UNITED STATES GOVERNMENT
MEMORANDUM

November 20, 2007

To: Public Information (MS 5030)

From: Plan Coordinator, FO, Plans Section (MS 5231)

Subject: Public Information copy of plan

Control #	-	N-09015
Type	-	Initial Development Operations Coordinations Document
Lease(s)	-	OCS-G16965 Block - 206 Walker Ridge Area OCS-G16969 Block - 249 Walker Ridge Area OCS-G16997 Block - 469 Walker Ridge Area
Operator	-	Petrobras America Inc.
Description	-	FPSO and Subsea Wells Nos. 2, 3, and 4
Rig Type	-	SEMISUBMERSIBLE

Attached is a copy of the subject plan.

It has been deemed submitted as of this date and is under review for approval.

MT

Michael Tolbert
Plan Coordinator

Site Type/Name	Botm Lse/Area/Blk	Surface Location	Surf Lse/Area/Blk
FPSO/FPSO		927 FSL, 1402 FEL	G16969/WR/249
WELL/NO. 2	G16997/WR/469	32 FNL, 7310 FEL	G16997/WR/469
WELL/NO. 3	G16969/WR/249	3984 FNL, 1623 FEL	G16969/WR/249
WELL/NO. 4	G16965/WR/206	2440 FSL, 3289 FWL	G16965/WR/206

Rec'd 11-27

Tolbert, Michael

From: Tolbert, Michael
Sent: Tuesday, November 20, 2007 1:15 PM
To: 'groland@petrobras-usa.com'
Cc: Mike Bigler; csaha@petrobras-usa.com
Subject: RE: CD's for N-9015 Cascade/Chinook

Hi Greg,

That date was predicated on receiving all the updated copies of the DOCD that I needed to send to the States. I apologize if that wasn't clear. The official deemed submitted date will be today, 11/20/07. That will put the DOCD due date on approximately March 19, 2008.

I checked and confirmed that the file "Cascade + Chinook DOCD Addendum 8-2-07" contains the info sent in October. Although this is more than a little bit confusing, I suppose I can go ahead and send it as is. I'll attach a copy of this email exchange as explanation.

Let me know if you have any further questions or comments.

Michael Tolbert
Petroleum Engineer
Office of Field Operations, Plans Section
Phone: (504) 736-2867
email: Michael.Tolbert@mms.gov

-----Original Message-----
From: groland@petrobras-usa.com [mailto:groland@petrobras-usa.com]
Sent: Tuesday, November 20, 2007 7:22 AM
To: Tolbert, Michael
Cc: Mike Bigler; csaha@petrobras-usa.com
Subject: Re: CD's for N-9015 Cascade/Chinook

Mike,

I got your voice message from yesterday and I left you a voice message this morning....the data your looking for is in the "Cascade + Chinook DOCD Addendum"

I inadvertently did not change the date on the second page when I changed the "Public Information" copy. Additionally, I left those two cover pages in the files so when IT burned the CD's I asked them to put all the files in the folder on the CD. I had already moved those two cover pages to the above file so the updated information for oil spills is there.

I'm a little concerned about your statement of the "deemed submitted" status. You assured me that the last date of 16 October 2007 was the confirmed deemed submitted date. Why would the clock have to be restarted at this point? That doesn't seem right.

Thanks,

Gregory D. Roland
Regulatory Administrator
Petrobras America Inc
10777 Westheimer Rd., Suite 1200, Houston, TX 77042 (Main Office Location)
Office: 713.808.2881
Cell: 281.777.9457

2101 City West Blvd, Bldg. 3, Floor 2, Rm. 3.222 (Extension Office Location for G.Roland)

"Tolbert ,
Michael" <Michael.Tolbert@mms.gov>

To "Greg Roland" <groland@petrobras-usa.com>

cc "Mike Bigler" <mbigler.indep@petrobras-usa.com>

Subject CD's for N-9015 Cascade/Chinook

11/19/07 04:05 PM

Hi Greg,

I got the CD's today and was able to open the files, but encountered another problem. The last amendment (dated 5 October 2007) only includes the cover letter and not the actual body of the amendment.
Please correct this ASAP and we'll get these CD's on their way to the States.

(The DOCD will be officially deemed submitted just as soon as I receive these CD copies, which will start our ~120 day regulatory DOCD clock.)

Let me know if you have any questions.

Michael Tolbert
Petroleum Engineer
Office of Field Operations, Plans Section
Phone: (504) 736-2867
email: Michael.Tolbert@mms.gov

(See attached file: winmail.dat)

****
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****

PETROBRAS AMERICA INC.

16 November 2007

Ms. Elizabeth Peuler, Chief, Plans Section
Office of Field Operations
Minerals Management Service
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Attn. Mr. Michael Tolbert – MS 5231

RE: Development Operations Coordination Document (DOCD) on CD, Plan N-09015, for Cascade / Chinook Development Project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico

Ladies and Gentlemen:

Pursuant to your request Petrobras America Inc. (PAI) encloses herewith d six (6) CDs, public information copies, of our DOCD with addendums for your files, use and distribution with respect to Plan N-09015 for our Cascade / Chinook development project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico.

PAI respectfully includes a brief addition to Section 14(b) with respect to transportation. Subsequent to our initial submittal and our latest addendum / supplemental information, PAI is in a very early stage of considering a minor change in one of the propose pipeline routes. The proposed route to Anaconda is currently being reviewed for possible change in approximately the last 15 miles and terminus. PAI recognizes pursuant to our discussions that this change should be noted and of course, should this consideration mature to a valid option, it will be covered extensively in our pipeline application for the export gas pipeline which will receive full review.

Should you have any additional questions or data needs please feel free to contact me directly at 713.808.2881 or by e-mail to groland@petrobras-usa.com.

Sincerely,
Petrobras America Inc

Gregory D. Roland
Regulatory Administrator

Enclosures – (6-CDs)

10777 Westheimer Road · Suite 1200 · Houston, Texas 77042 · Tel (713) 808-2000 · Fax (713) 808-2004

PETROBRAS AMERICA INC.

5 October 2007

Ms. Elizabeth Peuler, Chief - Plans Section
Office of Field Operations
Minerals Management Service
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Attn. Mr. Michael Tolbert – MS 5231

RE: Revised Addendum to Development Operations Coordination Document (DOCD), Plan N-09015, for Cascade / Chinook Development Project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico

Ladies and Gentlemen:

Please find enclose herewith a proprietary version of our revised addendum to the DOCD, Plan N-09015 for our Cascade / Chinook development project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico.

PAI respectfully includes summary pages of the modifications performed since the original submittal of 12 June 2007 with the appropriate documentation for each section in which changes were initiated.

Again, we trust the enclosed information will meet with your approval and satisfy the regulatory requirements however; should you have additional questions concerning this matter please contact me directly at 713.808.2881 or by e-mail to groland@petrobras-usa.com.

Sincerely,
Petrobras America Inc

Gregory D. Roland
Regulatory Administrator

Enclosures

10777 Westheimer Road · Suite 1200 · Houston, Texas 77042 · Tel (713) 808-2000 · Fax (713) 808-2004

Public Version

Addendum to Development Operations Coordination Document

for the

Cascade / Chinook Development Project

August 2, 2007

Submitted by:

PETROBRAS AMERICA INC.

PETROBRAS AMERICA INC.

25 September 2007

Ms. Elizabeth Peuler, Plans Section Chief
Office of Field Operations
Minerals Management Service
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Attn. Mr. Michael Tolbert – MS 5231

RE: Additional Information for Plan N-09015

Ladies and Gentlemen:

Mr. Tolbert,

In reference to your Informal Memorandum regarding the DOCD Plan Review for N-09015 dated 9/18/07, PAI provides the following responses.

Response to Question #1

The information included in Table 2-6 (FPSO Topsides Design Capacity) is intended to identify the maximum processing throughput per day design capacities for oil, produced water, total fluids, and gas. An updated Table 2-6 is included below for clarity.

Table 2-6 – FPSO Topsides Design Capacity

Product	Maximum Processing Throughput
Oil	80,000 bpd
Produced Water	16,000 bpd
Total Fluids	80,000 bpd
Gas	16 MMscfd

The information included in Table 1-2 (Storage Tanks and Production Vessels) is intended to identify the maximum amounts of hydrocarbons that may be included in the various tanks on the FPSO at any given time. The total inventories of hydrocarbons in the topsides tanks and process piping systems is estimated at 8,010 barrels (6,010 barrels for topsides tanks and 2,000 barrels for process piping) as described in Table 9-5 (Worst Case Discharge [MMS Jurisdiction]).

Response to Question #2

Mr. Skip Przelomski of Clean Caribbean Americas (CCA) has provided PAI with the information included in Attachments 1 and 2 regarding equipment and dispersant availability to Full Members and Associate Members for use outside of the CCA Area of Interest. This information is an excerpt from established CCA By-Laws. CCA has indicated that this information is more accurate than information currently included in its website. Note that PAI is an Associate Member of CCA.

Response to Question #3

PAI resubmits Table 9-5 (Worst Case Discharge [MMS Jurisdiction]) and supporting notes based on the request from MMS to delete the phrase "as it is not required per 30 CFR 254.47" in note #5.

Table 9-5 – Worst Case Discharge (MMS Jurisdiction)

Category	R-OSRP (Far Shore WCD)	DOCD
Type of Activity	Subsea Production Tie-Back to EC Block 373	Subsea Production Produced to FPSO
Facility Location(s)	GB Block 244 OCS-G 15860	WR Block 205 OCS-G 16964 WR Block 206 OCS-G 16965 WR Block 249 OCS-G 16969 WR Block 250 OCS-G 16970 WR Block 425 OCS-G 16987 WR Block 426 OCS-G 16988 WR Block 469 OCS-G 16997 WR Block 470 OCS-G 16998
Facility Designation	Subsea Wells #002 and #003ST01	FPSO and Subsea Wells Cascade #3, Cascade #4, and Chinook #2
Distance to Nearest Shoreline (Miles)	134	166
Volume (barrels) :		
Storage Tanks (total)	N/A (1)	6,010 (2)
On-facility Flowlines	N/A (1)	2,000 (3)
Lease Term Pipelines & Risers	N/A (1)	2,110 (4)
ROW Pipelines & Risers	N/A (1)	7,100 (5)
Uncontrolled Blowout (volume per day)	18,000	12,284
Total Volume	18,000	29,504
Type of Oil (e.g. Crude, Condensate, Diesel)	Crude	Crude
API Gravity	32	23 (6)

Notes :

(1) W&T is the operator of EC Block 373; on-facility volumes are not applicable.

(2) Includes FPSO Topsides Tanks only; does not include FPSO Cargo or Fuel Tanks.

(3) On-facility Flowlines includes Processing Piping (including Turret systems).

(4) Includes dual Flowlines from Cascade East DC to Cascade West DC, dual Flowlines from Cascade West DC to FSHR Riser Base near FPSO, and the associated FSHRs.

(5) Includes dual Flowlines from Chinook DC to FSHR Riser Base near FPSO and the associated FSHRs as requested by MMS to accommodate a comprehensive NEPA evaluation. Note that the volume of the ROW pipelines will not be included in the WCD calculation for Total Volume in the updated Regional OSRP (bi-annual update submitted in July 2007). The Total Volume without the ROW pipelines will be 22,404.

(6) API Gravity 23 is used for planning purposes; actual range is 17-29.

Response to Question #4

PAI recognizes that the FPSO provider (to be named in 4Q07) will have the primary responsibility for providing OSRO coverage associated with FPSO cargo tanks which are under USCG jurisdiction as they are the owner of the vessel. The FPSO provider will describe the required OSRO coverage in its Vessel Oil Spill Response Plan which shall be submitted to the USCG for review and approval in alignment with the regulatory framework.

It is recognized that PAI will not use Clean Gulf Associates (CGA) as the primary OSRO for covering FPSO operations as this will be the regulated responsibility of the FPSO provider as previously mentioned.

However, due to the fact that the DOCD was developed prior to FPSO contract award, PAI specifically developed Section 9 - Oil Spills Information to demonstrate for the NEPA review only that PAI (using its existing OSRO coverage by CGA) will have the capability to respond on a contingency basis to a USCG Worst Case Discharge from the FPSO.

PAI respectfully requests that MMS consider the information related to contingency FPSO OSRO coverage using CGA only to accommodate a comprehensive NEPA review, understanding that the primary OSRO coverage associated with FPSO operations will be provided by the FPSO provider.

We trust the enclosed information will meet with your approval and satisfy the regulatory requirements however; should you have additional questions concerning this matter please contact me directly at 713.808.2881 or by e-mail to groland@petrobras-usa.com.

Sincerely,
Petrobras America Inc

Gregory D. Roland
Regulatory Administrator

Attachment 1 – CCA Equipment Availability Information

CCA Equipment Access Guidelines

Approved at AGM 02/05/98

Membership Status	Within Area of Interest	Outside Area of Interest
Full Member	100%	25% of functional groups (Automatic) 50% of functional groups (Requires Approval by President, a designated employee, or two Directors)
Associate Member	100%	Same as Non-Member in AOI (Non-Member terms & financial conditions apply) 25% of functional groups (Requires Approval by President, a designated employee, or two Directors)
Non-Member	25% of functional groups (Requires Approval by President, a designated employee, or two Directors)	25% of functional groups (Requires Approval by President or a designated employee and the majority of the Board of Directors)

Attachment 2 – CCA Dispersant Availability Information

Dispersant Release Policy

Established at Board of Directors Meeting Feb 8-9, 2007

The Board of Directors established a new Dispersant Release Policy which is necessitated by changes at the manufacturer (Nalco) regarding the time it may take to restock dispersant. Previously, Nalco could replace dispersant immediately. It now appears that in a large mobilization of dispersant, it may take up to 30 days to restock.

CCA maintains 30,000 gallons (113,500 liters) of Corexit 9500. Each ADDS load is 5,000 gallons (18,925 liters). The new policy is as follows:

- Members (in the AOI): 100% of stockpile immediately available
- Members (outside the AOI): approx 20,000 gallons (75,700 liters) immediately available, 2 ADDS loads (10,000 gallons / 37,850 liters) held in reserve. This can be overridden by approval of 3 directors.
- Non-Members (in or outside the AOI): 50% immediately available, additional may be released with the approval of 3 directors.

Staff will re-order dispersant immediately and/or identify backfill opportunities from other industry dispersant stockpiles.

INFORMAL MEMORANDUM July 12, 2007

To: Chief, Plans Section, Field Operations, GOM OCS Region (MS 5230)

From: Chief, Environmental Assessment Section, Leasing and Environment, GOM OCS Region (MS 5410)

Subject: Plan Review, Petrobras America Inc., Plan No. N-9015, Walker Ridge Block 206 Unit and Walker Ridge Block 425 Unit

We are writing to inform you that the information in your Initial Development Operations Coordination Document is inadequate for our review. The following information is needed for our review:

Oil Spills

1. Section 2 General Information, Item 2(c)

Clarify whether the estimated duration of Phase 1 also represents the end of all production if Phase 2 is not initiated. If not, identify the estimated life of the reserves that could be produced via the original 3 wells and indicate how long the FPSO would be estimated to be in service if only Phase 1 is undertaken.

2. Section 2 General Information, Page 2-11 of the DOCD, first paragraph

Clarify whether you have had any spills associated with your FPSO operations in Brazil. As written, this section states that you have had no spills in Brazil that caused an environmental impact; not that there have been no spills.

3. Section 2 General Information, Page 2-17 of the DOCD, Table 2-7, Shuttle Vessel Environmental Operating Parameters

Clarify whether these same parameters will apply to the use of articulated barges.

4. Section 2, General Information, Item 2(d)

Provide item (8) in the table (as specified by NTL 2006 – G14, top of page 4) that lists the description of oil characteristics. The NTL requests *"(8) Boiling point distribution including, for each fraction, the percent volume or weight and the boiling point range in degrees C."* A note at the bottom of the table states that instead of Oil Characteristic (5) – (8) MMS will accept weight percent total of saturates, aromatics, waxes, asphaltenes, and resins and total BTEX (ppm).

The DOCD (pg 2-3) includes no information on the boiling point distribution of the oil, nor does it reference an Appendix where this data might be located. We were unable to find percent saturates, aromatics, or BTEX that would substitute.

5. Section 9, Oil Spills Information, Item 9(a)
Submit the modification to your Regional OSRP (ROSRP) in accordance with Section (a)(2)(iv)(B) of NTL No. 2006-G14. As stated in the NTL, this information must be received and approved by this office before approval will be given for the subject DOCD.

6. Section 9, Oil Spills Information, Item 9(a)
Revise the DOCD to include a discussion regarding the limited use of Clean Caribbean equipment and dispersants outside of Clean Caribbean's area of interest.

7. Section 9, Oil Spills Information, Item 9(a)
Include a copy of the contract with Clean Caribbean with the revision to the ROSRP.

8. Section 9, Oil Spills Information, Item 9(a)
Adjust the de-rated capacity cited for Clean Caribbean's mechanical equipment and dispersant stockpiles to reflect the limited use of this equipment outside of their area of interest.

9. Section 9, Oil Spills Information, Page 9-3 of the DOCD, Table 9-5, Worst Case Discharge (MMS Areas of Interest)
Provide an estimated worst-case discharge for the right-of-way pipeline and riser that connects the Chinook well to the FPSO so that the preparation of the EA covering this entire project will not be delayed pending the submittal of the ROW application.

10. Section 9, Oil Spills Information, Item 9(c) Page 9-7 of the DOCD, Oil Spill response Discussion – USCG Areas of Interest
The first paragraph of this section indicates that you plan to use Clean Gulf and Clean Caribbean to respond to an 850,000-bbl worst-case discharge from the FPSO. Using the USCG vessel response plan calculator, it is questionable whether the two cited OSRO's will be able to meet the USCG planning tiers for offshore response to a spill of this magnitude for group III oil. The equipment response time table included within the plan's Appendices does not indicate that you will have 68,000 bpd on-water recovery available within 12 hours and, considering that only half of Clean Caribbean's resources can be used outside of their area of interest, you will not be able to provide 142,800 bpd on-water recovery resources within 60 hours. This section may need to be revised to reflect additional OSRO's.

11. Section 19, Environmental Impact Analysis
Other than noise, which is addressed very briefly in the document, the other impact that may be the most significant is potential ship strikes to marine mammals and sea turtles. As this project involves numerous vessels of various types including shuttle tankers, service vessels, crew boats, tugs, etc., this impact-producing factor is particularly relevant and needs to be addressed in the document.

Gulf Sturgeon
12. Section 19, Environmental Impact Analysis

Gulf sturgeon should be included in the analysis due to potential impacts associated with both offshore and nearshore oil spills. Currently researched literature and personal communications with the Gulf Sturgeon Recovery Team researchers note that there is an offshore presence of Gulf Sturgeon, but how far offshore they go or their exact location is not known at this time.

Coastal Resources

13. Section 19, Environmental Impact Analysis
Barrier Islands should be included as one of the coastal resources since they may potentially be affected by oil spill events and possibly vessel traffic depending on location.

Waste Disposal

14. Section 16, Onshore Support Facilities Information, Item 16(d)
Clarify if all onshore waste disposal is being done at an appropriately permitted site that is currently in use or if a new site is to be used. Identify the locations of all waste sites.

Deepwater Benthic Communities

Appendix 2b

15. On page 28 of Appendix 2b, it states "Previous ROV studies have observed very local, small, dense chemosynthetic communities..." Clarify whether these communities are in the vicinity of your proposed operations, including possible MODU anchor locations. If you have the locations of these sites, provide this information also.

Please send the requested information to:

Attn: Mike Tolbert
Minerals Management Service
1201 Elmwood Park Blvd
New Orleans, LA 70123-2394
Fax: 504-736-2960
e-mail: michael.tolbert@mms.gov

Questions about the requested information should also be addressed to this person. Our processing of the plan will resume upon receipt of the requested information.

Dennis Chew

PETROBRAS AMERICA INC.

5 October 2007

Ms. Elizabeth Peuler, Chief - Plans Section
Office of Field Operations
Minerals Management Service
1201 Elmwood Park Blvd.
New Orleans, LA 70123-2394

Attn. Mr. Michael Tolbert – MS 5231

RE: Revised Addendum to Development Operations Coordination Document (DOCD), Plan N-09015, for Cascade / Chinook Development Project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico

Ladies and Gentlemen:

Please find enclose herewith a proprietary version of our revised addendum to the DOCD, Plan N-09015 for our Cascade / Chinook development project, Walker Ridge Area, Offshore Louisiana, Gulf of Mexico.

PAI respectfully includes summary pages of the modifications performed since the original submittal of 12 June 2007 with the appropriate documentation for each section in which changes were initiated.

Again, we trust the enclosed information will meet with your approval and satisfy the regulatory requirements however; should you have additional questions concerning this matter please contact me directly at 713.808.2881 or by e-mail to groland@petrobras-usa.com.

Sincerely,
Petrobras America Inc

Gregory D. Roland
Regulatory Administrator

Enclosures

10777 Westheimer Road · Suite 1200 · Houston, Texas 77042 · Tel (713) 808-2000 · Fax (713) 808-2004

Public Version

Addendum to Development Operations Coordination Document

for the

Cascade / Chinook Development Project

August 2, 2007

Submitted by:

PETROBRAS AMERICA INC.

