall only apply to gas carriers when the type of loading and containment systems allow safe retention of non-methane VOCs on board, or their safe return ashore.

Regulation 16
Shipboard incineration

(1) Except as provided in paragraph (5), shipboard incineration shall be allowed only in a shipboard incinerator.

(2) (a) Except as provided in sub-paragraph (b) of this paragraph, each incinerator installed on board a ship on or after 1 January 2000 shall meet the requirements contained in appendix IV to this Annex. Each incinerator shall be approved by the Administration taking into account the standard specifications for shipboard incinerators developed by the Organization.†

(b) The Administration may allow exclusion from the application of sub-paragraph (a) of this paragraph to any incinerator which is installed on board a ship before the date of entry into force of the Protocol of 1997, provided that the ship is solely engaged in voyages within waters subject to the sovereignty or jurisdiction of the State the flag of which the ship is entitled to fly.

* Refer to MSC/Circ.585, Standards for vapour emission control systems.

† Refer to resolution MEPC.76(40), Standard specification for shipboard incinerators, and resolution MEPC.93(45), Amendments to the standard specification for shipboard incinerators.

(3) Nothing in this regulation affects the prohibition in, or other requirements of, the Convention on the Prevention of Marine Pollution by Dumping of Wastes and Other Matter, 1972, as amended, and the 1996 Protocol thereto.

(4) Shipboard incineration of the following substances shall be prohibited:

(a) Annex I, II and III cargo residues of the present Convention and related contaminated packing materials;

(b) polychlorinated biphenyls (PCBs);

(c) garbage, as defined in Annex V of the present Convention, containing more than traces of heavy metals; and

(d) refined petroleum products containing halogen compounds.

(5) Shipboard incineration of sewage sludge and sludge oil generated during the normal operation of a ship may also take place in the main or auxiliary power plant or boilers, but in those cases, shall not take place inside ports, harbours and estuaries.

(6) Shipboard incineration of polyvinyl chlorides (PVCs) shall be prohibited, except in shipboard incinerators for which IMO Type Approval Certificates have been issued.

(7) All ships with incinerators subject to this regulation shall possess a manufacturer's operating manual which shall specify how to operate the incinerator within the limits described in paragraph (2) of appendix IV to this Annex.

(8) Personnel responsible for operation of any incinerator shall be trained and capable of implementing the guidance provided in the manufacturer's operating manual.

(9) Monitoring of combustion flue gas outlet temperature shall be required at all times and waste shall not be fed into a continuous-feed shipboard incinerator when the temperature is below the minimum allowed temperature of 850°C. For batch-loaded shipboard incinerators, the unit shall be designed so that the temperature in the combustion chamber shall reach 600°C within five minutes after start-up.

(10) Nothing in this regulation precludes the development, installation and operation of alternative design shipboard thermal waste treatment devices that meet or exceed the requirements of this regulation.

Regulation 17
Reception facilities

(1) The Government of each Party to the Protocol of 1997 undertakes to ensure the provision of facilities adequate to meet the:

(a) needs of ships using its repair ports for the reception of ozone-depleting substances and equipment containing such substances when removed from ships;

(b) needs of ships using its ports, terminals or repair ports for the reception of exhaust gas cleaning residues from an approved exhaust gas cleaning system when discharge into the marine environment of these residues is not permitted under regulation 14 of this Annex;

without causing undue delay to ships, and

(c) needs in ship breaking facilities for the reception of ozone-depleting substances and equipment containing such substances when removed from ships.

(2) Each Party to the Protocol of 1997 shall notify the Organization for transmission to the Members of the Organization of all cases where the facilities provided under this regulation are unavailable or alleged to be inadequate.

Regulation 18
Fuel oil quality

(1) Fuel oil for combustion purposes delivered to and used on board ships to which this Annex applies shall meet the following requirements:

(a) except as provided in sub-paragraph (b):

(i) the fuel oil shall be blends of hydrocarbons derived from petroleum refining. This shall not preclude the incorporation of small amounts of additives intended to improve some aspects of performance;

(ii) the fuel oil shall be free from inorganic acid;

(iii) the fuel oil shall not include any added substance or chemical waste which either:

(1) jeopardizes the safety of ships or adversely affects the performance of the machinery, or

(2) is harmful to personnel, or

(3) contributes overall to additional air pollution; and

(b) fuel oil for combustion purposes derived by methods other than petroleum refining shall not:

(i) exceed the sulphur content set forth in regulation 14 of this Annex;

(ii) cause an engine to exceed the NO_x emission limits set forth in regulation 13(3)(a) of this Annex;

(iii) contain inorganic acid; and

(iv) (1) jeopardize the safety of ships or adversely affect the performance of the machinery, or

(2) be harmful to personnel, or

(3) contribute overall to additional air pollution.