Summary of Modifications

DOCD Section No.	DOCD Section Name	Description of Modifications to DOCD Submitted to MMS on June 12, 2007	Addendum Attachment No.
1	Introduction and Plan Contents	PAI changed the OCS-G number from 16987 to 16997 on OCS Plan Information Form for Chinook Well #2 (page 1-15) in Section 1(a) to accurately represent the location of Chinook Well #2 in WR Block 469. Also changed the anchor locations on OCS Plan Information Forms for Cascade East and Cascade West to be consistent with the modified MODU anchor patterns described in R1.4.	R1.1
		PAI modified Figure 1-3 – Field Layout (page 1-18) in Section 1(b). This change allows for an accurate representation of the location of the Chinook Well #2 in WR Block 469.	R1.2
		PAI modified Figure 1-5 – Chinook Field Layout (page 1-20) in Section 1(b). This change allows for an accurate representation of the location of the Chinook Well #2 in WR Block 469.	R1.3
		PAI modified Figure 1-8 – FPSO / Rig Mooring Arrangements. The preliminary MODU anchor patterns for the Cascade East and Cascade West drill centers have been resubmitted in two new drawings in order to move several of the anchor locations away from the Sigsbee Escarpment.	R1.4
2	General Information	PAI provided clarification on the duration of Phase 1 production operations if Phase 2 is not initiated. Intended to supplement Section 2(c) on page 2-2 of the DOCD.	R2.1
		PAI provided additional information (boiling point distribution) to supplement 2(d) Table 2-3 – Oils Characteristics (page 2-3).	R2.2
		PAI provided additional information related to historical oil spill performance for FPSOs utilized in Brazil. Intended to supplement Section 2(e) on page 2-11 of the DOCD.	R2.3
		PAI clarifies that information in Section 2(e) Table 2-7 – Shuttle Vessel Environmental Operating Parameters is applicable to all types of shuttle Vessels being considered for the Cascade / Chinook Development Project (i.e. Shuttle Tankers and Articulated Tug Barges).	R2.4
9	Oil Spill Information	PAI has modified the information described in Section 9(a) Table 9-3 – OSRO Mechanical Recovery Capabilities (page 9-2) and in Section 9(a) Table 9-4 – Dispersant Inventories (page 9-2) associated with CCA to more accurately reflect the available resources from this OSRO outside of its area of interest (per their by-laws).	R9.1
		PAI modified the new WCD (MMS jurisdiction) information described in 9(a) Table 9-5 – Worst Case Discharge (page 9-3) to include volumes related to the Chinook-to-FPSO ROW Pipelines and Risers. PAI also modified the volume for the Lease Term Pipelines and Risers which were overstated due to a mathematical error.	R9.1
		PAI clarifies that the new WCD (MMS jurisdiction) information described in 9(a) Table 9-5 – Worst Case Discharge (page 9-3) will be submitted to MMS prior to approval of the DOCD.	R9.1
		PAI submits a new appendix (Appendix 7) to describe the CGA equipment response times to support the USCG WCD for offshore spills from the FPSO and Shuttle Vessel for NEPA evaluation considerations.	R9.2
		PAI submits a new appendix (Appendix 8) to describe the CGA equipment response times to support the USCG WCD for nearshore / inland spills near Houston region of GoM for NEPA evaluation considerations.	R9.3
		PAI submits a new appendix (Appendix 9) to describe the CGA equipment response times to support the USCG WCD for nearshore / inland spills near Mobile region of GoM for NEPA evaluation considerations.	R9.4
		PAI submits a new appendix (Appendix 10) to describe the CGA equipment response times to support the USCG WCD for nearshore / inland spills near Corpus Christi region of GoM for NEPA evaluation considerations.	R9.5
		PAI submits a new appendix (Appendix 11) to describe the CCA equipment response times to support the USCG WCD for offshore spills from the FPSO and Shuttle Vessel for NEPA evaluation considerations.	R9.6
		PAI submits a new appendix (Appendix 12) to describe the CCA equipment response times to support the USCG WCD for nearshore / inland spills near Corpus Christi region of GoM for NEPA evaluation considerations.	R9.7
		PAI has included a copy of the contact with CCA.	R9.8

Summary of Modifications, Continued

DOCD Section No.	DOCD Section Name	Description of Modifications to DOCD Submitted June 12, 2007	Addendum Attachment No.
14	Related Facilities and Operations Information	PAI modified Figure 14-3 – Illustration of Subsea Facilities Layout (page 14-4) in Section 14(a). This change allows for an accurate representation of the location of the Chinook Well #2 in WR Block 469.	R14.1
		PAI modified Figure 14-4 – Cascade East Drill Center (page 14-5) in Section 14(a). Changed to maintain consistent format with Figures 14-5 and 14-6.	R14.2
		PAI modified Figure 14-5 – Cascade West Drill Center (page 14-6) in Section 14(a). Changed to identify coordinates of the well location and to maintain consistent format with Figures 14-4 and 14-6.	R14.3
		PAI modified Figure 14-6 – Chinook Drill Center (page 14-7) in Section 14(a). This change allows for an accurate representation of the location of the Chinook Well #2 in WR Block 469.	R14.4
16	Onshore Support Facilities Information	PAI modified Section 16(d) Tables 16-2, 16-3, and 16-4 (pages 16-2 and 16-3) to identify the physical locations of the (permitted and existing) onshore waste disposal sites for Drilling and Completion Operations, FPSO Production Operations, and Shuttle Vessel Operations.	R16.1
19	EIA	PAI has modified Section 19(c) to include a description of potential ship strike impacts related to marine mammals and sea turtles.	R19.1
		PAI has modified Section 19(c) to include a description of potential oil spill impacts related to gulf sturgeon.	R19.2
		PAI has modified Section 19(c) to include a description of potential oil spill impacts related to barriers islands.	R19.3
		PAI has clarified Appendix 2(b) to indicate that no chemosynthetic communities have been identified in the Cascade / Chinook Project Development areas.	R19.4

Attachment R1.1

OCS PLAN INFORMATION FORM

Proposed Well/Structure Location					
Well or Structure Name/Number (If renaming well or structure, reference previous name): Chinook/Development Well No. 2				Subsea Completion	
Anchor Radius (if applicable) in feet: Not Applicable - DP Drilling Rig				X Yes	No
	Surface Location	**Bottom-Hole Location (For Wells) - PROPRIETARY**			
Lease No.	OCS-G 16997				
Area Name	Walker Ridge Protraction Area				
Block No.	Walker Ridge Block 469				
Blockline Departures (in feet)	7310.00' FEL				
	32.00' FNL				
Lambert X-Y coordinates	X: 2,447,890.00'				
	Y: 9,630,688.00'				
Latitude/ Longitude	Latitude: 26°31'10.78"				
	Longitude: 90°31'48.95"				
	TVD (Feet): **PROPRIETARY**	MD (Feet): **PROPRIETARY**	Water Depth (Feet): 8,800		

Anchor Locations for Drilling Rig

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
N/A	N/A	N/A	N/A	N/A	N/A

Paperwork Reduction Act of 1995 Statement: The Paperwork Reduction Act of 1995 (44 U.S.C. Chapter 35) requires us to inform you that MMS collects this information as part of an applicant's Exploration Plan or Development Operations Coordination Document submitted for MMS approval. We use the information to facilitate our review and data entry for OCS plans. We will protect proprietary data according to the Freedom of Information Act and 30 CFR 250.196. An agency may not conduct or sponsor, and a person is not required to respond to, a collection of information unless it displays a currently valid Office of Management and Budget Control Number. The use of this form is voluntary. The public reporting burden for this form is included in the burden for preparing Exploration Plans and Development Operations Coordination Documents. We estimate that burden to average 600 hours per response, or 640 with an accompanying EP, or 690 with an accompanying DPP or DOCD, including the time for reviewing instructions, gathering and maintaining data, and completing and reviewing the forms associated with subpart B. Direct comments regarding the burden estimate or any other aspect of this form to the Information Collection Clearance Officer, Mail Stop 4230, Minerals Management Service, 1849 C Street, NW., Washington, DC 20240.

OCS PLAN INFORMATION FORM

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Cascade West/Development Well No. 3	Subsea Completion			
Anchor Radius (if applicable) in feet: Approximately 8750'	X	Yes		No

	Surface Location	Bottom-Hole Location (For Wells) - PROPRIETARY
Lease No.	OCS-G 16969	
Area Name	Walker Ridge Protraction Area	
Block No.	Walker Ridge Block 249	
Blockline Departures (in feet)	1623.00' FEL	
	3984.00' FNL	
Lambert X-Y coordinates	X: 2,453,577.00'	
	Y: 9,705,936.00'	
Latitude/ Longitude	Latitude: 26°43'34.53"	
	Longitude: 90°30'30.24"	
	TVD (Feet): **PROPRIETARY**	MD (Feet): **PROPRIETARY** Water Depth (Feet): 8,100

Anchor Locations for Drilling Rig (Preliminary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1	WR	249	2,446,379.00'	9,700,918.00'	8748
2	WR	249	2,445,081.00'	9,703,679.00'	8748
3	WR	205	2,449,933.00'	9,714,083.00	8748
4	WR	205	2,452,882.00'	9,714,864.00'	8748
5	WR	206	2,460,968.00'	9,711,099.00'	8748
6	WR	250	2,462,269.00'	9,708,331.00'	8748
7	WR	250	2,457,418.00'	9,697,926.00'	8748
8	WR	249	2,454,469.00'	9,697,146'	8748
A	WR	249	2,444,819.00'	9,706,720.00'	8751
B	WR	205	2,447.435.00'	9,712,329.00'	8751
C	WR	250	2,462,531.00'	9,705,290.00'	8751
D	WR	250	2,459,915.00'	9,699,681.00'	8751

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Attachment R1.1, Continued

OCS PLAN INFORMATION FORM

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Cascade East/Development Well No. 4	Subsea Completion			
Anchor Radius (if applicable) in feet: Approximately 8750'	X	Yes		No

	Surface Location	Bottom-Hole Location (For Wells) - PROPRIETARY
Lease No.	OCS-G 16965	
Area Name	Walker Ridge Protraction Area	
Block No.	Walker Ridge Block 206	
Blockline Departures (in feet)	2440.00' FSL	
	3289.00' FWL	
Lambert X-Y coordinates	X: 2,458,489.00'	
	Y: 9,712,360.00'	
Latitude/ Longitude	Latitude: 26°44'37.17"	
	Longitude: 90°29'35.77"	
	TVD (Feet): **PROPRIETARY**	MD (Feet): **PROPRIETARY** Water Depth (Feet): 8,160

Anchor Locations for Drilling Rig (Preliminary)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1	WR	249	2,451,774.00'	9,706,449.00'	8748
2	WR	249	2,450,149.00'	9,709,031.00'	8748
3	WR	205	2,453,697.00'	9,719,949.00'	8748
4	WR	206	2,456.529.00'	9,721,083.00'	8748
5	WR	206	2,465,014.00'	9,718,332.00'	8748
6	WR	206	2,466,642.00'	9,715,743.00'	8748
7	WR	250	2,463,095.00'	9,704,825.00'	8748
8	WR	250	2,460,263.00'	9,703,691.00'	8748
A	WR	205	2,449,519.00'	9,712,018.00'	8751
B	WR	205	2,451,432.00'	9,717,903.00'	8751
C	WR	206	2,467,273.00'	9,712,756.00'	8751
D	WR	250	2,465,360.00'	9,706,870.00'	8751

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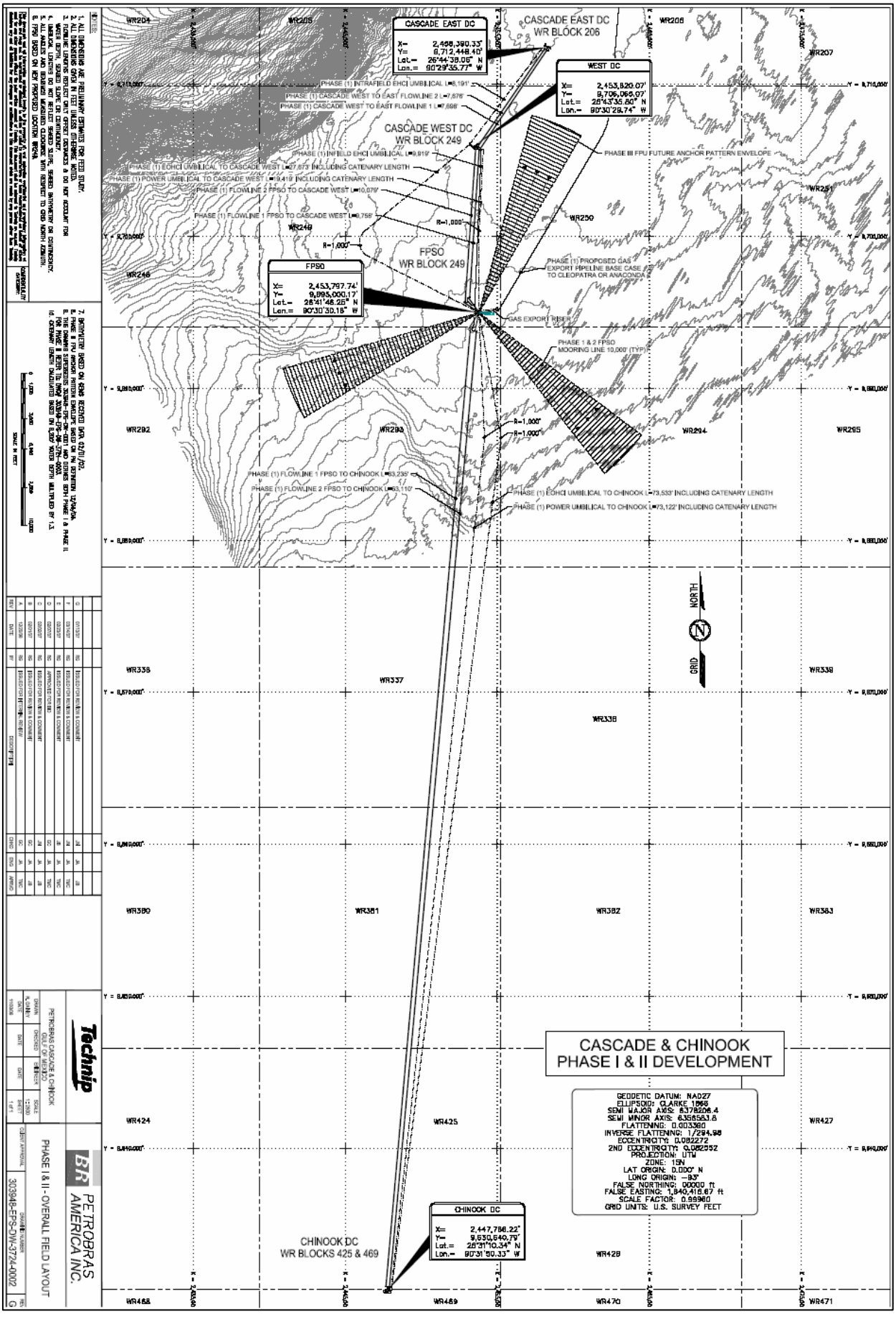
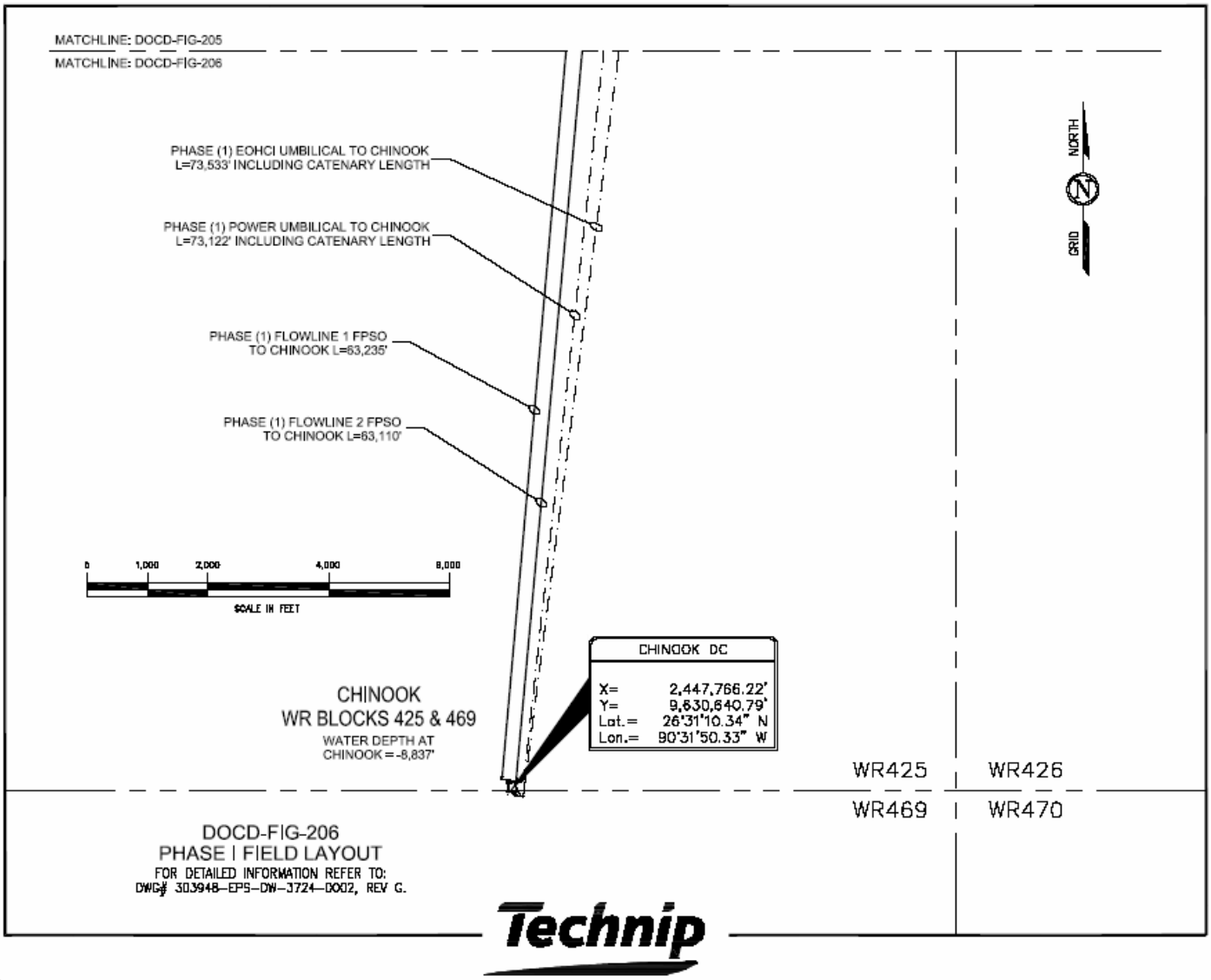
Attachment R1.2



Attachment R1.3



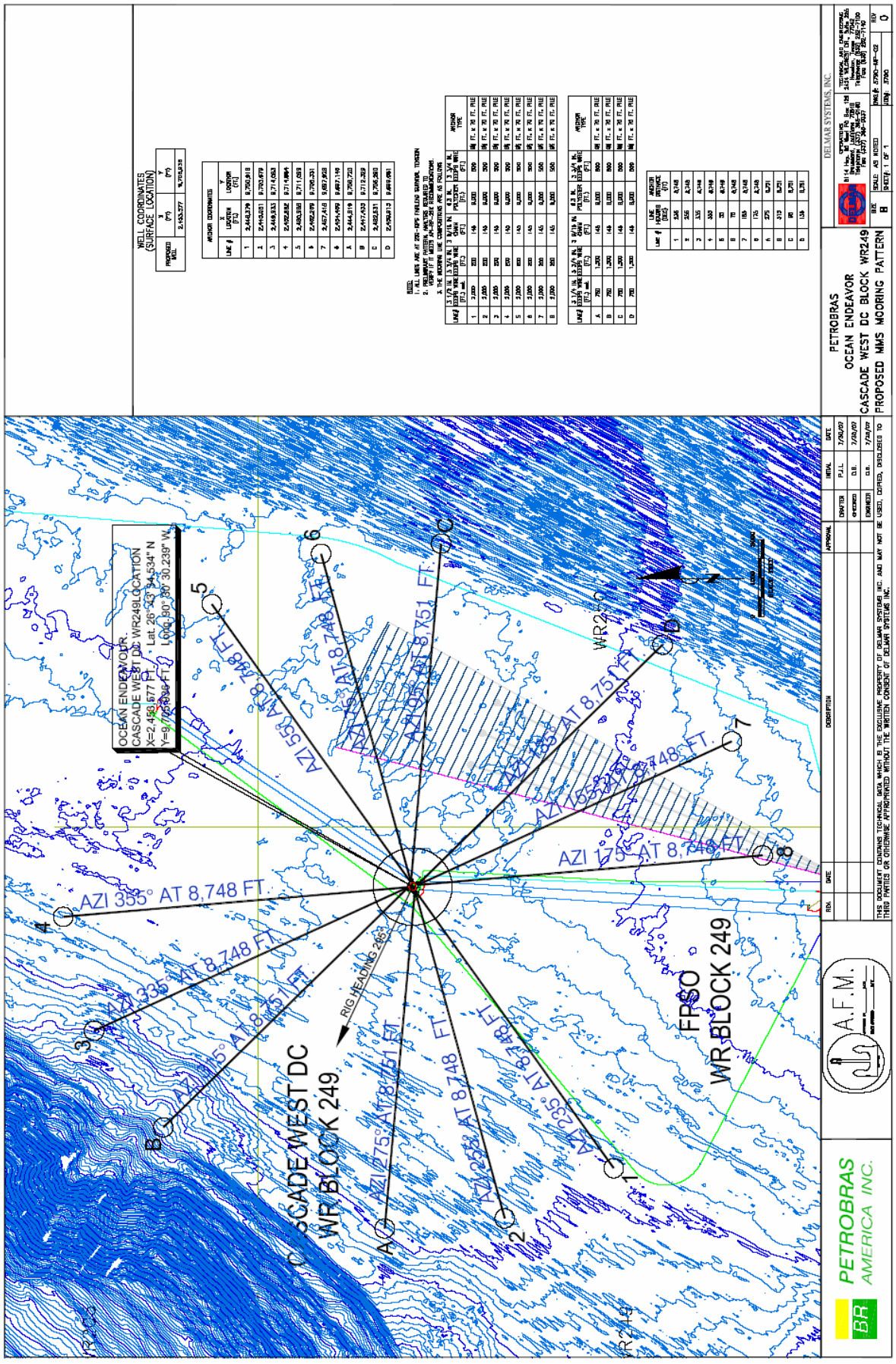
Attachment R1.4

MMS has communicated to PAI that there is a potential for chemosynthetic communities to exist on several areas of the Sigsbee Escarpment in the development areas of Cascade and Chinook. This information is based upon proprietary information that MMS has in its possession.

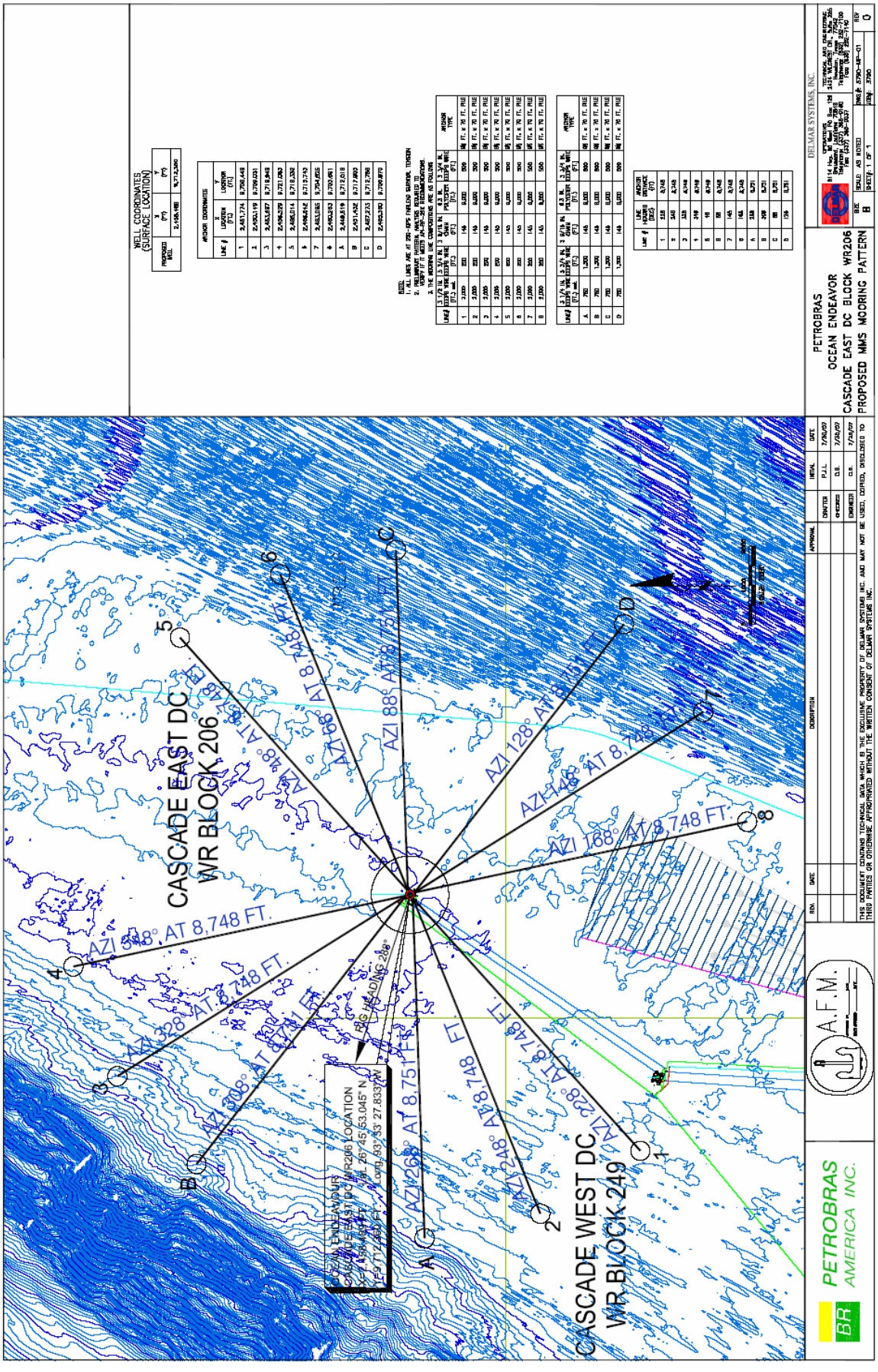
PAI has previously provided the preliminary MODU and FPSO anchor patterns in Figure 1-8 – FPSO / Rig Mooring Arrangements. These MODU anchors patterns were developed early to support planning for the soils survey program and for inclusion in the DOCD, fully understanding that the preliminary anchor patterns would be modified after more detailed engineering was to be performed.

PAI has recently revisited the preliminary locations of the MODU anchor patterns at the Cascade East and Cascade West drill centers. This results in all anchors being located off of the Sigsbee Escarpment which will allow PAI to avoid any potential chemosynthetic communities identified by MMS that may potentially exist on the escarpment. PAI has provided new (but still preliminary) MODU anchor patterns below to represent the change. Furthermore, PAI will not install any facilities in any areas that MMS has identified as potential locations for chemosynthetic communities.

Attachment R1.4, Continued



Attachment R1.4, Continued



Attachment R2.1

Future phases of the Cascade / Chinook development plan will be pursued depending on the performance of the Cascade and Chinook reservoirs in Phase 1. The three scenarios below are intended to describe how PAI would implement future phases of the development plan based on reservoir productivity.

Scenario 1 – High Reservoir Productivity

If the Cascade and Chinook reservoirs produce at the anticipated volumes (or higher), PAI would likely initiate Phase 2 of the development plan. Phase 2 of the development plan would likely include the addition of multiple wells (number to be determined) to the drilling & completion program. In this scenario, all of the Phase 1 and Phase 2 wells would produce back to the existing FPSO. In this scenario, the duration of production operations utilizing the FPSO will likely be 6-8 years. Furthermore, PAI would likely initiate Phase 3 of the development plan. Phase 3 would include the replacement of the Phase 1 FPSO with a different Floating Production Unit (i.e. the "definitive system") as well as the addition of multiple wells (number to be determined) to the drilling and completion program.

Scenario 2 – Medium Reservoir Productivity

If the Cascade and Chinook reservoirs produce significantly less than the anticipated volumes but at volumes which are commercial viable, PAI could either 1.) continue production operations from only (3) Phase 1 wells for up to 6-8 years utilizing the FPSO or 2.) continue production operations from (3) Phase 1 wells and several additional Phase 2 wells (number to be determined) for up to 6-8 years utilizing the FPSO. In this scenario, PAI would not likely initiate Phase 3 of the development plan.

Scenario 3 – Low Reservoir Productivity

If the Cascade and Chinook reservoirs produce at extremely low volumes, PAI would likely not initiate Phase 2 of the development plan. In this scenario, the duration of production operations utilizing the FPSO could be as short as 1 year. However, PAI could opt to continue producing to the FPSO for a longer duration (potentially up to 6-8 years) if it were commercially viable to do so.

Attachment R2.2

PAI provides the following supplemental oil characteristics information as requested by MMS. This information is representative of the oil from the Cascade and Chinook reservoirs. If additional information is required by MMS, PAI will have to conduct additional testing of limited samples.

Representative Oil Characteristics for Cascade and Chinook Reservoirs

		Boiling Point	
SIMULATED DISTILLATION	Percent Recovery (Weight)	Degree F	Degree C
	Percent Off - IBP	97	36
	Percent Off - 5	262	128
	Percent Off - 10	358	181
	Percent Off - 15	448	231
	Percent Off - 20	520	271
	Percent Off - 25	567	297
	Percent Off - 30	611	322
	Percent Off - 35	666	352
	Percent Off - 40	709	376
	Percent Off - 45	761	405
	Percent Off - 50	808	431
	Percent Off - 55	861	461
	Percent Off - 60	913	489
	Percent Off - 65	966	519
	Percent Off - 70	1021	549
	Percent Off - 75	1077	581
	Percent Off - 80	1202	650
	Percent Off - 85	1287	697
	Percent Off - 90	1288	698
	Percent Off - 95	>1355	>735
	Percent Off - 99	>1355	>735
	Percent Off - FBP	>1355	>735

Attachment R2.3

PAI has provided additional information on historical FPSO oil spill performance from Petrobras Brazil. See table below.

Period (1)	[M] bbls Produced from all FPSOs	Average FPSO Offloadings Per Year	No. of Spills > 1 bbl [Total Volume]	No. of Spills > 50 bbls [Total Volume]
2001 - 2005	887,315	604	10 [141.8]	0 [0]
2006	333,975	720	1 [12.6]	0 [0]
Total	1,221,290		11 [154.4]	0 [0]

Notes :

(1) FPSO specific oil spills could not be determined from data from 1998 through 2000.

Attachment R2.4

PAI clarifies that the information included in Section 2(e)Table 2-7 – Shuttle Vessel Environmental Operating Parameters is applicable to all types of Shuttle Vessels (e.g. Shuttle Tankers and Articulated Tug Barges) being considered for use during Phase 1 of the development plan.

These environmental operating parameters were included in the Shuttle Vessel Technical Specification and are based on FPSO safety guidelines derived from Petrobras Brazil's FPSO operating experience in Brazil.

Attachment R9.1

Sections 9(a) through 9(c) have been re-submitted in their entirety to reflect multiple changes and additional information.

9 Oil Spills Information

9(a) Oil Spill Response Planning

Regional Oil Spill Response Information

All the proposed activities in this DOCD will be covered by the PAI (MMS operator #1207) Regional Oil Spill Response Plan (R-OSRP) filed in accordance with 30 CFR 254.

PAI has submitted a newly updated R-OSRP to MMS in July 2007 in order to achieve the bi-annual updating requirement per the requirements of 30 CFR 254 and NTL 2006 G21.

The updated R-OSRP includes a new "Greater Than 10 Mile From Shore Worst Case Discharge Scenario" which describes the new Worst Case Discharge information associated with activities covered by the DOCD for Phase 1 of the Cascade / Chinook Development Project. The updated R-OSRP covers oil spills under MMS jurisdiction only (e.g. blowouts, topsides facilities, lease term pipelines).

Spill Response Sites

PAI is currently a member of Clean Gulf Associates (CGA) and Clean Caribbean & Americas (CCA).

PAI's primary spill response equipment is provided by CGA as described in the R-OSRP. Table 9-1 indicates the locations of PAI's primary spill response equipment and the locations of the planned staging areas.

Table 9-1 – CGA Oil Spill Response Equipment & Staging Areas

Primary Response Equipment Locations	Preplanned Staging Locations
Ingleside, TX	Fourchon, LA
Galveston, TX	Venice, LA
Lake Charles, LA	Houma, LA
Houma, LA	
Venice, LA	

PAI's also has access to spill response equipment provided by CCA. CCA resources will generally be utilized as secondary spill response equipment by PAI. Table 9-2 indicates the locations of CCA's spill response equipment and the locations of the planned staging areas.

Table 9-2 - CCA Oil Spill Response Equipment & Staging Areas

Response Equipment Locations	Preplanned Staging Locations
Fort Lauderdale, FL	Fourchon, LA (1)

Notes :

(1) CCA mechanical recovery equipment will be flown in to an airport nearest to the spill location and then trucked into a CGA pre-planned staging location. However, CCA equipment can be staged in a number of locations not typically utilized as pre-planned staging areas (e.g. Corpus Christi, Texas) by CGA in order to optimize the timing associated with mobilizing spill response resources in such locations.

OSRO Information

As previously stated, PAI is currently a member of CGA and CCA. The de-rated (i.e. 20% of equipment name plate per manufacturer specification) daily mechanical recovery capabilities for each OSRO is described in Table 9-3.

Table 9-3 – OSRO Mechanical Recovery Capabilities

OSRO	De-Rated Daily Recovery Capability (barrels per day)
CGA	112,291
CCA	18,345 (1)
TOTAL	130,366

Notes :

(1) CCA has (de-rated) daily mechanical recovery capabilities of approximately 48,000 barrels per day. Per CCA By-Laws, 100% of the equipment is available to support Members within CCA's areas of interest. Also per CCA By-Laws, only 25% of the equipment is available to support Members outside of CCA's areas of interest (i.e. in the U.S. GoM). As a result, PAI is only showing (de-rated) daily mechanical recovery capability associated with 25% of CCA's available equipment.

PAI will also utilize dispersants as an alternative response strategy in certain circumstances when approved by regulatory authorities. The dispersant inventories that are available to PAI are described in Table 9-4.

Table 9-4 – Dispersant Inventories

OSRO	Dispersant Inventory (gallons)
CGA	82,650
CCA	20,000 (1)
TOTAL	102,650

Notes :

(1) CCA has dispersant inventories of approximately 30,000 gallons. Per CCA By-Laws, 100% of the dispersants is available to support Members within CCA's areas of interest. Also per CCA By-Laws, only 20,000 gallons of the dispersant is available to support Members outside of CCA's areas of interest (i.e. in the U.S. GoM). As a result, PAI is only showing 20,000 gallons of dispersant. It should be noted that the 10,000 gallons of "reserve" dispersant can be made available with approval from the CCA Directors.

PAI also utilizes other complimentary specialist OSROs as appropriate, including but not limited to AMPOL, Garner Environmental Services, Industrial Cleanup, Oil Mop, and PSC Industrial Services. See the current R-OSRP for a complete listing.

Worst Case Scenario Determination

WCD Scenario for MMS Jurisdiction :

Table 9-5 provides a comparison of the Worst Case Discharge scenarios from PAI's approved R-OSRP with the Worst Case Discharge scenario from the proposed activities covered by this DOCD. As shown below, the Worst Case Discharge scenario from the proposed activities in this DOCD are greater than those described in PAI's approved R-OSRP. PAI has therefore submitted a new "Greater Than 10 Mile From Shore Worst Case Discharge Scenario" to MMS in July 2007 to reflect the new Worst Case Discharge scenario.

Table 9-5 – Worst Case Discharge (MMS Jurisdiction)

Category	R-OSRP (Far Shore WCD)	DOCD
Type of Activity	Subsea Production Tie-Back to EC Block 373	Subsea Production Produced to FPSO
Facility Location(s)	GB Block 244 OCS-G 15860	WR Block 205 OCS-G 16964 WR Block 206 OCS-G 16965 WR Block 249 OCS-G 16969 WR Block 250 OCS-G 16970 WR Block 425 OCS-G 16987 WR Block 426 OCS-G 16988 WR Block 469 OCS-G 16997 WR Block 470 OCS-G 16998
Facility Designation	Subsea Wells #002 and #003ST01	FPSO and Subsea Wells Cascade #3, Cascade #4, and Chinook #2
Distance to Nearest Shoreline (Miles)	134	166
Volume (barrels) :		
Storage Tanks (total)	N/A (1)	6,010 (2)
On-facility Flowlines	N/A (1)	2,000 (3)
Lease Term Pipelines & Risers	N/A (1)	2,110 (4)
ROW Pipelines & Risers	N/A (1)	7,100 (5)
Uncontrolled Blowout (volume per day)	18,000	12,284
Total Volume	18,000	29,504
Type of Oil (e.g. Crude, Condensate, Diesel)	Crude	Crude
API Gravity	32	23 (6)

Notes for Table 9-5 included on next page.

Notes :

(1) W&T is the operator of EC Block 373; on-facility volumes are not applicable.

(2) Includes FPSO Topsides Tanks only; does not include FPSO Cargo or Fuel Tanks.

(3) On-facility Flowlines includes Processing Piping (including Turret systems).

(4) Includes dual Flowlines from Cascade East DC to Cascade West DC, dual Flowlines from Cascade West DC to FSHR Riser Base near FPSO, and the associated FSHRs.

(5) Includes dual Flowlines from Chinook DC to FSHR Riser Base near FPSO and the associated FSHRs as requested by MMS to accommodate a comprehensive NEPA evaluation. Note that the volume of the ROW pipelines will not be included in the WCD calculation for Total Volume in the updated Regional OSRP (bi-annual update submitted in July 2007) as it is not required per 30 CFR 254.47. The Total Volume without the ROW pipelines will be 22,404.

(6) API Gravity 23 is used for planning purposes; actual range is 17-29.

Additional notes for MMS WCD Scenario :

- PAI is proposing to perform well testing for each of the three new wells covered by this DOCD. PAI is proposing to discharge the well completion fluids (which will not include EPA defined "priority pollutants") per NPDES requirements.

- PAI is not proposing to use oil-based drilling fluids. PAI is proposing to use water-based and synthetic-based drilling fluids for each of the three new wells covered by this DOCD.

9(b) Oil Spill Response Discussion – MMS Jurisdiction

Organization

PAI Qualified Individuals utilize a contract Spill Management Team, The O'Briens Group, to manage oil spill response. CGA and other complimentary specialist OSROs provide access to oil spill response equipment and personnel as described in the PAI R-OSRP.

WCD Planning Volume for NEPA Review

PAI is capable of responding to the Worst Case Discharge (WCD) scenario described in 9(a) which is focused on MMS jurisdiction (i.e. 30 CFR 254.26) related to well blowouts, topsides facilities, and lease term pipelines. For the oil spill response discussion per NTL 2006 G14, the WCD planning volume from an MMS area of interest perspective is 12,284 barrels per day with an API gravity of 23˚ based on the blowout scenario (which is a larger planning volume than the largest topside tank or production vessel).

Land Segment and Resource Identification

Trajectories of a spill and the probability of it impacting a land segment have been projected utilizing information in the MMS Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on MMS website using (30) day impact. The results are shown in Table 9-6. These trajectories are consistent with the site specific Oil Spill Risk Analysis (OSRA) performed by MMS in February 2007 as described in 9(d).

Table 9-6 – Trajectory by Land Segment

Area / Block	OCS-G	Launch Area	Land Segment and / or Resource	Conditional Probability (%) within 30 days
WR 205	16964	Central 48	Matagorda County, Texas	1
WR 206	16965		Brazoria County, Texas	1
WR 249	16969		Galveston County, Texas	2
WR 250	16970		Jefferson County, Texas	1
WR 425	16987		Cameron Parish, Louisiana	2
WR 426	16988		Vermilion Parish, Louisiana	1
WR 469	16997		Terrebonne Parish, Louisiana	1
WR 470	16998		LaFourche Parish, LA	1
			Plaquemines Parish, Louisiana	1

The MMS OSRAM identifies a 2% probability of impact to the shorelines of Galveston County, Texas; and / or Cameron Parish, Louisiana within 30 days.

Galveston County includes the Gulf Beach from the west end of Galveston Island at Texas Highway 3005 to the east coast of High Island at the Jefferson County line. Habitats include marshes at the west end of Seawall Boulevard and on the east end of the island and open beaches and avian feeding areas all along the coastline, including a National Audubon Society Sanctuary. The waters of Galveston Bay are classified as an EPA National Estuary.

Cameron Parish includes the east side of Sabine Lake, Sabine National Wildlife Refuge, Calcasieu Lake, Lacassine National Wildlife Refuge (inland) and Grand Lake; along the Gulf beach from Sabine Pass to Big Constance Lake in Rockefeller Wildlife Refuge. This region is composed of open public beaches, marshlands and swamps. It serves as a habitat for numerous birds, finfish and other animals, including several rare, threatened and endangered species.

Additional discussion of protection strategies for potentially affected resources is included in the PAI R-OSRP.

Spill Response

PAI will make every effort to respond to the Worst Case Discharge as effectively as possible. A description of the response equipment available to contain and recover the Worst Case Discharge is shown in Appendix 5.

Using the estimated chemical and physical characteristics of crude, an ADIOS weathering model was run on a similar product from the ADIOS oil database. The results indicate 91% of the product would remain after 12 hours, leaving approximately 11,178 (of the 12,284 total spilled) barrels on the water.

Appendix 5 outlines equipment, personnel, materials and support vessels, and temporary storage equipment to be considered in order to cope with an initial spill of 12,284 barrels. The list estimates individual times needed for procurement, load out, travel time to the site and deployment. If appropriate, 5 sorties (10,000 gallons) from the DC-4 and 5 sorties (5,000 gallons) from the DC-3 should disperse approximately 6,429 barrels of oil.

Offshore response strategies may also include attempting to skim utilizing the HOSS Barge, and five Fast Response Units (FRU), with a total de-rated skimming capacity of 60,740 barrels. Temporary storage associated with the identified skimming equipment equals 5,130 barrels. An additional open ocean storage barge with a capacity of 23,000 barrels would be mobilized as necessary. Safety is first priority; air monitoring will be performed and operations deemed safe prior to any containment / skimming attempts.

If the spill would go unabated, shoreline impact in coastal environments would depend upon existing environmental conditions. Onshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom in vegetated areas. Strategies would be based upon surveillance and real time trajectories that depict areas of potential impact given actual sea and weather conditions. Strategies from the One Plan Gulf of Mexico Area Contingency Plan (ACP) and Unified Command would be consulted to ensure that environmental and special economic resources would be correctly identified and prioritized to ensure optimal protection. ACPs depict the protection response modes applicable for oil spill clean-up operations. Each response mode is schematically represented to show optimum deployment and operation of the equipment in areas of environmental concern. Supervisory personnel have the option to modify the deployment and operation of equipment allowing a more effective response to site-specific circumstances.

9(c) Oil Spill Response Discussion – USCG Jurisdiction

This section is provided to assure a comprehensive NEPA review.

PAI is capable of responding to the Worst Case Discharge, the Maximum Most Probable Discharge, and Average Most Probable Discharge scenarios which are focused on USCG jurisdiction related to marine vessels as described in the most recent Memorandum of Agreement between the MMS and the USCG (OCS-03) and 33 CFR Part 155 Subpart D. PAI will utilize existing memberships in CGA and CCA to demonstrate oil spill response capability.

Although PAI is capable of responding to the various USCG defined discharge scenarios, it should be noted that the owners of the FPSO and the Shuttle Vessels will also be responsible for demonstrating that they have the capability to respond to the USCG defined discharge scenarios prior to USCG approval of their vessel specific oil spill response plans. Although each of the organizations (PAI and vessels owners) will be capable of responding to the USCG defined discharge scenarios, it is anticipated that the vessel owners' will have the primary regulatory responsibility as vessel operators while PAI will have secondary regulatory responsibility due to ownership of the produced oil. The details regarding primary and secondary regulatory responsibility will be finalized with the USCG after PAI awards contracts for the provision of the FPSO and Shuttle Vessels (anticipated 3Q07).