(2) This regulation does not apply to coal in its solid form or nuclear fuels.

(3) For each ship subject to regulations 5 and 6 of this Annex, details of fuel oil for combustion purposes delivered to and used on board shall be recorded by means of a bunker delivery note which shall contain at least the information specified in appendix V to this Annex.

(4) The bunker delivery note shall be kept on board the ship in such a place as to be readily available for inspection at all reasonable times. It shall be retained for a period of three years after the fuel oil has been delivered on board.

(5) (a) The competent authority* of the Government of a Party to the Protocol of 1997 may inspect the bunker delivery notes on board any ship to which this Annex applies while the ship is in its port or offshore terminal, may make a copy of each delivery note, and may require the master or person in charge of the ship to certify that each copy is a true copy of such bunker delivery note. The competent authority may also verify the contents of each note through consultations with the port where the note was issued.

(b) The inspection of the bunker delivery notes and the taking of certified copies by the competent authority under this paragraph shall be performed as expeditiously as possible without causing the ship to be unduly delayed.

(6) The bunker delivery note shall be accompanied by a representative sample of the fuel oil delivered, taking into account guidelines to be developed by the Organization. The sample is to be sealed and signed by the supplier's representative and the master or officer in charge of the bunker operation on completion of bunkering operations and retained under the ship's control until the fuel oil is substantially consumed, but in any case for a period of not less than 12 months from the time of delivery.

(7) Parties to the Protocol of 1997 undertake to ensure that appropriate authorities designated by them:

(a) maintain a register of local suppliers of fuel oil;

* Refer to resolution A.787(19), Procedures for port State control, as amended by A.882(21); see IMO sales publication IMO-650E.

(b) require local suppliers to provide the bunker delivery note and sample as required by this regulation, certified by the fuel oil supplier that the fuel oil meets the requirements of regulations 14 and 18 of this Annex;

(c) require local suppliers to retain a copy of the bunker delivery note for at least three years for inspection and verification by the port State as necessary;

(d) take action as appropriate against fuel oil suppliers that have been found to deliver fuel oil that does not comply with that stated on the bunker delivery note;

(e) inform the Administration of any ship receiving fuel oil found to be non-compliant with the requirements of regulations 14 or 18 of this Annex; and

(f) inform the Organization for transmission to Parties to the Protocol of 1997 of all cases where fuel oil suppliers have failed to meet the requirements specified in regulations 14 or 18 of this Annex.

(8) In connection with port State inspections carried out by Parties to the Protocol of 1997, the Parties further undertake to:

(a) inform the Party or non-Party under whose jurisdiction a bunker delivery note was issued of cases of delivery of non-compliant fuel oil, giving all relevant information; and

(b) ensure that remedial action as appropriate is taken to bring non-compliant fuel oil discovered into compliance.

Regulation 19
Requirements for platforms and drilling rigs

(1) Subject to the provisions of paragraphs (2) and (3) of this regulation, fixed and floating platforms and drilling rigs shall comply with the requirements of this Annex.

(2) Emissions directly arising from the exploration, exploitation and associated offshore processing of sea-bed mineral resources are, consistent with article 2(3)(b)(ii) of the present Convention, exempt from the provisions of this Annex. Such emissions include the following:

(a) emissions resulting from the incineration of substances that are solely and directly the result of exploration, exploitation and associated offshore processing of sea-bed mineral resources, including but not limited to the flaring of hydrocarbons and the

burning of cuttings, muds, and/or stimulation fluids during well completion and testing operations, and flaring arising from upset conditions;

(b) the release of gases and volatile compounds entrained in drilling fluids and cuttings;

(c) emissions associated solely and directly with the treatment, handling, or storage of sea-bed minerals; and

(d) emissions from diesel engines that are solely dedicated to the exploration, exploitation and associated offshore processing of sea-bed mineral resources.

(3) The requirements of regulation 18 of this Annex shall not apply to the use of hydrocarbons which are produced and subsequently used on site as fuel, when approved by the Administration.