Table 9-7 describes the amounts associated with each USCG discharge scenario for the FPSO.

Table 9-7 – FPSO Discharge Scenarios (USCG Jurisdiction)

USCG Discharge Scenario for FPSO	Estimated Amount (barrels)	Comments
Worst Case Discharge	550,000 - 850,000	Equal to discharge of a marine vessel's entire cargo tanks in adverse weather conditions. See notes (1) and (2) for additional details.
Maximum Most Probable Discharge	2,500	Equal to 2,500 barrels of oil for vessels with a cargo capacity equal to or greater than 25,000 barrels OR 10% of the vessels oil cargo capacity with a capacity of less than 25,000 barrels. See note (3) for additional details.
Average Most Probable Discharge	50	Equal to the lessor of 50 barrels of oil or 1% of the cargo from the vessel during cargo oil transfer operations to or from the vessel

Notes for Table 9-7 on next page.

Notes :

(1) The USCG Worst Case Discharge would involve a total loss of the FPSO which is an extreme low probability event given the industry proven controls that PAI will put in place.

(2) The USCG has implemented a geographic (i.e. inland, nearshore, offshore, open ocean) based cap system to identify the amount of planning volumes that must be covered by contract. For offshore spills, the planning volume caps are 12,500 barrels per day for Tier 1, 25,000 barrels per day for Tier 2, and 50,000 barrels per day for Tier 3. When the required planning volume exceeds the cap amounts, the vessel owner is only required to have OSRO contracts in place up to the amount of the caps, but the vessel owner is required to identify sources of additional OSRO resources equivalent to twice the caps listed for each tier or the amount necessary to respond to the required planning volumes (whichever is less). The identified equipment must be capable of arriving at the FPSO within 24 hours for Tier 1, 48 hours for Tier 2, and 72 hours for Tier 3. Although PAI will not be the owner of the FPSO, PAI currently has the capability to respond to the required offshore planning volumes for Tiers 1-3 through CGA spill response resources as described in Appendix 7. Note that for Tier 3, the CGA spill response resources alone exceed the required 50,000 barrel cap (for which spill response resources must be contracted) as well as the incremental 50,000 barrel amount (for which spill response equipment must be identified). Therefore, PAI is not required to identify an additional OSRO to comply with USCG regulations. Note that the FPSO owner will also provide OSRO coverage as required by USCG regulatory requirements. The FPSO owner will describe its OSRO coverage in its vessel specific Oil Spill Response Plan (i.e. SOPEP). The FPSO owner will provide OSRO coverage (over and above PAI's OSRO coverage) as required by the USCG.

(3) The USCG Maximum Most Probable Discharge is significantly greater than an oil spill associated with FPSO offloading, which may be the highest exposure regarding oil spills associated with FPSOs. As described in section 1(f), PAI will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during FPSO offloading. If multiple controls described in section 1(f) failed, the amount of oil spilled during FPSO offloading would likely be an order of magnitude lower (i.e. the amount of oil in the offloading hose) than the amount of the USCG Maximum Most Probable Discharge.

(4) CCA spill response resources are not discussed regarding the FPSO discharge scenarios as they are not needed to comply with planning volume requirements. However, response times for CCA equipment to be mobilized to the FPSO location are included in Attachment 11.

Table 9-8 describes the amounts associated with each USCG discharge scenario for the Shuttle Vessels.

Table 9-8 – Shuttle Vessel Discharge Scenarios (USCG Jurisdiction)

USCG Discharge Scenario for Shuttle Vessels	Estimated Amount (barrels)	Comments
Worst Case Discharge	185,000 - 500,000	Equal to discharge of a marine vessel's entire cargo tanks in adverse weather conditions. See notes (1) and (2) for additional details.
Maximum Most Probable Discharge	2,500	Equal to 2,500 barrels of oil for vessels with a cargo capacity equal to or greater than 25,000 barrels OR 10% of the vessels oil cargo capacity with a capacity of less than 25,000 barrels. See note (3) for additional details.
Average Most Probable Discharge	50	Equal to the lessor of 50 barrels of oil or 1% of the cargo from the vessel during cargo oil transfer operations to or from the vessel

Notes for Table 9-8 on next page.

Attachment R9.1, Continued

Notes :

(1) The USCG Worst Case Discharge would involve a total loss of the Shuttle Vessel which is an extreme low probability event given the industry proven controls that PAI will put in place.

(2) The USCG has implemented a geographic (i.e. inland, nearshore, offshore, open ocean) based cap system to identify the amount of planning volumes that must be covered by contract. For offshore spills, the planning volume caps are 12,500 barrels per day for Tier 1, 25,000 barrels per day for Tier 2, and 50,000 barrels per day for Tier 3. When the required planning volume exceeds the cap amounts, the vessel owner is only required to have OSRO contracts in place up to the amount of the caps, but the vessel owner is required to identify sources of additional OSRO resources equivalent to twice the caps listed for each tier or the amount necessary to respond to the required planning volumes (whichever is less). The identified equipment must be capable of arriving at the offshore spill location (i.e. at the FPSO) within 24 hours for Tier 1, 48 hours for Tier 2, and 72 hours for Tier 3. Although PAI will not be the owner of the Shuttle Vessel, PAI currently has the capability to respond to the required offshore planning volumes for Tiers 1-3 through CGA spill response resources as described in Appendix 7. Note that for Tier 3, the CGA spill response resources alone exceed the required 50,000 barrel cap (for which spill response resources must be contracted) as well as the incremental 34,000 barrel amount (for which spill response equipment must be identified). Therefore, PAI is not required to identify an additional OSRO to comply with USCG regulations for the offshore spill scenario.

    For nearshore / inland spills related to Shuttle Vessel operations near High Volume Ports, the planning volume caps remain 12,500 barrels per day for Tier 1, 25,000 barrels per day for Tier 2, and 50,000 barrels per day for Tier 3. It is anticipated that most of the terminals to be utilized will be defined as High Volume Ports. In such ports, the identified equipment must be capable of arriving at the nearshore / inland spill location (i.e. within 50 miles of the entrance to the High Volume Port) within 12 hours for Tier 1, 36 hours for Tier 2, and 60 hours for Tier 3. Although PAI will not be the owner of the Shuttle Vessels, PAI currently has the capability to respond to essentially all of the required nearshore / inland planning volumes for Tiers 1-3 through CGA spill response resources. The available CGA spill response resources and their respective response times for three geographic regions of the GoM that are representative of the potential terminals to be used by PAI are described in Appendices 8 (Houston, Texas), 9 (Mobile, Alabama), and 10 (Corpus Christi, Texas). With the exception of Tier 3 in the Corpus Christi region, the CGA spill response resources alone exceed the required caps (for which spill response resources must be contracted) as well as the incremental amounts (for which spill response equipment must be identified). Regarding Tier 3 in the Corpus Christi region, the CGA resources cover the required cap amount of 50,000 barrels within 60 hours. However, the CGA resources do not quite cover the required planning volume (i.e. twice the cap or 100,000 barrels) as the HOSS Barge (43,000 barrels) mobilizing from Houma, Louisiana does not accomplish the required 60 hour mobilization requirement by 10 hours, which requires an additional 31,000 barrels of recovery capability to be identified (but not contracted). If PAI mobilizes additional spill response resources from CCA (see Appendix 12), PAI would still need to identify (but not contract) an additional OSRO to cover a shortfall of approximately 13,000 barrels. Considering that the Shuttle Vessel owner and the terminal operator will also be required by regulations to provide OSRO coverage to cover the planning volumes associated with Shuttle Vessel offloading at terminals, the Tier 3 planning volumes shortfall in the Corpus Christi region will be easily covered. Note that PAI anticipates that the Shuttle Vessel owner will have an existing contract with MSRC as this OSRO provides resources for numerous major shipping companies. MSRC is a major OSRO recognized by the USCG. The Shuttle Vessel owner will describe its OSRO coverage in its vessel specific Oil Spill Response Plan (i.e. SOPEP). The Shuttle Vessel owner will provide OSRO coverage (over and above PAI's OSRO coverage) as required by the USCG.

(3) The USCG Maximum Most Probable Discharge is significantly greater than an oil spill associated with Shuttle Vessel loading at the FPSO or Shuttle Vessel offloading at terminals, which may be the highest exposures regarding oil spills associated with Shuttle Vessels. As described in section 1(f), PAI will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during Shuttle Vessel loading at the FPSO while terminal operators will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during Shuttle Vessel offloading at terminals. If multiple controls described in section 1(f) failed, the amount of oil spilled would likely be an order of magnitude lower (i.e. the amount of oil in the offloading hose) than the amount of the USCG Maximum Most Probable Discharge.

PAI and the USCG will require the FPSO and Shuttle Vessel providers to implement vessel specific Oil Spill Response Plans (i.e. SOPEPs) which will be approved by the USCG and which will be bridged into the PAI R-OSRP.

Attachment R9.1, Continued

Comprehensive drills will be performed to verify readiness from all involved parties (PAI, FPSO provider, and Shuttle Vessel provider).

PAI will utilize a dedicated field support tug during FPSO operations. In addition to offloading support, the tug will be outfitted with equipment (e.g. spill booms) to support spill response. PAI will response to oils spills under USCG jurisdiction with an organizational structure and a response strategy consistent with that described in Section 9(b).

Attachment R9.2

Attachment 7

WCD Scenario for > 10 Miles From Shore – BASED ON MAJOR SPILL FROM FPSO or SHUTTLE VESSEL (USCG JURISDICATION) FOR NEPA EVALUATION -- 166 miles from shore
Walker Ridge Blocks 205, 206, 249, 250, 425, 426, 469, 470
API Gravity 23°

CGA Equipment Response Time to: WR 205, 206, 249, 250, 425, 426, 469, 470

	EQUIPMENT TYPE	Derated Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/Location	Initial Staging	Hours To Staging Area	Total Time to Procure (1)	Time to Load Out (2)	Travel Time (Staging/ Spill) (3)	Time to Deploy (4)	Total Estimated Response Time
A	DC 4 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	DC 3 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	Spotter Plane			1	ASI/HOUMA	HOUMA	0					
	Spotter Personnel			2	ASI/HOUMA	HOUMA	1					
	Dispersant				CGA/HOUMA	HOUMA	0	1	1	1.5	0	3.5
B	HOSS Barge	43,000	4,130	1	CGA/HOUMA	HOUMA	4					
	Operators			12	STARS	HOUMA	2					
	Tugs			3	Vessel of Opportunity	HOUMA	4	4	1	28	1	34
C	FRU/Expandi	10,200	600	3	CGA/HOUMA	FOURCHON	1					
	Operators			18	STARS*	FOURCHON	2					
	Utility Boat			3	Vessel of Opportunity	FOURCHON	2					
	Crew Boat			3	Vessel of Opportunity	FOURCHON	2	2	1	14.25	1	18.25
D	FRU/Expandi	7,170	200	2	CGA/VENICE	VENICE	1					
	Operators			12	STARS*	VENICE	2					
	Utility Boat			2	Vessel of Opportunity	VENICE	2					
	Crew Boat			2	Vessel of Opportunity	VENICE	2	2	1	13	1	17
E	FRU/Expandi	3,770	200	1	CGA/BELLE CHASSE	VENICE	1					
	Operators			6	STARS*	VENICE	2					
	Utility Boat			1	Vessel of Opportunity	VENICE	2					
	Crew Boat			1	Vessel of Opportunity	VENICE	2	2	1	14	1	18
F	FRU/Expandi	3,770	200	1	CGA/LAKE CHARLES	CAMERON	1					
	Operators			6	STARS*	CAMERON	2					
	Utility Boat			1	Vessel of Opportunity	CAMERON	2					
	Crew Boat			1	Vessel of Opportunity	CAMERON	2	2	1	19	1	23
G	FRU/Expandi	3,770	200	1	CGA/INGLESIDE	INGLESIDE	1					
	Operators			6	STARS*	INGLESIDE	2					
	Utility Boat			1	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			1	Vessel of Opportunity	INGLESIDE	2	2	1	26	1	30
H	FRU/Expandi	3,770	200	1	CGA/GALVESTON	GALVESTON	1					
	Operators			6	STARS*	GALVESTON	2					
	Utility Boat			1	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			1	Vessel of Opportunity	GALVESTON	2	2	1	22	1	26

Attachment 7

I	R/V Armstrong Operators	5,000	65	1 3	CGA/HOUMA STARS*	FOURCHON FOURCHON	1 2	2	1	9	1	13
J	R/V Grand Bay Operators	5,000	65	1 3	CGA/VENICE STARS*	VENICE VENICE	1 2	2	1	9.15	1	13.15
K	R/V Bastian Bay Operators	5,000	65	1 3	CGA/LAKE CHARLES STARS*	CAMERON CAMERON	1 2	2	1	12.7	1	16.7
L	R/V Timbalier Bay Operators	5,000	65	1 3	CGA/GALVESTON STARS*	GALVESTON GALVESTON	1 2	2	1	14.25	1	18.25
M	CGA 52 (Marco) Operators	3,588	34	1 3	CGA/HOUMA STARS*	FOURCHON FOURCHON	1 2	2	1	9	1	13
N	CGA 53 (Marco) Operators	3,588	34	1 3	CGA/VENICE STARS*	VENICE VENICE	1 2	2	1	9.15	1	13.15
O	CGA 51 (Marco) Operators	3,588	34	1 3	CGA/LAKE CHARLES STARS*	CAMERON CAMERON	1 2	2	1	12.7	1	12.7
P	CGA 55 (Egmopol) Operators	3,000	100	1 3	CGA/HOUMA STARS*	FOURCHON FOURCHON	1 2	2	1	9	1	13
Q	CGA 54 (Egmopol) Operators	3,000	100	1 3	CGA/GALVESTON STARS*	GALVESTON GALVESTON	1 2	2	1	14.25	1	18.25
R	Rope Mop Skimmer Operatores	77	4.28	1 3	CGA/HOUMA STARS*	FOURCHON FOURCHON	1 2	2	1	9	1	13
S	**INITIAL SUPPORT** Spotter Helo Surveillance Helo Hand Held Radios Open Ocean Barge Open Ocean Barge Open Ocean Barge Open Ocean Barge Open Ocean Barge Tugs	 -- -- -- -- -- -- -- -- --	 -- -- -- 25,000 24,000 23,000 11,000 9,500 --	 1 1 25 1 1 1 1 1 2	 PHI/HOUMA PHI/HOUMA STARS* CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA Vessel of Opportunity	 SPILL SITE SPILL SITE HOUMA HOUMA HOUMA HOUMA HOUMA HOUMA HOUMA	 1 1 1.5 2 2 2 2 2 2	 1 1 1.5 4 4 4 4 4 4	 -- -- -- 1 1 1 1 1 1	 1.75 1.75 1.75 28 28 28 28 28 28	 -- -- -- 1 1 1 1 1 1	 2.75 2.75 3.25 34 34 34 34 34 34
	TOTAL	112,291	98,796.28										

* STARS contractor called out by MSRC

Attachment R9.3

Attachment 8

Response Times for CGA Equipment to Respond - Houston, Texas Region of GoM

	EQUIPMENT TYPE	Derated Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/Location	Initial Staging	Hours To Staging Area	Total Time to Procure (1)	Time to Load Out (2)	Travel Time (Staging/ Spill) (3)	Time to Deploy (4)	Total Estimated Response Time
A	DC 4 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	DC 3 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	Spotter Plane			1	ASI/HOUMA	HOUMA	0					
	Spotter Personnel			2	ASI/HOUMA	HOUMA	1					
	Dispersant				CGA/HOUMA	HOUMA	0	1	1	2.5	0	4.5
B	HOSS Barge	43,000	4,130	1	CGA/HOUMA	HOUMA	4					
	Operators			12	STARS	HOUMA	2					
	Tugs			3	Vessel of Opportunity	HOUMA	4	4	1	39	1	45
C	FRU/Expandi	10,200	600	3	CGA/HOUMA	GALVESTON	7					
	Operators			18	STARS*	GALVESTON	2					
	Utility Boat			3	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			3	Vessel of Opportunity	GALVESTON	2	7	1	1	1	10
D	FRU/Expandi	7,170	200	2	CGA/VENICE	GALVESTON	9					
	Operators			12	STARS*	GALVESTON	2					
	Utility Boat			2	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			2	Vessel of Opportunity	GALVESTON	2	9	1	1	1	12
E	FRU/Expandi	3,770	200	1	CGA/BELLE CHASSE	GALVESTON	7					
	Operators			6	STARS*	GALVESTON	2					
	Utility Boat			1	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			1	Vessel of Opportunity	GALVESTON	2	7	1	1	1	10
F	FRU/Expandi	3,770	200	1	CGA/LAKE CHARLES	GALVESTON	4					
	Operators			6	STARS*	GALVESTON	2					
	Utility Boat			1	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			1	Vessel of Opportunity	GALVESTON	2	4	1	1	1	7
G	FRU/Expandi	3,770	200	1	CGA/INGLESIDE	GALVESTON	5					
	Operators			6	STARS*	GALVESTON	2					
	Utility Boat			1	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			1	Vessel of Opportunity	GALVESTON	2	5	1	1	1	8
H	FRU/Expandi	3,770	200	1	CGA/GALVESTON	GALVESTON	1					
	Operators			6	STARS*	GALVESTON	2					
	Utility Boat			1	Vessel of Opportunity	GALVESTON	2					
	Crew Boat			1	Vessel of Opportunity	GALVESTON	2	2	1	1	1	5
I	R/V Armstrong	5,000	65	1	CGA/HOUMA	FOURCHON	2					
	Operators			3	STARS*	FOURCHON	2	2	1	13	1	17

Attachment 8

J	R/V Grand Bay	5,000	65	1	CGA/VENICE	VENICE	1						
	Operators			3	STARS*	VENICE	2	2	1	15	1	19
K	R/V Bastian Bay	5,000	65	1	CGA/LAKE CHARLES	CAMERON	1						
	Operators			3	STARS*	CAMERON	2	2	1	4	1	8
L	R/V Timbalier Bay	5,000	65	1	CGA/GALVESTON	GALVESTON	1						
	Operators			3	STARS*	GALVESTON	2	2	1	1	1	5
M	CGA 52 (Marco)	3,588	34	1	CGA/HOUMA	GALVESTON	7						
	Operators			3	STARS*	GALVESTON	2	7	1	1	1	10
N	CGA 53 (Marco)	3,588	34	1	CGA/VENICE	GALVESTON	9						
	Operators			3	STARS*	GALVESTON	2	9	1	1	1	12
O	CGA 51 (Marco)	3,588	34	1	CGA/LAKE CHARLES	GALVESTON	4						
	Operators			3	STARS*	GALVESTON	2	4	1	1	1	7
P	CGA 55 (Egmopol)	3,000	100	1	CGA/HOUMA	GALVESTON	7						
	Operators			3	STARS*	GALVESTON	2	7	1	1	1	10
Q	CGA 54 (Egmopol)	3,000	100	1	CGA/GALVESTON	GALVESTON	1						
	Operators			3	STARS*	GALVESTON	2	2	1	1	1	5
R	Rope Mop Skimmer	77	4.28	1	CGA/HOUMA	GALVESTON	7						
	Operators			3	STARS*	GALVESTON	2	7	1	1	1	10
S	**INITIAL SUPPORT**												
	Spotter Helo	--	--	1	PHI/VENICE	SPILL SITE	1	1	--	-	--	1
	Surveillance Helo	--	--	1	PHI/VENICE	SPILL SITE	1	1	--	-	--	1
	Hand Held Radios	--	--	25	STARS*	HOUMA	2	1	--	1	--	4
	Open Ocean Barge	--	25,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	24,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	23,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	11,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	9,500	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Tugs	--	--	2	Vessel of Opportunity	HOUMA	4	4	1	31.5	1	37.5
	TOTAL	112,291	98,796.28									

* STARS contractor called out by MSRC

Attachment R9.4

Attachment 9

Response Times for CGA Equipment to Respond - Mobile, Alabama Region of GoM

	EQUIPMENT TYPE	Derated Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/Location	Initial Staging	Hours To Staging Area	Total Time to Procure (1)	Time to Load Out (2)	Travel Time (Staging/ Spill) (3)	Time to Deploy (4)	Total Estimated Response Time
A	DC 4 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	DC 3 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	Spotter Plane			1	ASI/HOUMA	HOUMA	0					
	Spotter Personnel			2	ASI/HOUMA	HOUMA	1					
	Dispersant				CGA/HOUMA	HOUMA	0	1	1	2.0	0	4.0
B	HOSS Barge	43,000	4,130	1	CGA/HOUMA	HOUMA	4					
	Operators			12	STARS	HOUMA	2					
	Tugs			3	Vessel of Opportunity	HOUMA	4	4	1	31.5	1	37.5
C	FRU/Expandi	10,200	600	3	CGA/HOUMA	MOBILE	5					
	Operators			18	STARS*	MOBILE	4					
	Utility Boat			3	Vessel of Opportunity	MOBILE	2					
	Crew Boat			3	Vessel of Opportunity	MOBILE	2	5	1	1	1	8.0
D	FRU/Expandi	7,170	200	2	CGA/VENICE	VENICE	1					
	Operators			12	STARS*	VENICE	2					
	Utility Boat			2	Vessel of Opportunity	VENICE	2					
	Crew Boat			2	Vessel of Opportunity	VENICE	2	2	1	7	1	11
E	FRU/Expandi	3,770	200	1	CGA/BELLE CHASSE	MOBILE	5					
	Operators			6	STARS*	MOBILE	3					
	Utility Boat			1	Vessel of Opportunity	MOBILE	2					
	Crew Boat			1	Vessel of Opportunity	MOBILE	2	5	1	1	1	8
F	FRU/Expandi	3,770	200	1	CGA/LAKE CHARLES	MOBILE	7					
	Operators			6	STARS*	MOBILE	5					
	Utility Boat			1	Vessel of Opportunity	MOBILE	2					
	Crew Boat			1	Vessel of Opportunity	MOBILE	2	7	1	1	1	10
G	FRU/Expandi	3,770	200	1	CGA/INGLESIDE	MOBILE	13					
	Operators			6	STARS*	MOBILE	5					
	Utility Boat			1	Vessel of Opportunity	MOBILE	2					
	Crew Boat			1	Vessel of Opportunity	MOBILE	2	13	1	1	1	16
H	FRU/Expandi	3,770	200	1	CGA/GALVESTON	MOBILE	10					
	Operators			6	STARS*	MOBILE	5					
	Utility Boat			1	Vessel of Opportunity	MOBILE	2					
	Crew Boat			1	Vessel of Opportunity	MOBILE	2	10	1	1	1	13
I	R/V Armstrong	5,000	65	1	CGA/HOUMA	FOURCHON	1					
	Operators			3	STARS*	FOURCHON	2	2	1	8.25	1	12.25