Appendices to Annex VI

Appendix I

Form of IAPP Certificate (Regulation 8)

INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE

Issued under the provisions of the Protocol of 1997 to amend the International Convention for the Prevention of Pollution from Ships, 1973, as modified of the Protocol of 1978 related thereto (hereinafter referred to as "the Convention") under the authority of the Government of:

....

(full designation of the country)

by ....

(full designation of the competent person or organization authorized under the provisions of the Convention)

Name of ship	Distinctive number or letters	IMO number	Port of registry	Gross tonnage

Type of ship: ☐ tanker
☐ ships other than a tanker

THIS IS TO CERTIFY:

1. That the ship has been surveyed in accordance with regulation 5 of Annex VI of the Convention; and

2. That the survey shows that the equipment, systems, fittings, arrangements and materials fully comply with the applicable requirements of Annex VI of the Convention.

This certificate is valid until .... subject to surveys in accordance with regulation 5 of Annex VI of the Convention.

Issued at ....

(Place of issue of certificate)

....

(Date of issue) *(Signature of duly authorized official issuing the certificate)*

(Seal or stamp of the authority, as appropriate)

ENDORSEMENT FOR ANNUAL AND INTERMEDIATE SURVEYS

THIS IS TO CERTIFY that at a survey required by regulation 5 of Annex VI of the Convention the ship was found to comply with the relevant provisions of the Convention:

Annual survey: Signed ....

(Signature of duly authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

Annual*/Intermediate* survey: Signed ....

(Signature of duly authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

Annual*/Intermediate* survey: Signed ....

(Signature of duly authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

Annual survey: Signed ....

(Signature of duly authorized official)

Place ....

Date ....

(Seal or stamp of the authority, as appropriate)

* Delete as appropriate.

SUPPLEMENT TO INTERNATIONAL AIR POLLUTION PREVENTION CERTIFICATE (IAPP CERTIFICATE)

RECORD OF CONSTRUCTION AND EQUIPMENT

In respect of the provisions of Annex VI of the International Convention for the Prevention of Pollution from Ships, 1973, as modified by the Protocol of 1978 relating thereto (hereinafter referred to as "the Convention").

Notes:

1 This Record shall be permanently attached to the IAPP Certificate. The IAPP Certificate shall be available on board the ship at all times.

2 If the language of the original Record is not English, French or Spanish, the text shall include a translation into one of these languages.

3 Entries in boxes shall be made by inserting either a cross (x) for the answer "yes" and "applicable" or a (-) for the answers "no" and "not applicable" as appropriate.

4 Unless otherwise stated, regulations mentioned in this Record refer to regulations of Annex VI of the Convention and resolutions or circulars refer to those adopted by the International Maritime Organization.

1 Particulars of ship

1.1 Name of ship ....

1.2 Distinctive number or letters ....

1.3 IMO number ....

1.4 Port of registry ....

1.5 Gross tonnage ....

1.6 Date on which keel was laid or ship was at a similar stage of construction ....

1.7 Date of commencement of major engine conversion (if applicable) (regulation 13): ....

2 Control of emissions from ships

2.1 *Ozone-depleting substances (regulation 12)*

2.1.1 The following fire-extinguishing systems and equipment containing halons may continue in service: .... ☐

System equipment	Location on board

2.1.2 The following systems and equipment containing CFCs may continue in service: .... ☐

System equipment	Location on board

2.1.3 The following systems containing hydro-chlorofluorocarbons (HCFCs) installed before 1 January 2020 may continue in service:.... ☐

System equipment	Location on board

2.2 *Nitrogen oxides (NO_x) (regulation 13)*

2.2.1 The following diesel engines with power output greater than 130 kW, and installed on a ship constructed on or after 1 January 2000, comply with the emission standards of regulation 13(3)(a) in accordance with the NO_x Technical Code: .... ☐

Manufacturer and model	Serial number	Use	Power output (kW)	Rated speed (rpm)

2.2.2 The following diesel engines with power output greater than 130 kW, and which underwent major conversion per regulation 13(2) on or after 1 January 2000, comply with the emission standards of regulation 13(3)(a) in accordance with the NO_x Technical Code: .... ☐

Manufacturer and model	Serial number	Use	Power output (kW)	Rated speed (rpm)

2.2.3 The following diesel engines with a power output greater than 130 kW and installed on a ship constructed on or after 1 January 2000, or with a power output greater than 130 kW and which underwent major conversion per regulation 13(2) on or after 1 January 2000, are fitted with an exhaust gas cleaning system or other equivalent methods in accordance with regulation 13(3), and the NO_x Technical Code: ...... ☐