Attachment 9

J	R/V Grand Bay	5,000	65	1	CGA/VENICE	VENICE	1						
	Operators			3	STARS*	VENICE	2	2	1	4.5	1	8.5
K	R/V Bastian Bay	5,000	65	1	CGA/LAKE CHARLES	CAMERON	1						
	Operators			3	STARS*	CAMERON	2	2	1	18	1	22
L	R/V Timbalier Bay	5,000	65	1	CGA/GALVESTON	GALVESTON	1						
	Operators			3	STARS*	GALVESTON	2	2	1	21	1	25
M	CGA 52 (Marco)	3,588	34	1	CGA/HOUMA	MOBILE	5						
	Operators			3	STARS*	MOBILE	4	5	1	1	1	8
N	CGA 53 (Marco)	3,588	34	1	CGA/VENICE	MOBILE	5.5						
	Operators			3	STARS*	MOBILE	4	5.5	1	1	1	8.5
O	CGA 51 (Marco)	3,588	34	1	CGA/LAKE CHARLES	MOBILE	7						
	Operators			3	STARS*	MOBILE	5	7	1	1	1	10
P	CGA 55 (Egmopol)	3,000	100	1	CGA/HOUMA	MOBILE	5						
	Operators			3	STARS*	MOBILE	4	5	1	1	1	8
Q	CGA 54 (Egmopol)	3,000	100	1	CGA/GALVESTON	MOBILE	10						
	Operators			3	STARS*	MOBILE	5	10	1	1	1	13
R	Rope Mop Skimmer	77	4.28	1	CGA/HOUMA	MOBILE	5						
	Operators			3	STARS*	MOBILE	4	5	1	1	1	8
S	**INITIAL SUPPORT**												
	Spotter Helo	--	--	1	PHI/VENICE	SPILL SITE	2	2	--	-	--	2
	Surveillance Helo	--	--	1	PHI/VENICE	SPILL SITE	2	1	--	-	--	2
	Hand Held Radios	--	--	25	STARS*	HOUMA	5	5	--	1	--	6
	Open Ocean Barge	--	25,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	24,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	23,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	11,000	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Open Ocean Barge	--	9,500	1	CENAC/HOUMA	HOUMA	4	4	1	31.5	1	37.5
	Tugs	--	--	2	Vessel of Opportunity	HOUMA	4	4	1	31.5	1	37.5
	TOTAL	112,291	98,796.28									

* STARS contractor called out by MSRC

Attachment R9.5

Attachment 10

Response Times for CGA Equipment to Respond - Corpus Christi, Texas Region of GoM

	EQUIPMENT TYPE	Denied Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/Location	Initial Staging	Hours To Staging Area	Total Time to Procure (1)	Time to Load Out (2)	Travel Time (Staging/ Spill) (3)	Time to Deploy (4)	Total Estimated Response Time
A	DC 4 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	DC 3 Spray Aircraft	--	--	1	ASI/HOUMA	HOUMA	0					
	Spotter Plane			1	ASI/HOUMA	HOUMA	0					
	Spotter Personnel			2	ASI/HOUMA	HOUMA	1					
	Dispersant				CGA/HOUMA	HOUMA	0	1	1	4.0	0	6.0
B	HOSS Barge	43,000	4,130	1	CGA/HOUMA	HOUMA	4					
	Operators			12	STARS	HOUMA	2					
	Tugs			3	Vessel of Opportunity	HOUMA	4	4	1	64	1	70
C	FRU/Expandi	10,200	600	3	CGA/HOUMA	INGLESIDE	11					
	Operators			18	STARS*	INGLESIDE	4					
	Utility Boat			3	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			3	Vessel of Opportunity	INGLESIDE	2	11	1	1	1	14
D	FRU/Expandi	7,170	200	2	CGA/VENICE	INGLESIDE	13					
	Operators			12	STARS*	INGLESIDE	4					
	Utility Boat			2	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			2	Vessel of Opportunity	INGLESIDE	2	13	1	1	1	16
E	FRU/Expandi	3,770	200	1	CGA/BELLE CHASSE	INGLESIDE	11					
	Operators			6	STARS*	INGLESIDE	4					
	Utility Boat			1	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			1	Vessel of Opportunity	INGLESIDE	2	11	1	1	1	14
F	FRU/Expandi	3,770	200	1	CGA/LAKE CHARLES	INGLESIDE	7					
	Operators			6	STARS*	INGLESIDE	4					
	Utility Boat			1	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			1	Vessel of Opportunity	INGLESIDE	2	7	1	1	1	10
G	FRU/Expandi	3,770	200	1	CGA/INGLESIDE	INGLESIDE	1					
	Operators			6	STARS*	INGLESIDE	1					
	Utility Boat			1	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			1	Vessel of Opportunity	INGLESIDE	2	2	1	1	1	5
H	FRU/Expandi	3,770	200	1	CGA/GALVESTON	INGLESIDE	6					
	Operators			6	STARS*	INGLESIDE	2					
	Utility Boat			1	Vessel of Opportunity	INGLESIDE	2					
	Crew Boat			1	Vessel of Opportunity	INGLESIDE	2	6	1	1	1	9
I	R/V Armstrong	5,000	65	1	CGA/HOUMA	DULAC	1					
	Operators			3	STARS*	DULAC	1	1	1	20	1	23

Attachment 10

J	R/V Grand Bay Operators	5,000	65	1 3	CGA/VENICE STARS*	VENICE VENICE	1 2	2	1	24	1	28
K	R/V Bastian Bay Operators	5,000	65	1 3	CGA/LAKE CHARLES STARS*	CAMERON CAMERON	1 2	2	1	13	1	17
L	R/V Timbalier Bay Operators	5,000	65	1 3	CGA/GALVESTON STARS*	GALVESTON GALVESTON	1 2	2	1	9	1	13
M	CGA 52 (Marco) Operators	3,588	34	1 3	CGA/HOUMA STARS*	INGLESIDE INGLESIDE	11 4	11	1	1	1	14
N	CGA 53 (Marco) Operators	3,588	34	1 3	CGA/VENICE STARS*	INGLESIDE INGLESIDE	13 4	13	1	1	1	16
O	CGA 51 (Marco) Operators	3,588	34	1 3	CGA/LAKE CHARLES STARS*	INGLESIDE INGLESIDE	7 5	7	1	1	1	10
P	CGA 55 (Egmopol) Operators	3,000	100	1 3	CGA/HOUMA STARS*	INGLESIDE INGLESIDE	11 4	11	1	1	1	14
Q	CGA 54 (Egmopol) Operators	3,000	100	1 3	CGA/GALVESTON STARS*	INGLESIDE INGLESIDE	6 5	6	1	1	1	9
R	Rope Mop Skimmer Operators	77	4.28	1 3	CGA/HOUMA STARS*	INGLESIDE INGLESIDE	11 4	11	1	1	1	14
S	**INITIAL SUPPORT** Spotter Helo Surveillance Helo Hand Held Radios Open Ocean Barge Open Ocean Barge Open Ocean Barge Open Ocean Barge Open Ocean Barge Tugs	 -- -- -- -- -- -- -- -- --	 -- -- -- 25,000 24,000 23,000 11,000 9,500 --	 1 1 25 1 1 1 1 1 2	 PHI/CORPUS PHI/CORPUS STARS* CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA CENAC/HOUMA Vessel of Opportunity	 SPILL SITE SPILL SITE INGLESIDE HOUMA HOUMA HOUMA HOUMA HOUMA HOUMA	 1 1 2 4 4 4 4 4 4	 1 1 2 4 4 4 4 4 4	 -- -- -- 1 1 1 1 1 1	 - - 1 64 64 64 64 64 64	 -- -- -- 1 1 1 1 1 1	 1 1 3 70 70 70 70 70 70
	TOTAL	112,291	98,796.28									

* STARS contractor called out by MSRC

Attachment R9.6

Attachment 11

CCA Equipment Response to WR 205, 206, 249, 250, 425, 426, 469, 470

	EQUIPMENT TYPE	Darated Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/ Location	Staging Area	Hours To Staging Area	TOTAL Time to Procure (1)	Time to Load Out (2)	Travel Time (Spill Site) (3)	Time to Deploy (4)	TOTAL Estimated Response Time
A	Foilex TDS 200 RDSS Skimmer	10,500	0	4 @ 2625 barrels	CCA, Fort Lauderdale, FL	Fourchon, LA	24	24	1	16.5	1	42.5
B	Lamor LWS 70 w/brush adapter Skimmer	1509	0	1 @ 1509 barrels	CCA, Fort Lauderdale, FL	Fourchon, LA	24	24	1	16.5	1	42.5
C	Ro-Clean 4090 vertical Ropemop	6336	0	6 @ 1056 barrels	CCA, Fort Lauderdale, FL	Fourchon, LA	24	24	1	16.5	1	42.5
D	Canflex Sea Slug Floating Bladder	0	300	8	CCA, Fort Lauderdale, FL	Fourchon, LA	24	24	1	16.5	1	42.5
E	Offshore Containment Boom	0	0	10,500 feet	CCA, Fort Lauderdale, FL	Fourchon, LA	24	24	1	16.5	1	42.5
F	Spray Aircraft (C130)	0	0	1	Lynden Air Cargo, Anchorage, AK	Fourchon, LA (via New Orleans, LA)	26	26	0	1.5	0	27.5
	Dispersant	0	0	20,000 gallons	CCA, Fort Lauderdale, FL							
	TOTAL	18,345	300									

Notes :

1. Mechanical recovery equipment shown represents 25% of specific type of equipment in CCA inventory for an Out of Area response in accordance with CCA By-Laws.
2. 20,000 out of inventory of 30,000 gallons of dispersant are available for an Out of Area response in accordance with CCA By-Laws.
3. 24 Hours to Staging Area for mechanical recovery equipment is the CCA Planning Standard to deliver equipment from time of notification by a CCA Member Company to a specified Staging Area; depending on charter aircraft availability the time could be shorter.
4. 26 Hours to Staging Area for Spray Aircraft and Dispersant includes 20 hours to acquire aircraft, 3 hours to pickup the CCA Airborne Dispersant Delivery System (ADDS) and load dispersant, and 3 hours to arrive in New Orleans. The time can be shorter depending on the location of available Spray Aircraft & spray qualified crews at the time of activation by PAI.
5. Travel Time to Spill Site is based upon 10 knots per hour for supply boat(s) which are vessels of opportunity.

Attachment R9.7

Attachment 12

CCA Equipment Response to Corpus Christi Region of the GoM

	EQUIPMENT TYPE	Derated Capacity (BBLS)	Storage (BBLS)	No. of Units	Owner/ Location	Staging Area	Hours To Staging Area	TOTAL Time to Procure (1)	Time to Load Out (2)	Travel Time (Spill Site) (3)	Time to Deploy (4)	TOTAL Estimated Response Time
A	Foilex TDS 200 RDSS Skimmer	10,500	0	4 @ 2625 barrels	CCA, Fort Lauderdale, FL	Corpus Christi, TX	24	24	1	5	1	31
B	Lamor LWS 70 wbrush adapter Skimmer	1509	0	1 @ 1509 barrels	CCA, Fort Lauderdale, FL	Corpus Christi, TX	24	24	1	5	1	31
C	Ro-Clean 4090 vertical Ropemop	6336	0	6 @ 1056 barrels	CCA, Fort Lauderdale, FL	Corpus Christi, TX	24	24	1	5	1	31
D	Canflex Sea Slug Floating Bladder	0	300	8	CCA, Fort Lauderdale, FL	Corpus Christi, TX	24	24	1	5	1	31
E	Offshore Containment Boom	0	0	10,500 feet	CCA, Fort Lauderdale, FL	Corpus Christi, TX	24	24	1	5	1	31
	TOTAL	18,345	300									

Notes :

1. Mechanical recovery equipment shown represents 25% of specific type of equipment in CCA inventory for an Out of Area response in accordance with CCA By-Laws.
2. 24 Hours to Staging Area for mechanical recovery equipment is the CCA Planning Standard to deliver equipment from time of notification by a CCA Member Company to a specified Staging Area; depending on charter aircraft availability the time could be shorter.
3. Travel Time to Spill Site is based upon 10 knots per hour for supply boat(s) which are vessels of opportunity. Assume spill is located 50 miles from the terminal (i.e. furthest location inside of High Volume Port).
4. It is assumed that dispersant use would not be approved for a proximity so close to shore.

Attachment R9.8

MEMBERSHIP AGREEMENT
BY AND BETWEEN
THE CLEAN CARIBBEAN CORPORATION (CCC)
AND
PETROLEO BRASILEIRO S.A. (PETROBRAS)
AND
PETROBRAS AUTHORIZATION FOR MOBILIZATION OF CCC STAFF, EQUIPMENT & MATERIALS

I. MEMBERSHIP AGREEMENT

PURSUANT TO Article 3.3 of the ByLaws of the Clean Caribbean Corporation ("CCC"), this acknowledges that Petroleo Brasileiro S.A., ("Petrobras") has agreed to join the Clean Caribbean Corporation effective June 1, 2000, for a period of not less than two (2) years.

Further, that as a Member of the Corporation, Petrobras shall have all rights, privileges, duties and responsibilities commensurate with Membership and THAT BY SIGNATURE BELOW, Petrobras hereby accepts

1. and agrees to subscribe to and abide by the Bylaws of the Corporation, and any subsequent amendments or revisions to the Bylaws;
2. that unless otherwise mutually agreed by the CCC and Petrobras, the calculated Membership Interest for Petrobras shall be based on an annual Reported Volume of 500,000, 000 barrels;
3. that Petrobras, in fulfillment of all financial requirements of Article 8.2 of the Bylaws of the Corporation, shall remit via wire transfer to the CCC's bank within seven (7) days of this agreement, the sum OF NINETY THOUSAND THREE HUNDRED AND TWENTY DOLLARS ($90,320), for Associate Membership, [redacted]
4. that Petrobras shall execute and submit a current Sale Agreement for Members as required by Article 3.3 of the Bylaws of the Corporation.

5. that Petrobras shall submit the written designation of the Petrobras' named Representative and any alternates as required by Article 3.3 of the Bylaws of the Corporation.

II. MOBILIZATION AUTHORIZATION

PURSUANT TO Article IX of the CCC Bylaws, on July 16, 2000, Petrobras notified the CCC that Petrobras requires the mobilization of some CCC staff, equipment or materials, and contractors, and has requested that the CCC take all necessary actions to ensure the rapid mobilization of said staff, equipment and materials, and contractors.

Furthermore, that Petrobras authorizes, and agrees to reimburse the CCC in accordance with the terms and conditions of the CCC Bylaws and Sale Agreement, all expenses incurred for preparing for and/or mobilizing CCC staff, equipment, materials, and contractors, regardless of actual shipment of equipment and materials.

IN WITNESS WHEREOF, the undersigned have executed this Membership Agreement effective as of the date set forth below.

CLEAN CARIBBEAN CORPORATION	PETROLEO BRASILEIRO S.A.
By: Paul A. Schuler	By: [signature]
Name (Print): PAUL A. SCHULER	Name (Print): Luis Fernando Mendonça Freire
Title: President	Title: Industrial Safety Manager - Corp.
Date: July 17, 2000	Date: July 17, 2000
	on behalf of Ivan Carlos Varella HSE manager - Corp.

[illegible]

Attachment R9.8, Continued

Duplicate Original

CONTRACT AMENDMENT

It is hereby agreed between the Clean Caribbean Corporation d/b/a Clean Caribbean & Americas ("CCA") and Petrolao Brasileiro S.A., ("Purchaser") that the provisions of the Clean Caribbean Corporation Sale Agreement, Contract No. C01-12, dated to be effective as of June 1, 2001, be amended as follows:

Article II, Paragraph 2.1 – Term – is hereby replaced with the following:

2. Term. Subject to Section 9.13 hereof, this Agreement shall be effective as of September 1, 2006 and shall terminate on August 31, 2010 (the "Term"), unless earlier terminated pursuant to Sections 2.2 and/or 2.3 hereof.

Except as modified hereinabove, all other terms and conditions of Contract No. C04-13 shall remain in full force and effect.

Clean Caribbean Corporation		**Petroleo Brasileiro S.A.**	
By:	Paul A. Schuler	By:	
Name:	Paul A. Schuler	Name:	JAYME DE SETA FILHO
Title:	President	Title:	COUNTRY MANAGER
Date:	February 21, 2007	Date:	MARCH 02, 2007

Duplicate Original
CCC Copy

Rev. 3a (10/23/00)

CCC Contract No.: **C01-012**
(effective from 09/25/01 through 08/31/06)
This Contract supersedes CCC Contract No. C00-004 effective from 01/01/00 to 12/31/04

CLEAN CARIBBEAN CORPORATION

SALE AGREEMENT

THIS AGREEMENT is made as of June 1, 2001 by and between **PETROLEO BRASILEIRO S.A.**, a Brasil corporation ("Purchaser") and **CLEAN CARIBBEAN CORPORATION**, a Texas nonprofit corporation ("CCC").

RECITALS

WHEREAS, CCC acquires and stores Inventory for the purpose of containment and clean-up of oil spills in the Area of Interest; and

WHEREAS, Purchaser desires to purchase certain requested segments, elements or pieces of such Inventory on the terms and conditions set forth herein; and

WHEREAS, CCC desires to sell to Purchaser the Purchased Inventory on the terms and conditions set forth herein;

NOW, THEREFORE, for and in consideration of the premises and the mutual covenants, conditions, representations and undertakings hereinafter contained, and other valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the parties hereto do hereby agree as follows:

ARTICLE I

Definitions

As used in this Agreement, the following terms shall have the following respective meanings:

1.1 "Area of Interest" shall have the meaning ascribed thereto in the Bylaws, which meaning, as may be amended from time to time in accordance with the Bylaws, is hereby incorporated by reference herein for all purposes.

1.2 "Bylaws" shall mean the Bylaws of CCC as in effect from time to time.

1.3 "Designated Spill" shall mean any actual or potential emission (other than natural seepage) of Oil, intentional or unintentional, and includes, but is not limited to, spilling, leaking, pumping, pouring, emitting, emptying or dumping of Oil upon land or water within the Area of Interest as designated by Purchaser to CCC and for which Inventory is sought to be purchased hereunder and utilized by Purchaser, or its agents, to mitigate, remediate and/or eliminate Oil from the land or water where it was emitted.

1.4 "Guarantee" shall have the meaning ascribed thereto in Section 3.2.

1.5 "Impositions" shall have the meaning ascribed thereto in Section 6.2.

1.6 "Indemnified Parties" shall have the meaning ascribed thereto in Section 8.1.

1.7 "Inventory" shall mean the stockpile of oil spill response equipment, materials and supplies owned, leased, maintained and mobilized by CCC for the purpose of containment and clean-up of a Designated Spill within the Area of Interest.

1.8 "Member" shall mean an entity that is admitted as a Member of CCC pursuant to its Bylaws, and for whom a certificate of membership has been issued by CCC.

1.9 "Nonmember" shall mean an entity that is not a Member.

1.10 "Oil" shall mean petroleum oil of any kind or in any form, including but not limited to crude oil or petroleum, fuel oil or sludge, oil refuse, and oil mixed with wastes other than dredged spoil, and in specific those compounds, oils and materials listed on Attachment B to the Bylaws, which list, as may be amended from time to time in accordance with the Bylaws, is hereby incorporated by reference herein for all purposes; however such definition does not and shall not include any of those petroleum compounds, including (if applicable) crude oil or its fractions, which are specifically listed or designated as hazardous substances under subparagraphs (A) through (F) of Section 101(14) of the Comprehensive Environmental Response Compensation and Liability Act, as amended (42 USC 9601) (the "Act") and which are or may become subject to the provisions of that Act.

ARTICLE II

Term; Termination

2.1 Term. Subject to Section 9.13 hereof, this Agreement shall begin on the effective date hereof and shall terminate on August 31, 2006 (the "Term"), unless earlier terminated pursuant to Sections 2.2 and/or 2.3 hereof.

2.2 Termination by CCC or Purchaser. This Agreement may be terminated upon ten (10) days notice by CCC or by Purchaser at any time without cause, subject to Section 9.13 hereof.

2.3 Termination Upon Dissolution of CCC. This Agreement shall terminate without notice, automatically and concurrently, upon the dissolution of CCC.

ARTICLE III

Purchase

3.1 General. (a) In the event of a Designated Spill and subject to the provisions of this Agreement, CCC shall sell to Purchaser the segments, elements or pieces of the Inventory (the "Purchased Inventory") listed on a Sales Order executed by CCC and Purchaser in the form attached hereto as Exhibit A (the "Sales Order"), for the purchase price set forth on such Sales Order and subject to the terms and conditions set forth therein. CCC and Purchaser shall execute a new Sales Order and shall pay an additional purchase price upon each additional sale of Purchased Inventory during the Term of this Agreement, which Sales Orders shall be subject to the terms and conditions of this Agreement. Unless otherwise mutually agreed in writing by the parties to this Agreement, Purchaser shall be deemed to have acquired legal title to the Purchased Inventory and shall assume and bear the entire risk of loss, theft, destruction of or damage to the Purchased Inventory, whether or not insured, from any cause whatsoever, at CCC's warehouse in the State of Florida, and no such event of loss, theft, destruction of or damage to the Purchased Inventory shall relieve Purchaser of any of its obligations hereunder.

(b) CCC shall have no responsibility for the management of, or participation in, any oil spill cleanup effort. Purchaser hereby represents and warrants to CCC that it will use the Purchased Inventory solely for the purposes of containing and cleaning up Oil within the Area of Interest. If the Designated Spill originates within the Area of Interest but the containment and cleanup requires the use of the Purchased Inventory outside of the Area of Interest, Purchaser may continue to use the Purchased Inventory as reasonably required, subject to meeting requirements of applicable law (domestic or foreign), and such use shall not be deemed to be a breach of this Agreement. Notwithstanding anything to the contrary in this Agreement or otherwise, complete possession and control of the Purchased Inventory shall be maintained by Purchaser from and after the time and place of agreed delivery by CCC. During such time, no Member (other than Purchaser, if Purchaser is a Member) shall have any responsibility or liability therefor, regardless of such Member's negligence.

(c) Except as set forth in this Section 3.1(c) and in Section 3.7 hereof, it is not anticipated that CCC will supply personnel to provide response, training or maintenance services to Purchaser. Notwithstanding anything to the contrary set forth herein, in the event that CCC determines in its reasonable discretion that trained contractor personnel under current contract to CCC or participants in the CCC contractor and resource network are required to accompany the Purchased Inventory in order to provide proper operation for the Purchased Inventory or for purposes of maintaining the Purchased Inventory for Purchaser, Purchaser shall enter into separate agreements with such parties designated by CCC.

3.2 Guarantee of Funds. Unless otherwise mutually agreed in writing by the parties to this Agreement, Purchaser shall post a non-refundable and irrevocable Letter of Credit for the benefit of CCC substantially in the form of Attachment 1 to the Sales

Order, issued from a financial institution acceptable to CCC in an amount determined appropriate by CCC, and/or provide such other security or financial arrangements, including without limitation, the Promissory Note and Guaranty substantially in the forms of Attachments 2 and 3 to the Sales Order, as deemed necessary or appropriate by CCC in its sole discretion (the "Guarantee"). The actual posting of such Guarantee shall be accomplished prior to the delivery of any Purchased Inventory by CCC to Purchaser. The amount of the Guarantee shall include but not be limited to the purchase price of the Purchased Inventory that is requested, applicable taxes, and any reasonable costs of transportation, shipping, packing, crating and marking, maintenance, integration, estimated expenses due hereunder related to liability coverage, insurance and reasonable costs of stocking/restocking, administration and overhead. As security for all payment obligations of Purchaser in connection with this Agreement, Purchaser hereby grants to CCC a first priority security interest in the Purchased Inventory, together with all instruments, documents, chattel papers and general intangibles relating thereto or arising therefrom, whether now existing or hereafter created or acquired by Purchaser, and all cash and non-cash proceeds and products thereof (the "Collateral"). Purchaser hereby covenants and agrees to keep the Collateral free and clear of all attachments, levies, taxes, liens and encumbrances of every kind and nature (other than those granted to CCC) until CCC has received all amounts payable to it in connection with this Agreement. Purchaser covenants and agrees to execute such financing statements, security agreements or other instruments with respect to any of the Collateral as CCC may reasonably request, and hereby irrevocably appoints CCC as Purchaser's attorney-in-fact and irrevocably authorizes CCC to execute and file at any time such financing statements without Purchaser's signature and, if upon request Purchaser fails to do so, to execute such security agreements or other instruments on Purchaser's behalf.

3.3 Notice/Request. If Purchaser desires to acquire Inventory with respect to a Designated Spill, then Purchaser shall promptly notify CCC of its order for such Inventory. The notification and order shall include the location, nature and size of the Designated Spill, if known, the specific Inventory being ordered and the method of transportation that Purchaser is arranging for the Inventory to the site of the Designated Spill or other location where Inventory is to be deployed. The initial notification may be oral but it shall be confirmed in writing as soon as practicable. Upon receipt of the notification and order, the Guarantee and evidence of contracts with transporters, CCC shall release the identified Inventory from its stockpile, subject to the conditions of Section 3.4 below.

3.4 Priority for Member Orders. It is mutually agreed and acknowledged that CCC will respond to orders for Inventory on a "first come, first serve" basis; provided, however, that CCC shall first respond to orders from Members in the order that requests are received from individual Members. After fulfilling all orders from Members, CCC may, at its discretion, respond to Nonmember orders for Inventory to the extent permitted by CCC's Articles of Incorporation and the Bylaws.

3.5 Status Reports. Purchaser shall provide at CCC's request status reports on the Purchased Inventory, including its use, condition, location, and maintenance

accomplished and any other information requested by CCC relative to the Purchased Inventory, its use, condition and its usefulness.

3.6 Repurchase of Purchased Inventory. Purchaser will have the right to propose a resale by Purchaser to CCC of any Purchased Inventory ordered within sixty (60) days from when said Purchased Inventory was removed from CCC's warehouse(s); such repurchase to be at the discretion of CCC and on terms, price and conditions to be mutually agreed upon.

3.7 CCC Forward Sales Representative and Technical Advisor. Unless otherwise mutually agreed in writing by the parties to this Agreement, a CCC Staff Forward Sales Representative and/or Technical Advisor will accompany the Purchased Inventory, subject to CCC operational and other considerations, to provide assistance and advice on the documentation, operation, maintenance, logistics support, and deployment of equipment or materials purchased from CCC. Prior to dispatch of a CCC Forward Sales Representative and/or Technical Advisor, Purchaser and CCC shall execute the "CCC Staff Assistance Agreement" in the form attached hereto as Exhibit B.

ARTICLE IV

Disclaimer of Warranties

4.1 Disclaimers. Notwithstanding anything to the contrary in this Agreement or otherwise, Purchaser shall be deemed to have accepted delivery, and the quantity and quality, of the Purchased Inventory under this Agreement **"AS IS, WHERE IS"** in whatever condition it may be without any agreement, representation or warranty, express or implied, by CCC. **CCC IS NOT A MANUFACTURER OF THE PURCHASED INVENTORY. CCC HAS NOT MADE AND DOES NOT MAKE BY VIRTUE OF HAVING SOLD THE PURCHASED INVENTORY UNDER THIS AGREEMENT OR BY VIRTUE OF ANY DISCUSSIONS, DISCLOSURES OR NEGOTIATIONS IN RESPECT OF THIS AGREEMENT, ANY REPRESENTATION OR WARRANTY, EXPRESS OR IMPLIED, AS TO CONDITIONS, COMPLIANCE WITH SPECIFICATIONS, REGULATIONS OR LAWS, QUALITY, VALUE, DURABILITY, SUITABILITY, WORKMANSHIP, PERFORMANCE, CAPACITY, MERCHANTABILITY, OR FITNESS OR USE OR FITNESS FOR A PARTICULAR PURPOSE OR ANY OTHER WARRANTY WHATSOEVER, EXPRESS OR IMPLIED, WITH RESPECT TO THE PURCHASED INVENTORY;** it being agreed and understood that all risks arising as a result of any such matters, as between CCC and Purchaser, are to be borne solely and exclusively by Purchaser, without recourse.

4.2 Support. Purchaser acknowledges and agrees that it is responsible for, and shall provide, at its sole cost and expense, all transportation, maintenance support, subcontractor support, and any other support and/or assistance necessary for the Purchased Inventory to be used and/or operated for Purchaser's intended use.

ARTICLE V

Purchaser's Covenants and Warranties

Purchaser represents, warrants and covenants to CCC as follows:

5.1 Use of Purchased Inventory. Purchaser: (a) shall not use or employ any item of Purchased Inventory in any manner contrary to applicable law, (b) shall be solely responsible for obtaining, and shall obtain, all governmental and other approvals necessary for the ownership and use of the Purchased Inventory, and (c) shall not use, store, trade or operate any item of Purchased Inventory in any way so as to suspend or endanger any insurance coverage applicable thereto.

5.2 Due Authority. The execution, delivery and performance of this Agreement and all Exhibits and Addenda hereto and the transactions contemplated hereby by Purchaser have been duly and effectively authorized by all necessary corporate action by Purchaser. This Agreement and all Exhibits and Addenda hereto constitute the valid and binding obligation of Purchaser and is enforceable against it in accordance with its terms. The execution, delivery and performance of this Agreement and all Exhibits and Addenda hereto by Purchaser do not, and the consummation of the transactions contemplated hereby will not, conflict with or cause a default under any contract or agreement to which Purchaser is a party or by which Purchaser is bound, and will not conflict with or result in any violation of the constituent documents of Purchaser.

5.3 No Consents. No consent or approval of any third party is necessary for the execution and delivery of this Agreement and all Exhibits and Addenda hereto by Purchaser and the consummation by Purchaser of the transactions contemplated hereby. Neither the execution, delivery nor performance of this Agreement or the other agreements, Exhibits and Addenda referred to herein will, with or without the giving of notice or the passage of time, or both, conflict with, result in default or loss of rights under, or adversely affect the Purchased Inventory, or result in the creation of any lien, charge or encumbrance on the Purchased Inventory pursuant to any law, rule or regulation applicable to Purchaser, any provision of Purchaser's constituent documents as currently in effect, or any mortgage, lease, license, understanding, order, judgment, decree or agreement to which Purchaser is a party, and the execution, delivery and performance of this Agreement, all Exhibits and Addenda hereto and other agreements referred to herein does not violate any provision of law applicable to Purchaser.

ARTICLE VI
Costs

6.1 Purchase Price. The purchase price and payment terms for the Purchased Inventory are set forth on each applicable Sales Order. Unless otherwise mutually agreed to by the parties to this Agreement in an executed Sales Order, payment for the Purchased Inventory shall be made by Purchaser to CCC via wire transfer of funds prior to shipment of such Purchased Inventory. CCC shall have the right to amend each Sales Order from time to time without the consent of Purchaser. Upon receipt of

payment in full of the purchase price for the Purchased Inventory, CCC shall deliver to Purchaser a bill of sale in substantially the form attached hereto as Exhibit C for said Purchased Inventory. Wire transfer of funds shall be made in accordance with the following instructions:

BANK ROUTING NUMBER:	066000604
BANK NAME AND ADDRESS:	Suntrust Bank, Miami, N.A. Ponce at Alhambra Office 201 Alhambra Circle Coral Gables, FL 33134
FOR CREDIT TO THE ACCOUNT OF:	Clean Caribbean Corporation
ACCOUNT NUMBER:	0802001026205

6.2 Impositions. All payments to be made by Purchaser hereunder will be free of expense to CCC with respect to the amount of any local, state, federal, national, foreign or international taxes or license fees, assessments, charges, fines or penalties (all such taxes, license fees, assessments, charges, fines and penalties being hereinafter called "Impositions") hereinafter levied or imposed upon or in connection with or measured by this Agreement or the payments hereunder, or any purchase, sale, use, payment, shipment, delivery or transfer of title under the terms hereof, all of which Impositions as applicable to the purchase of the Purchased Inventory, Purchaser assumes and agrees to pay on demand by CCC in addition to all other payments to be made by Purchaser hereunder. Without limiting the generality of the foregoing, Purchaser will also pay promptly Impositions which may be imposed upon any Purchased Inventory or for the use or operation thereof. If any Impositions shall have been charged or levied against CCC directly and paid by CCC, Purchaser shall reimburse CCC within ten (10) days of presentation by CCC of an invoice for said Impositions. If said payment is not received by CCC within thirty (30) days of CCC's demand, Purchaser shall pay to CCC interest on such unpaid amount from its due date to the date of payment in accordance with Section 6.4 hereof.

6.3 Operating Costs. Purchaser shall reimburse CCC within ten (10) days of written demand for all costs incurred by CCC in mobilizing and deploying Purchased Inventory to the port of embarkation as designated by Purchaser in the order.

6.4 Payment. Purchaser shall pay all amounts payable under this Agreement in such coin or currency of the United States of America as at the time of payment shall be the legal tender for the payment of public or private debt by cashier's check or bank wire transfer within ten (10) days of demand by CCC. If said payment is not received by CCC within thirty (30) days of CCC's demand, Purchaser shall pay to CCC interest on such unpaid amount from its due date to the date of payment at a rate equal to two percent (2%) over the floating prime or base rate charged by Citibank, N.A. (New York, New York), as adjusted from time to time, per annum. All amounts payable by Purchaser in connection with this Agreement shall be payable at the office of CCC, at the address set forth in Section 9.5 hereinbelow.

6.5 Insurance. (a) Unless otherwise mutually agreed to in writing by the parties to this Agreement, until CCC has been paid in full for the Purchased Inventory, Purchaser, at its own expense, shall obtain, furnish from time to time to CCC true and complete copies of, and maintain with respect to each item of the Purchased Inventory ordered hereunder: (i) all risk physical loss insurance on such item of the Purchased Inventory for an amount at least equal to the purchase price set out on the applicable Sales Order; (ii) general and comprehensive public liability and property damage insurance in amounts of at least $1,000,000 for bodily injury per person, $1,000,000 for bodily injury per occurrence, and $1,000,000 for property damage per occurrence; and (iii) all other forms of insurance coverage required pursuant to applicable laws, rules and regulations with respect to the Purchased Inventory. CCC shall have no obligation to maintain insurance on the Purchased Inventory once Purchaser has acquired title thereto and risk of loss has passed to Purchaser pursuant to the terms of this Agreement.

(b) Such insurance shall be on terms and with companies reasonably acceptable to CCC, shall contain such endorsements as may be requested by CCC, shall be primary insurance up to and including the stated policy limits and shall include a waiver of subrogation in favor of CCC. Such insurance shall also (i) with respect to liability insurance, name CCC as an additional insured, and include the following coverages: premises/operations, independent contractors, broad form contractual in support of the indemnity sections of this Agreement, and personal injury liability; and (ii) with respect to all physical loss insurance, name CCC as loss payee and additional insured.

(c) All insurance required to be maintained by Purchaser hereunder shall provide that coverage may not be altered or cancelled by the insurer without at least thirty (30) days prior written notice to CCC. Such insurance shall not be invalidated, as against CCC, by any action or inaction of Purchaser or any person and shall insure CCC regardless of any breach or violation by Purchaser or any other person of any warranties, declarations or conditions contained in the policies evidencing such insurance. Purchaser hereby appoints CCC as Purchaser's attorney-in-fact to make claims for, receive payment of, and execute and endorse all documents, checks or drafts for loss or damages or return premium under any insurance policy issued on the Inventory as long as this Agreement remains in effect or any amounts due to CCC in connection with this Agreement remain outstanding, whichever is later.

ARTICLE VII
Independent Cleanup Operations

7.1 Independent Cleanup Operations. Nothing in this Agreement shall require or be construed as requiring Purchaser to solely purchase Inventory in connection with oil spill cleanup or containment activities from CCC, and Purchaser may, if it so desires, purchase or contract with CCC or with other parties for similar equipment or materials.

ARTICLE VIII

Indemnification

8.1 Indemnification. (a) Purchaser shall hold harmless and indemnify CCC, each current and future Member, and the agents, directors, officers and employees of each of them, (collectively, "Indemnified Parties") against all claims, obligations, losses, actions, suits, liabilities, damages (including, but not limited to, strict liabilities imposed upon an owner, operator or holder of any item of the Purchased Inventory), and costs incurred, including, but not limited to, attorneys' fees, expenses, penalties, fines (including penalties or other charges or costs imposed by any international, foreign, national, federal, state or local authority), which the Indemnified Parties suffer, sustain or become liable for by reason of any (i) breach of this Agreement by or on behalf of Purchaser, and/or (ii) accidents, damages or injuries, either to the person (including any employee or agent thereof) or property (including any equipment or material provided by a Member or CCC, and any natural resources) of the Indemnified Parties or to the person and/or property (including any natural resources) of any third party, including, but not limited to federal, state and foreign governments and agencies thereof, in any matter arising out of or connected with (A) oil spill cleanup or containment activities in which the Purchased Inventory is utilized or acquired hereunder and the furnishing of Purchased Inventory hereunder and to Purchaser, and/or (B) any act or omission of Purchaser, its agents, directors, officers and/or employees where such liability is asserted against any Indemnified Party. **THE FOREGOING INDEMNITY AND HOLD HARMLESS PROVISIONS BY PURCHASER SHALL BE APPLICABLE TO THE INDEMNIFIED PARTIES REGARDLESS OF WHETHER SUCH ACCIDENT, DAMAGES OR INJURIES ARE THE RESULT OF NEGLIGENCE (SOLE, GROSS OR OTHERWISE) OF AN INDEMNIFIED PARTY.** Purchaser further agrees that the parties to whom this indemnification and hold harmless provision extends shall have the right, but not the obligation, to tender the defense to Purchaser of any and all lawsuits arising out of or in any way connected with matters which are the subject of this indemnification and hold harmless provision, but that failure to tender any such lawsuit for defense shall in no way release or relieve Purchaser of its obligations hereunder. Purchaser also covenants and agrees that the indemnification and hold harmless provision granted hereunder shall not be limited, restricted or in any way affected by the amount of insurance carried by Purchaser or any Indemnified Party.

(b) Purchaser agrees that CCC and the Indemnified Parties shall not be liable to Purchaser for, and Purchaser hereby waives and releases any present or future claim in favor of Purchaser against any Indemnified Parties, on account of all costs, expenses, damages, claims, judgments or causes of action in any way connected with or relating to this Agreement and the Purchased Inventory including without limitation, the injury to or death of personnel of Purchaser or of any third person, the loss or damage to property of Purchaser or any third person, or the loss or use of any such property, which relates to or is attributable in whole or in part to any actions or inactions of any Indemnified Parties, regardless of the extent of Purchaser's exercise of the discretion and control over CCC's personnel or any other Indemnified Parties.

ARTICLE IX

Miscellaneous

9.1 Amendments. Except as set forth in Section 8.1this Agreement may not be amended, modified, supplemented or otherwise altered except pursuant to and in accordance with a written modification or agreement between CCC and Purchaser.

9.2 Governing Law. This Agreement shall be governed by and construed in accordance with the laws of the State of New York, U.S.A., excluding those laws which would transfer the interpretation of the Agreement to another jurisdiction.

9.3 Jurisdiction and Venue. The parties acknowledge that a substantial portion of negotiations and anticipated performance and execution of this Agreement occurred or shall occur in Broward County, Florida, and that, therefore, each of the parties irrevocably and unconditionally (a) agrees that any suit, action or legal proceeding arising out of or relating to this Agreement shall be brought in the courts of record of the State of Florida in Broward County or the court of the United States, Southern District of Florida; (b) consents to the jurisdiction of each such court in any suit, action or proceeding; (c) waives any objection which it may have to the laying of venue of any such suit, action or proceeding in any of such courts; and (d) agrees that service of any court paper may be effected on such party by mail, as provided in this Agreement, or in such other manner as may be provided under applicable laws or court rules in said state.

9.4 Enforcement Costs. If any legal action or other proceeding is brought for the enforcement of this Agreement, or because of an alleged dispute, breach, default or misrepresentation in connection with any provision of this Agreement, the successful or prevailing party or parties shall be entitled to recover reasonable attorneys' fees, sales and use taxes, court costs and all expenses even if not taxable as court costs (including, without limitation, all such fees, taxes, costs and expenses incident to arbitration, appellate, bankruptcy and post-judgment proceedings), incurred in that action or proceeding, in addition to any other relief to which such party or parties may be entitled. Attorneys' fees shall include, without limitation, paralegal fees, investigative fees, administrative costs, sales and use taxes and all other charges billed by the attorney to the prevailing party.

9.5 Notices. Except for initial oral notices relating to requests for Inventory in connection with Designated Spills, any notice provided for by this Agreement and any other notice, demand or communication which any party may wish to send to another shall be in writing and either delivered to such party in person, sent via a nationally recognized express mail service, sent via facsimile transmission with receipt confirmed or sent by first-class U.S. mail, postage prepaid, return receipt requested, and addressed to the party at such party's address as set forth below or, if to CCC:

Clean Caribbean Corporation
2361 Stirling Road
Fort Lauderdale, FL 33312
Attn: Paul Schuler, President

Phone: 954-983-9880
Fax: 954-987-3001

or to such other address as any party shall specify by written notice so given. Any notice, demand or other communication shall be deemed given and effective as of the date of delivery in person or by facsimile, the day after the date of deposit with a nationally-recognized express mail service, or upon receipt as set forth on the return receipt if sent through the U.S. mail. The inability to deliver because of changed address of which no notice was given, or the rejection or other refusal to accept any notice, demand or other communication shall be deemed to be the receipt of the notice, demand or other communication as of the date of such inability to deliver or the rejection or refusal to accept.

9.6 Severability. If any provision of this Agreement or portion thereof should be declared invalid for any reason, the invalid provision or portion thereof shall be deemed omitted and the remaining terms shall nevertheless be carried into effect. If any transfer of any interest or control of any Purchased Inventory contemplated hereunder would require the approval of any governmental authority in order to be lawful, obtaining such approval is a condition precedent to the effectiveness of any agreement to so transfer, and any actual such transfer.

9.7 Waiver. The waiver of a breach of any term or condition of this Agreement shall not be deemed to constitute the waiver of any other breach of the same or any other term or condition hereof.

9.8 Enforcement by Creditors. Neither the provisions requiring payments of costs nor any other provision of this Agreement shall be for the benefit of or enforceable by any creditor of Purchaser or of CCC.

9.9 Number and Gender. Whenever required by the context, the singular number shall include the plural, and the masculine or neuter gender shall include all genders.

9.10 Entire Agreement. This Agreement, together with all exhibits and addenda hereto, contains the entire understanding between the parties and supersedes any prior written or oral agreements between them respecting the subject matter contained herein. This Agreement can only be altered, changed or amended by written Addendum, attached hereto and executed by the duly authorized representatives of both parties.

9.11 Assignment; Binding Effect. Purchaser may not assign its rights and obligations under this Agreement. Subject to and without affecting the prohibitions herein with respect to assignment, this Agreement shall be binding on the parties and their respective successors and assigns.