Manufacturer and model	Serial number	Use	Power output (kW)	Rated speed (rpm)

2.2.4 The following diesel engines from 2.2.1, 2.2.2 and 2.2.3 above are fitted with NO_x emission monitoring and recording devices in accordance with the NO_x Technical Code: .... ☐

Manufacturer and model	Serial number	Use	Power output (kW)	Rated speed (rpm)

2.3 *Sulphur oxides (SO_x) (regulation 14)*

2.3.1 When the ship operates within an SO_x emission control area specified in regulation 14(3), the ship uses:

.1 fuel oil with a sulphur content that does not exceed 1.5% m/m as documented by bunker delivery notes; or .... ☐

.4 relevant information pertaining to the meteorological conditions in the proposed area of application of the SO_x emission controls and the land and sea areas at risk, in particular prevailing wind patterns, or to topographical, geological, oceanographic, morphological, or other conditions that may lead to an increased probability of higher localized air pollution or levels of acidification;

.5 the nature of the ship traffic in the proposed SO_x emission control area, including the patterns and density of such traffic; and

.6 a description of the control measures taken by the proposing Contracting State or Contracting States addressing land-based sources of SO_x emissions affecting the area at risk that are in place and operating concurrent with the consideration of measures to be adopted in relation to provisions of regulation 14 of Annex VI of the present Convention.

2.3 The geographical limits of an SO_x emission control area will be based on the relevant criteria outlined above, including SO_x emission and deposition from ships navigating in the proposed area, traffic patterns and density, and wind conditions.

2.4 A proposal to designate a given area as an SO_x emission control area should be submitted to the Organization in accordance with the rules and procedures established by the Organization.

3 *Procedures for the assessment and adoption of SO_x emission control areas by the Organization*

3.1 The Organization shall consider each proposal submitted to it by a Contracting State or Contracting States.

3.2 A SO_x emission control area shall be designated by means of an amendment to this Annex, considered, adopted and brought into force in accordance with article 16 of the present Convention.

3.3 In assessing the proposal, the Organization shall take into account the criteria which are to be included in each proposal for adoption as set forth in section 2 above, and the relative costs of reducing sulphur depositions from ships when compared with land-based controls. The economic impacts on shipping engaged in international trade should also be taken into account.

4 *Operation of SO_x emission control areas*

4.1 Parties which have ships navigating in the area are encouraged to bring to the Organization any concerns regarding the operation of the area.

Appendix IV

Type approval and operating limits for shipboard incinerators (Regulation 16)

(1) Shipboard incinerators described in regulation 16(2) shall possess an IMO type approval certificate for each incinerator. In order to obtain such certificate, the incinerator shall be designed and built to an approved standard as described in regulation 16(2). Each model shall be subject to a specified type approval test operation at the factory or an approved test facility, and under the responsibility of the Administration, using the following standard fuel/waste specification for the type approval test for determining whether the incinerator operates within the limits specified in paragraph (2) of this appendix:

Sludge oil consisting of:	75% sludge oil from HFO; 5% waste lubricating oil; and 20% emulsified water
Solid waste consisting of:	50% food waste 50% rubbish containing approx. 30% paper, approx. 40% cardboard, approx. 10% rags, approx. 20% plastic The mixture will have up to 50% moisture and 7% incombustible solids.

(2) Incinerators described in regulation 16(2) shall operate within the following limits:

O_2 in combustion chamber:	6–12%
CO in flue gas maximum average:	200 mg/MJ
Soot number maximum average:	Bacharach 3 or Ringelman 1 (20% opacity) (A higher soot number is acceptable only during very short periods such as starting up)
Unburned components in ash residues:	maximum 10% by weight
Combustion chamber flue gas outlet temperature range:	850–1200°C

Appendix V

Information to be included in the bunker delivery note (Regulation 18(3))

Name and IMO number of receiving ship

Port

Date of commencement of delivery

Name, address, and telephone number of marine fuel oil supplier

Product name(s)

Quantity (metric tons)

Density at 15°C (kg/m^3)*

Sulphur content (% m/m)†

A declaration signed and certified by the fuel oil supplier's representative that the fuel oil supplied is in conformity with regulation 14 (1) or (4)(a) and regulation 18(1) of this Annex.

* Fuel oil should be tested in accordance with ISO 3675.

† Fuel oil should be tested in accordance with ISO 8754.