9.12 Counterparts. This Agreement may be executed in any number of counterparts, each of which when so executed shall be deemed to be an original, and such counterparts together shall constitute and be one and the same instrument.

9.13 Survival. All covenants, agreements, representations and warranties made herein or otherwise made in writing by any party pursuant hereto shall survive the execution and delivery of this Agreement and the consummation of the transactions contemplated hereby. Without limiting the generality of the foregoing, the provisions of Sections 3.2, 3.4, 3.6, 4.1, 5.1, 5.2, 5.3, 6.1, 6.2, 6.3, 6.4, 6.5, 8.1 and Article IX shall survive the expiration and/or termination of the term of this Agreement.

9.14 Further Assurances. The parties hereby agree from time to time to execute and deliver such further and other transfers, assignments and documents and do all matters and things which may be convenient or necessary to more effectively and completely carry out the intentions of this Agreement.

9.15 Relationship of Parties. The parties acknowledge that Purchaser is not and shall not be considered an agent or Member of CCC as a result of the execution or performance of the parties of this Agreement, and that this Agreement shall not be construed, expressly or by implication, as creating a partnership, joint venture, agency or other similar relationship between CCC and Purchaser or any other parties.

IN WITNESS WHEREOF, the parties have executed this Sale Agreement as of the date first above written, to remain effective for the Term, as specified herein.

CCC:

CLEAN CARIBBEAN CORPORATION

By: Paul A. Schuler
Name: Paul A. Schuler
Title: President

Tax ID: 65-0270063

Resale Certificate No:
16-03-246150-58

Purchaser:

PETROLEO BRASILEIRO S.A.

By:
Name: [illegible]
Title: [illegible]

Address: AV. CHILE 65 S 602
RIO DE JANEIRO - RJ - BRASIL
Phone: (55 21) 534-3401
Fax: (55 21) 534-1846
Telex:

TRANSFER OF TITLE AND RISK OF LOSS ADDENDUM

This Addendum made and effective as of June 1, 2001, by and between PETROLEO BRASILEIRO S.A., a Brasil corporation ("Purchaser") and CLEAN CARIBBEAN CORPORATION, a Texas nonprofit corporation ("CCC").

This is an Addendum to that certain Sale Agreement by and between Purchaser and CCC dated and effective as of June 1, 2001 (the "Sale Agreement").

1. The last sentence of Section 3.1(a) of the Sale Agreement is hereby deleted and there is inserted in lieu thereof the following:

> "Purchaser shall be deemed to have acquired legal title to the Purchased Inventory and shall assume and bear the entire risk of a loss, theft, destruction of or damage to the Purchased Inventory, whether or not insured, from any cause whatsoever, at a point one (1) mile outside of the United States' territorial limit in or above international waters (the "Delivery Location"); and no such event of loss, theft, destruction of or damage to the Purchased Inventory shall relieve Purchaser of any of its obligations hereunder. Upon direction of Purchaser, CCC will deliver the Purchased Inventory ordered by Purchaser to a licensed exporter or carrier for export outside of the United States of America from the nearest available airport or seaport and shall provide CCC with a shipper's export declaration. Purchaser shall be responsible for making all on-going transportation arrangements, at its expense, for the transportation of such inventory from and beyond such ports. Any and all costs resulting from the deployment of the Purchased Inventory, including, but not limited to, additional insurance coverage, transportation, freight and forwarding costs and any fees and taxes related to the deployment or mobilization of Purchased Inventory, are to be borne by Purchaser."

2. As amended hereby, the Sale Agreement shall remain in full force and effect in accordance with its terms.

IN WITNESS WHEREOF, the parties have executed this Transfer of Title and Risk of Loss Addendum to the Sale Agreement as of the date first above written.

CCC:

CLEAN CARIBBEAN CORPORATION

By: Paul A. Schulz
Name: Paul A. Schulz
Title: President

Tax ID: 65-0270083

Resale Certificate No:
16-03-246150-58

Purchaser:

PETROLEO BRASILEIRO S.A.

By:
Name: [illegible]
Title: [illegible]

Address: [illegible]
[illegible]

Phone: [illegible]
Fax: [illegible]

WAIVER OF FUNDS GUARANTEE ADDENDUM

This Addendum made and effective as of June 1, 2001, by and between PETROLEO BRASILEIRO S.A., a Brasil corporation ("Purchaser") and CLEAN CARIBBEAN CORPORATION, a Texas nonprofit corporation ("CCC").

This is an Addendum to that certain Sale Agreement by and between Purchaser and CCC dated and effective as of June 1, 2001 (the "Sale Agreement").

1. The Security required by Section 3.2 of the Sale Agreement has been previously provided to the satisfaction of the CCC, and Purchaser has thereby complied with all provisions of such Section. No further "Guarantee" shall be required by CCC from Purchaser in connection with any sale consummated under this Sale Agreement.

2. As amended hereby, the Sale Agreement shall remain in full force and effect in accordance with its terms.

IN WITNESS WHEREOF, the parties have executed this Waiver of Funds Guarantee Addendum to the Sale Agreement as of the date first above written.

CCC:

CLEAN CARIBBEAN CORPORATION

By: Paul G. Schaub
Name: Paul A. Schaub
Title: President

Tax ID: 65-0270063

Resale Certificate No:
16-03-246150-58

Purchaser:

PETROLEO BRASILEIRO S.A.

By: _____
Name: [illegible]
Title: [illegible]

Address: [illegible]

Phone: [illegible]
Fax: [illegible]
Telex: _____

SELF INSURANCE ADDENDUM

This Addendum made and effective as of June 1, 2001, by and between PETROLEO BRASILEIRO S.A., a Brasil corporation ("Purchaser") and CLEAN CARIBBEAN CORPORATION, a Texas nonprofit corporation ("CCC").

This is an Addendum to that certain Sale Agreement by and between Purchaser and CCC dated and effective as of June 1, 2001 (the "Sale Agreement").

1. Notwithstanding Section 6.5(a), Purchaser may meet its obligations thereunder by means of self-insurance. Accordingly, Sections 6.5 (b) and (c) are hereby deleted.

2. As amended hereby, the Sale Agreement shall remain in full force and effect in accordance with its terms.

IN WITNESS WHEREOF, the parties have executed this Self Insurance Addendum to the Sale Agreement as of the date first above written.

CCC:

CLEAN CARIBBEAN CORPORATION

By: Paul A. Schauer
Name: Paul A. Schauer
Title: President

Tax ID: 65-0270063

Resale Certificate No:
16-03-246150-58

Purchaser:

PETROLEO BRASILEIRO S.A.

By:
Name:
Title:

Address:
Phone:
Fax:
Telex:

Attachment R9.8, Continued

Clean Caribbean & Americas Report of Volumes and Declared Affiliates

Please submit by May 1, 2007 to:

Clean Caribbean & Americas
Fax Number: (954) 987-3001
E-Mail: psaldon@cleancaribbean.org

PETRÓLEO BRASILEIRO S/A - PETROBRAS
Member Company

VOLUMES - In accordance with Article VIII, paragraph 8.1 and Attachment C.1.d of the CCA Bylaws, our **volumes for the calendar year ending Dec. 31, 2006** (for the Member Company and all Declared Affiliates) are hereby reported as follows:

I.	Titled Volumes	500.000.000	Barrels
II.	Shipping Volumes	500.000.000	Barrels
III.	Facility Related Volumes	500.000.000	Barrels
TOTAL VOLUMES REPORTED		**500.000.000**	**Barrels**

(To be used for 2006 Membership and Cash Call Percentages)

DECLARED AFFILIATES - In accordance with Article 1 and Attachment C.4 of the CCA Bylaws, our Declared Affiliates are hereby reported as follows:

(Check the appropriate box)

☐ We have No Declared Affiliates

☒ We designate the below named entities as Declared Affiliates to be included under our CCA membership, and hereby affirm that all oil volumes attributable to each Declared Affiliate have been accounted for in the volumes reported above. (List each Declared Affiliate. Attach additional pages if needed.)

Declared Affiliates:

1- Petrobras America Inc.
10777 Westheimer Road , Suite 1200, Houston, Texas, 77042
Phone: +1 713 808 2000
Fax: +1 713 808 2007
Contacts:
Alberto Guimarães – President
Sergio Baron – Commercial Department Manager
João Carlos Barros - Commercial Department
Renato Goulart - Commercial Department
José Antonio Pinheiro Pires – Development and Production Department Manager
Dalmo Barros - Development and Production Department
Teofanes Elias – QHSE Department Manager

Attachment R9.8, Continued

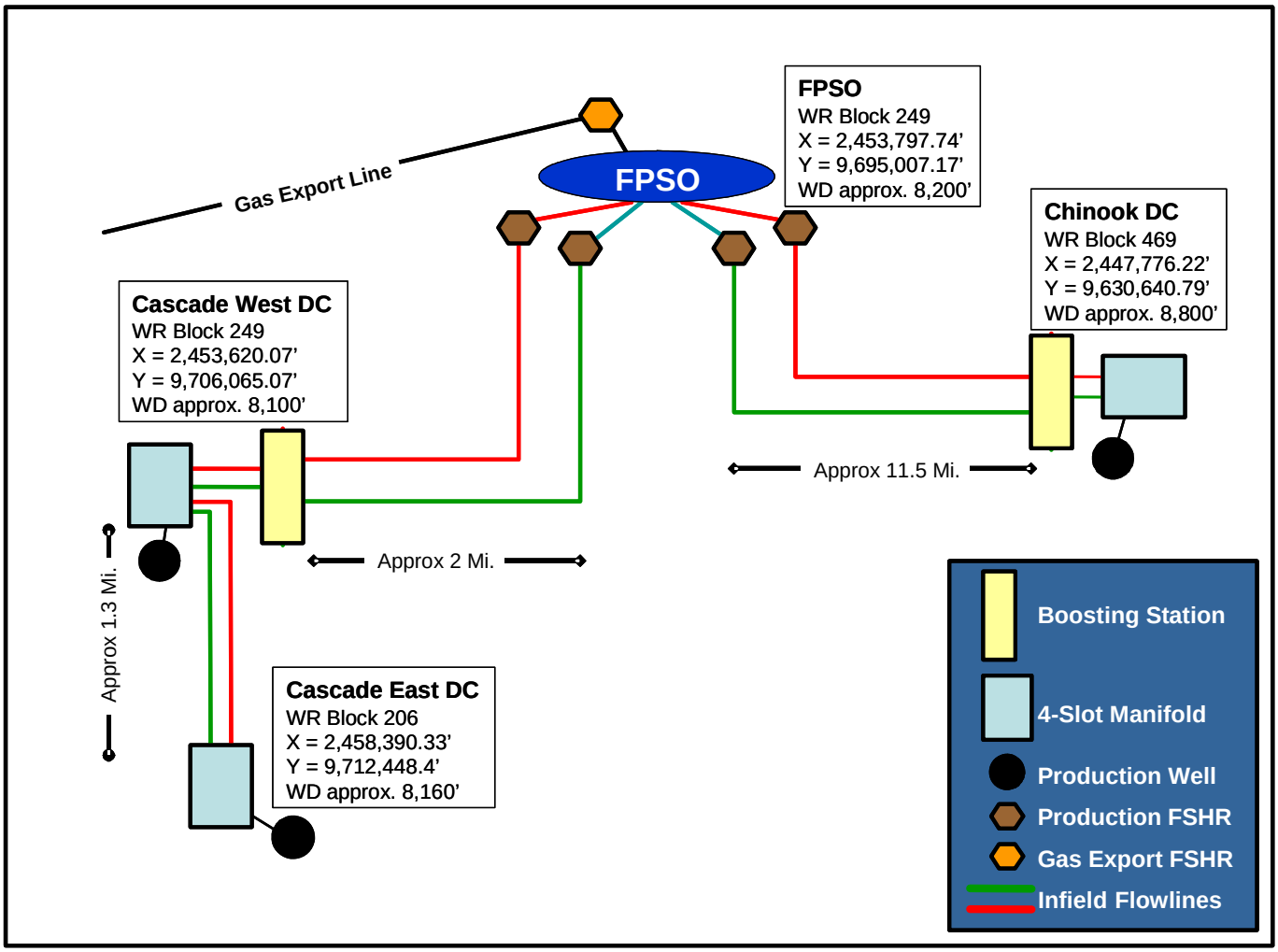
Thea Vieira - QHSE Department

2- Petrobras International Finance Company - PIFCO
4th Floor Harbour Place
103 South Church Street
Georgetown – Grand Cayman
Phone: +1 713 808 2000
Fax: +1 713 808 2007
Contacts: Same as Petrobras America Inc.

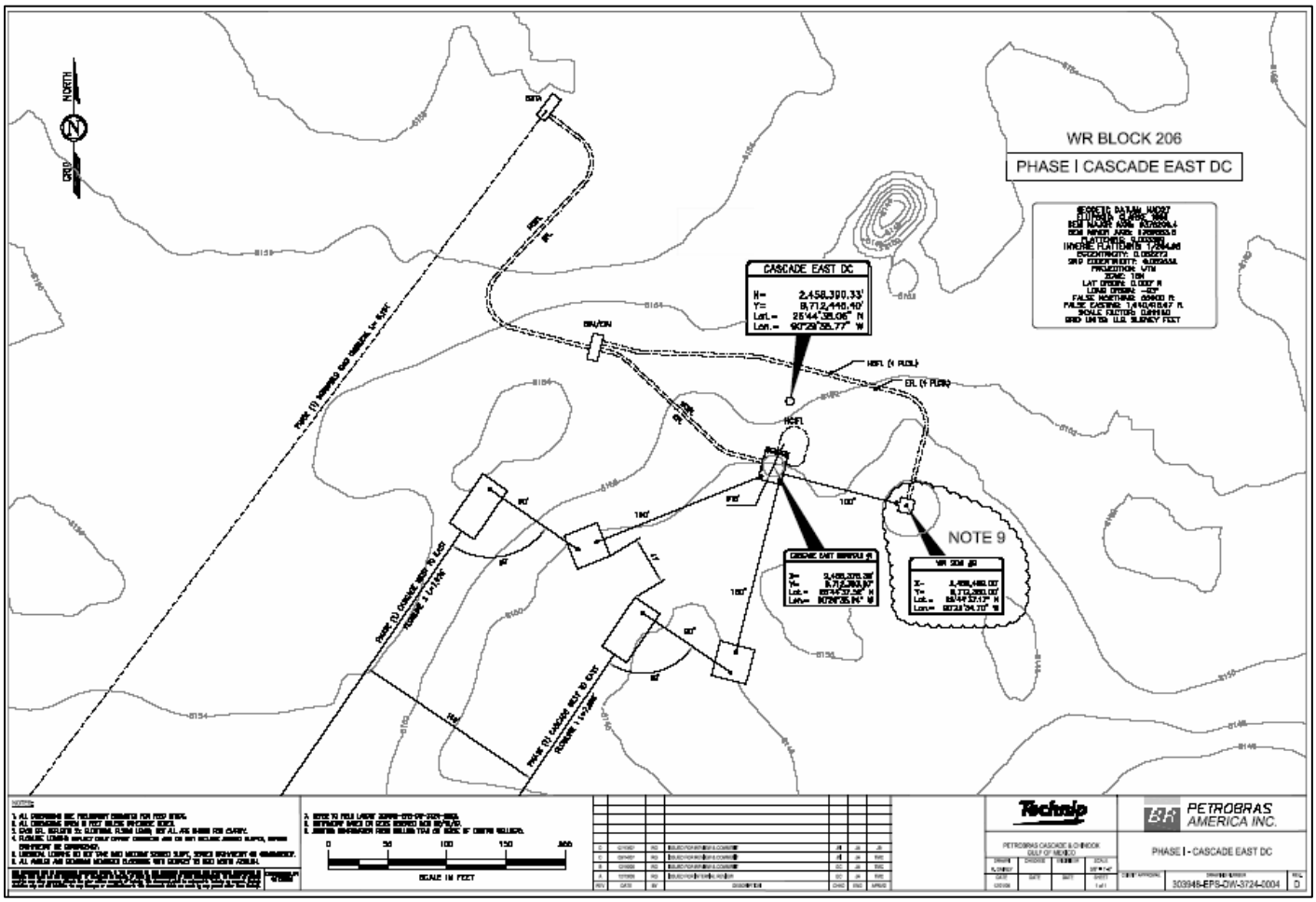
Signature:

Printed Name: Jayme de Seta Filho Date: Feb, 15. 2007

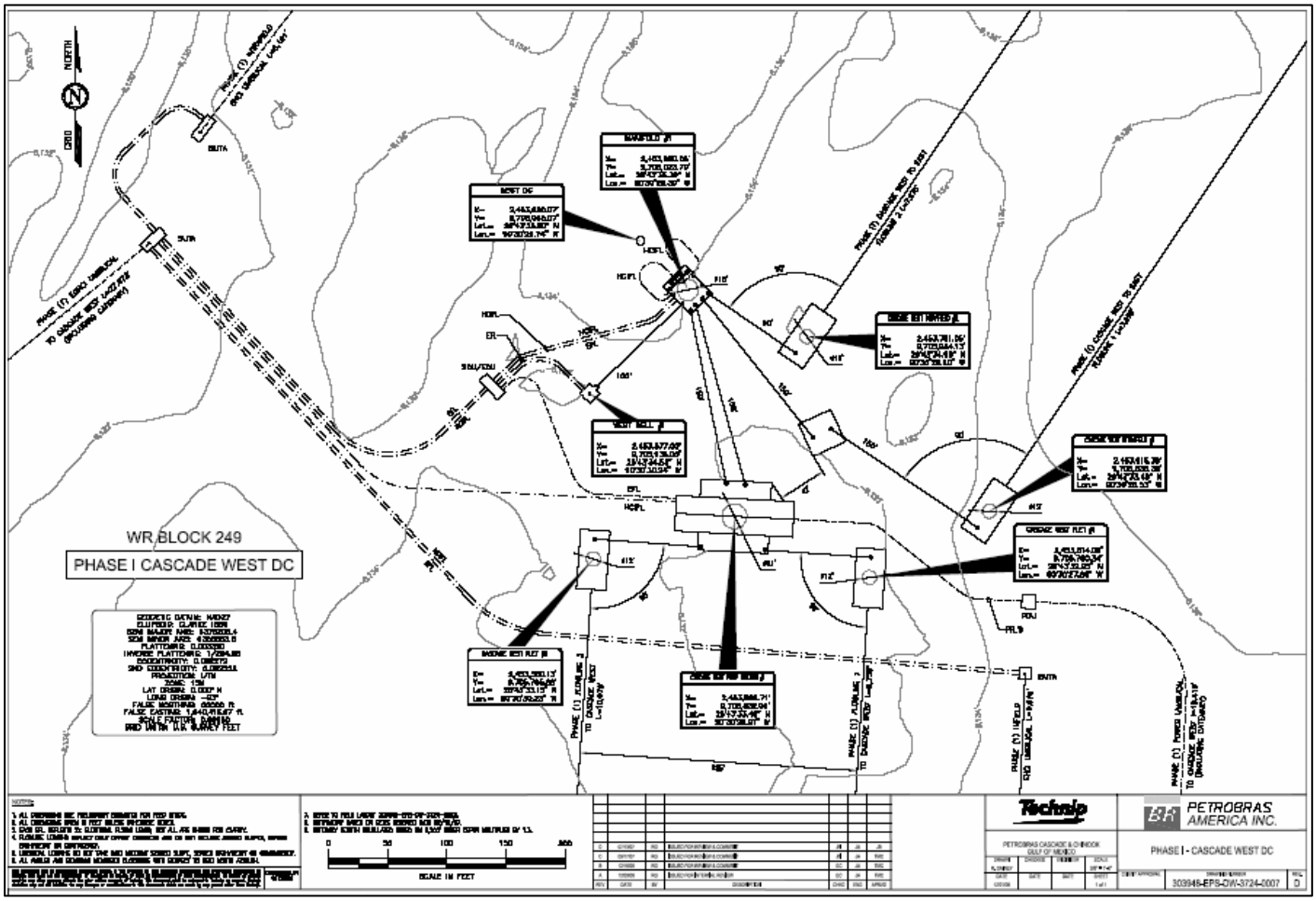
Attachment R14.1



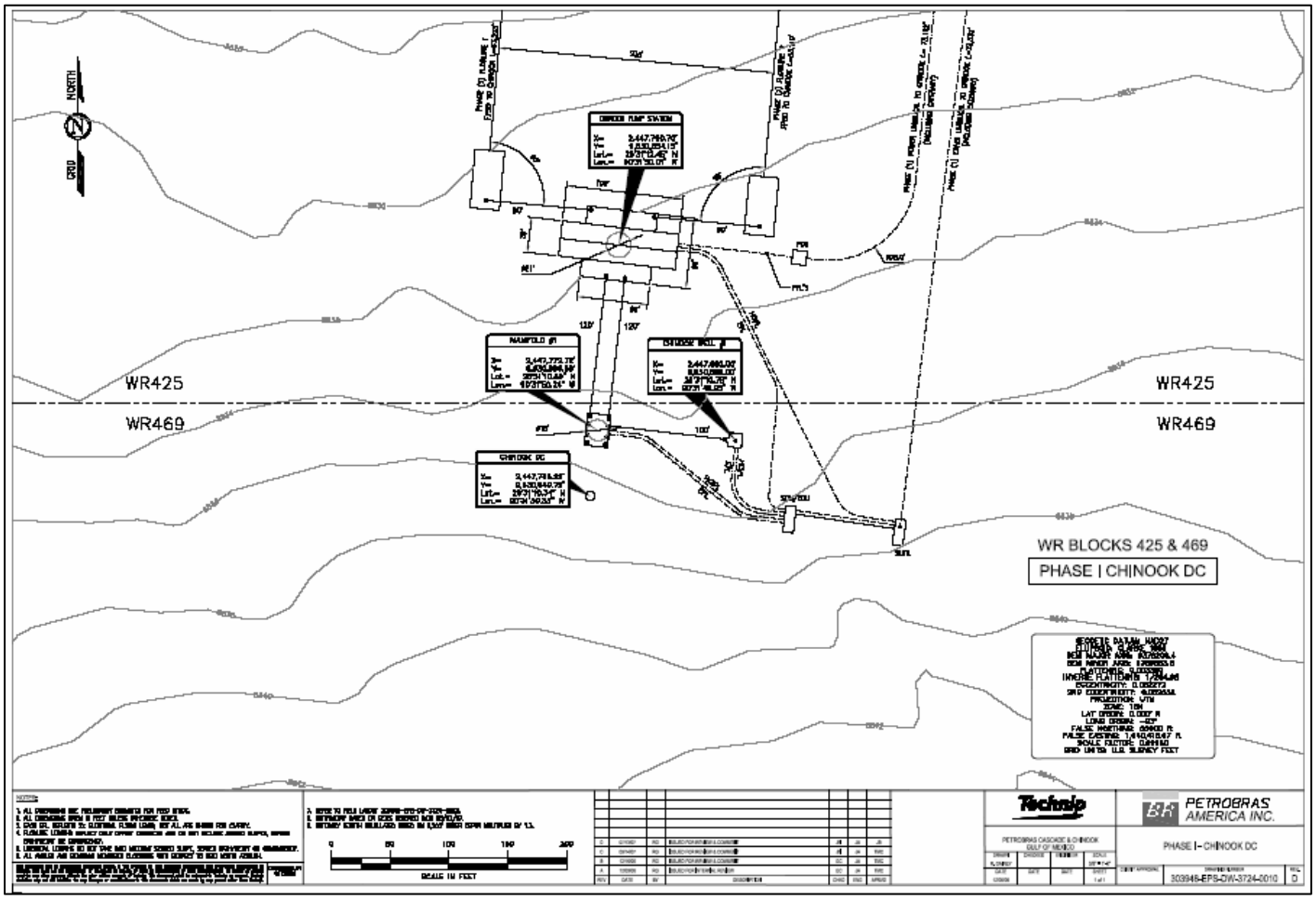
Attachment R14.2



Attachment R14.3



Attachment R14.4



Attachment R16.1

PAI clarifies that all wastes to be disposed of onshore will be disposed of at permitted waste facilities. PAI clarifies that existing onshore waste facilities will be utilized and that no expansions or modifications will be required to accommodate the needs of Phase 1 of the development plan. Physical locations of onshore waste facilities have been added to Tables 16-2 and 16-3. Physical locations of onshore waste facilities to be used in associated with the Shuttle Vessel are not currently known as PAI has not yet determined which terminals will be utilized.

Table 16-2 – Disposal of Solid and Liquid Wastes (Drilling and Completion Operations)

Name of Facility	Location of Facility	Type of Waste	Amount	Rate	Disposal Method
US Liquids or Newpark Services or CCS Waste	Fourchon, Louisiana Fourchon, Louisiana Golden Meadow, Louisiana	Synthetic drilling based fluids	2,250 barrels	750 barrels per well	Recycled
Solid Waste Disposal or Galliano Waste	Fourchon, Louisiana Galliano, Louisiana	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
L & L	Golden Meadow, Louisiana	Waste oil	1-3 barrels per month	0-1 barrels per week	Recycled

Table 16-3 - Disposal of Solid and Liquid Wastes (FPSO Production Operations)

Name of Facility	Location of Facility	Type of Waste	Amount	Rate	Disposal Method
US Liquids or Newpark Services or CCS Waste	Fourchon, Louisiana Fourchon, Louisiana Golden Meadow, Louisiana	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
L & L	Golden Meadow, Louisiana	Waste oil	10 barrels per month	2-3 barrels per week	Recycled

Table 16-4 - Disposal of Solid and Liquid Wastes (Shuttle Vessel Operations)

Name of Facility	Location of Facility	Type of Waste	Amount	Rate	Disposal Method
To Be Determined (1)	To Be Determined (1)	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
To Be Determined (1)	To Be Determined (1)	Waste oil	1 barrels per month	0-1 barrels per week	Recycled

(1) Existing facilities located near terminals of choice in Texas, Louisiana, Mississippi, or Alabama

Attachment R19.1

Marine Mammals

Air breathing animals such as sea turtles and marine mammals are vulnerable to ship strikes because they must surface to breath and while basking, mating, and resting.

Marine mammals are known to have been injured or killed from collisions with the hulls and propellers of both large and small vessels but there is insufficient evidence to determine how frequently this may happen. Estimates of serious injury due to ship strikes are considered to be underestimated because the whale may be impacted far offshore and its fate not known unless there is a direct sighting or a stranding that indicates impact from a ship.

The only cetacean species that is known to be significantly impacted from ship strikes is the right whale (*Eubalaena glacialis*), which is typically found along the East coast of the U.S. It is believed that the mortality and injury to right whales due to ship strikes in U.S. waters is 0.8 whales per year (Waring *et al.* 2007). Right whales seem particularly susceptible to vessel collisions since they swim slowly, spend considerable time at the surface, and apparently take little or no evasive action when ships approach (Swingle *et al.* 2006).

It believed that humpback whales (*Megaptera novaeangliae*) may also be impacted more significantly by ship strikes than is reported (Wiley *et al*. 1995). Between 1985 and 1992, approximately 30% (6 of 20) of humpback whales stranded along the U.S. Atlantic coast (most near Chesapeake Bay) had injuries caused by ships. However, neither the right whale nor the humpback whale is likely to occur in the GoM. Sightings of these species are considered rare and of accidental occurrence (refer to Table 19-3).

There have been 292 confirmed or possible ship strikes on large whales worldwide from 1975 to 2002 (Jensen and Silber 2003). Records indicate that collisions between vessels and whales in U.S. waters are most common along the east coast, followed by the west coast and Alaska/Hawaii. Collisions were least common in the GoM (Jensen and Silber 2003). Between 1975 and 1996, there have been 31 dead whale strandings involving four species along the U.S. GoM coast from Texas to Monroe County, Florida. These included 2 sei whales, 4 Minke whales, 8 Bryde's whales, and 17 sperm whales (Laist 2001). Only one stranding, a sperm whale found in Louisiana in 1990, was identified as a possible ship strike. The report noted that their search of databases worldwide included evidence of at least two other species struck by ships in the GoM. One was a northern right whale calf that was found dead in Texas in 1972 and the other was a live humpback whale seen swimming off Naples, Florida in 1994 that had fresh propeller wounds.

Sea Turtles

The direct and indirect effects of boating activity on sea turtle populations are largely unknown. Despite the specialized capability of marine turtles to hear low frequency sounds, the time available between a turtle detecting an oncoming boat and diving to escape being struck by the hull or propeller may not be sufficient. This problem may be exacerbated if the turtle is in shallow water and unable to dive deep enough to avoid collision with an oncoming boat motor. Boat propeller strikes may result in lacerations, fractures, paralysis, buoyancy problems, breathing difficulties, and mortality.

For turtles in coastal waters, the most significant human associated source of mortality is incidental capture in shrimp trawls, which accounts for more deaths than all other human related causes combined (National Research Council 1990). Mortality from shrimping is estimated to kill between 5,000-50,000 loggerheads and 500-5,000 Kemp's ridleys each year. Collectively, other trawl fisheries; fisheries that use passive gear, such as traps, gill nets, and long lines; and entanglement in lost or discarded fishing gear and debris are responsible for an additional 500-5,000 loggerhead deaths and 50-500 Kemp's ridley deaths a year (National Research Council 1990). It is estimated that a maximum of 400 turtles per year are killed by collisions offshore (National Research Council 1990).

An estimate of the number of boat collisions with turtles can be derived from injuries seen on turtles that strand themselves. One study analyzed sea turtles that had been entrained in the intake canal at the St. Lucie Nuclear Power Plant (SLNPP) located on Hutchinson Island, a barrier island offshore St. Lucie County on the east coast of Florida (Noren 2005). Since 1976, an estimated 10,500 sea turtles, including those captured multiple times, have become entrained in the facility. Although five species (*Coretta caretta*, *Coretta mydas*, *Dermochelys coriacea*, *Eretmochelys imbricata*, and *Lepidochelys kempii*) have been captured, the most common were small juvenile green turtles and large juvenile and adult loggerhead turtles (Noren 2005).

Signs of injuries on turtles were quantified and statistically compared from the study period of May 2000 through July 2005. There was a significant age-related difference, with a total of 4.6% (n=16) of the 351 adults, 3.5% (n=13) of the 371 transitional-stage turtles, and only 1.06% (n=20) of the 1881 juveniles that were found with boat propeller strikes (Noren 2005).

Impacts

PAI will likely utilize one Shuttle Vessel to perform one offloading every two weeks in the first year of production operations (i.e. during production ramp-up). PAI will likely utilize two Shuttle Vessels (on a staggered schedule) to perform one offloading every week in subsequent years of production operations for Phase 1 of the development plan. The frequency of offloading will evolve over time as the frequency is driven by the size / speed / number of the Shuttle Vessels relative to the production profile of the reservoirs.

A number of Support Vessels will also be used over the life of Phase 1, which will vary depending on the drilling and completion or production activities. Refer to Section 15 of the DOCD for specific details.

It is expected that impacts to sea turtles and cetaceans due to collisions from marine vessels associated with the Cascade / Chinook Development Project would be rare events. The magnitude of marine vessel use supporting construction, drilling, and production operations for the project is consistent with that of other deepwater developments in the GoM. The incremental marine vessel utilization for the project relative to other deepwater developments in the GoM is associated with the use of Shuttle Vessels (in lieu of an oil transportation pipeline) and a dedicated field vessel to support FPSO offloading to Shuttle Vessels. Given the overall volume of marine vessel traffic in the GoM, marine vessels utilized for the project should not represent a significant increase in the risk associated with impacts to sea turtles and marine mammals.

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Attachment R19.2

Protected Fish Species

The gulf sturgeon (*Acipenser oxyrinchus desotoi*) is listed as threatened in the GoM. The sturgeon is anadromous, inhabiting coastal rivers from Louisiana to Florida during the warmer months and overwintering in estuaries, bays, and the GoM (United States Fish and Wildlife Service [USFWS] 1995). The sturgeon is primarily threatened by habitat loss and the damming of rivers, but also by modifications to habitat associated with dredged material disposal, de-snagging (removal of trees and their roots), and other navigation maintenance activities; incidental take by commercial fishermen; poor water quality associated with contamination by pesticides, heavy metals, and industrial contaminants; aquaculture and incidental or accidental introductions; and the gulf sturgeon's slow growth and late maturation.

The gulf sturgeon currently ranges from Lake Pontchartrain and the Pearl River (in the Louisiana and Mississippi river systems) to the Suwannee River in Florida. It inhabits coastal waters up to 2 miles offshore, and can be found up to 10 miles offshore only near the Suwannee River where the Continental Shelf is shallow.

In March 2003, fourteen areas were designated along rivers and tributaries of the GoM as critical habitat necessary for spawning, resting, migration, and feeding of gulf sturgeon. Within Louisiana, Mississippi, and Alabama, the units include Borgne Lake, Little Lake, Lake Pontchartrain, Lake St. Catherine, the Rigolets, Mississippi Sound, and Mississippi nearshore Gulf (NOAA 2003). The Endangered Species Act (ESA) requires consultation for any action that may jeopardize the existence of the gulf sturgeon or that may destroy or adversely modify its critical habitat. "Adverse modification" of critical habitat is considered to be any direct or indirect alteration that appreciably diminishes the value of critical habitat for conservation of a listed species.

Boats and other vessels may also impact the gulf sturgeon. The most common instances involve sturgeon jumping out of the water and colliding with boats. Jumping typically occurs in shallow water where the concentration of sturgeon is relatively high but its exact causes are unknown. Such incidents have only been recorded by the Florida Fish and Wildlife Commission in the Suwannee River and have not been observed on the coast or in deeper waters.

Impacts

An oil spill from a Shuttle Vessel close to shore could affect sturgeon habitat but this risk is considered low given the safety and pollution prevention controls described in 1(e) and 1(f). In general, the use of Shuttle Vessels (in lieu of an oil transportation pipeline) to transport produced oil from the FPSO to terminals along the GoM coast does not provide any incremental oil spill exposure at terminals or otherwise near shore. The rationale is that the terminals are generally operating at full capacity; if a Shuttle Vessel associated with the Phase 1 development plan would not transport oil to a terminal that has available capacity, the available capacity will likely be filled by a "traditional" tanker loaded with oil from another source (US or foreign). There is an estimated 2% probability that an oil spill at the site of the FPSO would impact the shoreline of Louisiana within 30 days of the release (Ji *et al*. 2007; refer to Section 9 of the DOCD for more information regarding oil spill response and the potential worst case discharges.)

The gulf sturgeon is not known to migrate into deeper waters of the GoM, and is not known to occur in or near the Cascade / Chinook site. As the Cascade / Chinook blocks and associated offshore vessel traffic are not near areas where gulf sturgeon collisions have occurred or are expected to occur, the risk of such collisions is considered to be very low. The risk of gulf sturgeon collisions caused by Shuttle Vessel traffic near the coast of Alabama and Mississippi (if terminals in such areas would be utilized from time to time) is also expected to be very low.

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Attachment R19.3

Barrier Islands

The beaches along the northern Gulf coast are typically of the barrier island and barrier beach type. These beaches all occur in conjunction with various other habitats, including tidal flats, bays, sounds, and lagoons (Mitsch and Gosselink 1993).

The formation of barrier islands is complex and not completely understood. The current theory is the GoM barrier islands were formed about 18,000 years ago when the last Ice Age ended. As the glaciers melted and receded, the sea levels began to rise and flooded areas behind the beach ridges. The rising waters carried sediments from those beach ridges and deposited them along shallow areas just off the new coastlines. Waves and currents continued to bring in sediments that built up, forming the barrier islands. These barrier islands are long, narrow, and parallel to the coastline. In addition, rivers washed sediments from the mainland that settled behind the islands and helped build them up (Carter 1991). Within the resource area, barrier islands form in chains along the low lying sandy coasts, separated by tidal inlets, located just offshore from the mainland (Scott 1992).

Predominant currents occurring in the northern GoM are greatly affecting coastal beaches. These currents typically run from east to west along the Northern Gulf. The direction causes the beaches to migrate westward. The predominant current erodes beach material from the eastern point of the beach and, over time, deposits that material along the western point, thus migrating the beach westward. Many beaches within the region have implemented engineering controls to slow this westward progress; however, dredging of tidal inlets continues to adversely affect beach material migration across tidal channels (Scott 1992).

Barrier islands in Alabama and Mississippi get most of their sand from the adjacent Continental Shelf but Texas islands are nurtured by rivers such as the Rio Grande and the Brazos, which supply sand directly to the shoreline during every flood. If the sand supply is stopped by dams, the beaches will “starve” and retreat more rapidly (Canis *et al*. 1985). The Mississippi-Alabama barrier islands are also undergoing rapid land loss due to loss of sand in the alongshore sediment transport system (Morton 2007). Overall, barrier island chains from Mobile Bay, Alabama to Atchafalya Bay, Louisiana are disintegrating rapidly as a result of combined physical processes involving sediment availability, sediment transport, and sea level (Morton 2007).

Primary threats to barrier islands include dredging, erosion, and damage from construction. The islands of the northern Gulf provide habitat for a variety of plants and animals, including economically valuable species, such as sport fish. They also aid in coastal stabilization, shelter coastal communities from storms, and are a recreational destination for tourists and residents.

Impacts

An oil spill from a Shuttle Vessel close to shore could have a significant impact on barrier islands but this risk is considered low given the safety and pollution prevention controls described in 1(e) and 1(f). In general, the use of Shuttle Vessels (in lieu of an oil transportation pipeline) to transport produced oil from the FPSO to terminals along the GoM coast does not provide any incremental oil spill exposure at terminals or otherwise near shore. The rationale is that the terminals are generally operating at full capacity; if a Shuttle Vessel associated with the Phase 1 development plan would not transport oil to a terminal that has available capacity, the available capacity will likely be filled by a “traditional” tanker loaded with oil from another source (US or foreign).

Of the total potential FPSO-unique spills, it is estimated that if a spill were to occur, approximately 94% of the volume would likely occur during oil transfers from the FPSO to the Shuttle Vessel and from the Shuttle Vessel's transit to shore. The MMS Oil Spill Response Risk Analysis Model (OSRAM) identified a 2% probability of impact to the shorelines of Galveston County, Texas; and/or Cameron Parish, Louisiana within 30 days (Ji *et al*. 2007; refer to Section 9 of the DOCD for more information regarding oil spill response and the potential worst case discharges.) A spill offshore near the FPSO is not likely to significantly impact barrier islands due to the distance from shore, weathering, and the cleanup efforts that would occur.

If a spill were to go unabated, shoreline impact in coastal environments would depend upon existing environmental conditions. Onshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom in vegetated areas. Strategies for oil spill response would be based upon surveillance and real time trajectories that depict areas of potential impact given actual sea and weather conditions. Strategies from the One Plan Gulf of Mexico Area Contingency Plan (ACP) and Unified Command would be consulted to ensure that environmental and special economic resources would be correctly identified and prioritized to ensure optimal protection. ACPs depict the protection response modes applicable for oil spill cleanup operations. Each response mode is schematically represented to show optimum deployment and operation of the equipment in areas of environmental concern. Supervisory personnel have the option to modify the deployment and operation of equipment allowing a more effective response to site specific circumstances.

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Attachment R19.4

PAI clarifies the following paragraph which is included in Appendix 2(b) - Summary of Environmental Considerations for Cascade and Chinook.

"The (Gas Export Pipeline routing option #2) route is planned to cross the Sigsbee Escarpment. It is difficult to distinguish, in the side-scan data areas of potential chemosynthetic communities from outcrops of older, firmer strata as both will display a darker texture in the mosaic. Previous ROV studies, in other areas, have observed very local, small, dense chemosynthetic communities on the steep slopes of the Escarpment. When necessary to place subsea architecture on the Escarpment, operators in the past have selected to perform site specific ROV investigations to confirm the sites are clear. PAI will perform an ROV survey of the areas if this routing option is chosen."

For clarity, PAI has verified with GEMS that no evidence of chemosynthetic communities has been identified on the Sigsbee Escarpment in the development areas of Cascade and Chinook. However, GEMS has suggested that PAI perform an ROV survey of the area in question to confirm that no chemosynthetic communities exist. GEMS has indicated that the rationale for suggesting an ROV survey is due to 1) the technical limitations of side-scan sonar when utilized near the firm strata of the Sigsbee Escarpment and 2.) the fact that other operators have identified chemosynthetic communities on the Sigsbee Escarpment in other development areas. PAI will perform an ROV survey will be performed if Gas Export Pipeline routing option #2 is chosen.

See Attachment R1.4 for additional information regarding PAI's decision to alter the preliminary anchor locations of the MODU anchor patterns for the Cascade East and West drill centers due to the potential for chemosynthetic communities on the Sigsbee Escarpment.

PETROBRAS AMERICA INC.

1 June 2007

U.S. Department of the Interior
Minerals Management Service
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

Attention: Ms. Elizabeth Peuler – Chief, Plans Unit (MS 5231)

RE: Initial Development Operations Coordination Document for Walker Ridge Block 206 Unit and Walker Ridge Block 425 Unit, OCS Federal Waters, Gulf of Mexico, Offshore, Louisiana

Ladies and Gentlemen:

In accordance with the provisions of Titles 30 CFR 250.203 and 30 CFR 250.103 and those certain Notice to Lessees (NTL's 2006-G14 and 2007-G11), Petrobras America Inc. (PAI) hereby submits for your review and approval an Initial Development Operations Coordination Document (Plan) for Walker Ridge Block 206 Unit (Unit No. 754306012) and Walker Ridge Block 425 Unit (Unit No. 754306013), Offshore, Louisiana. The unit/lease descriptions are specified within the plan. Excluded from the Public Information copies are certain geologic and geophysical discussions and attachments.

Enclosed are two Proprietary Information copies (one hard copy and one CD) and three Public Information copies (one hard copy and two CD's) of the Plan.

Included in the original proprietary copy of this Plan is the Pay.Gov receipt in the amount of $11,250.00 for the cost recovery fee in accordance with Notice to Lessees (NTL 2006-N05).

Contingent upon receiving regulatory approvals and based on equipment and personnel availability, PAI anticipates operations under this Plan commencing no sooner than 15 July 2008.

Should additional information be required, please contact the undersigned, or our regulatory administrator, Gregory D. Roland at 713.808.2881 or groland@petrobras-usa.com.

Sincerely,

Petrobras America Inc.

Cheryl Ann Saha
Attorney-in-Fact

CAS:gdr
Attachments

10777 Westheimer Road · Suite 1200 · Houston, Texas 77042 · Tel (713) 808-2000 · Fax (713) 808-2004

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Public Version

Development Operations Coordination Document

for the

Cascade / Chinook Development Project

June 8, 2007

Submitted by:

PETROBRAS AMERICA INC.

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Acronyms and Abbreviations

2-D	two dimensional
3-D	three dimensional
ABS	American Bureau of Shipping
ACAMP	Alabama Coastal Area Management Program
ACP	Area Contingency Plan
ADCP	acoustic doppler current profiler
APD	Application to Drill
API	American Petroleum Institute
ATB	articulated tug barge
BHP	BHP Billiton
BLS	bow loading system
BNWA	Breton National Wilderness Area
BOP	blowout preventer
CCA	Clean Air Act
CCA	Clean Caribbean & Americas
CCTV	closed circuit television
CFR	Code of Federal Regulations
CGA	Clean Gulf Associates
CID	Confirmation Information Document
CITES	Convention on International Trade in Endangered Species
CMD	Coastal Management Division
CMI	Coastal Marine Institute
COC	Certificate of Compliance
COE	Core of Engineers
COI	Certificate of Inspection
CPP	controllable pitch propeller
CS	classification society
CSA	Continental Shelf Associates
CVA	certified verification agent
CWA	Clean Water Act
CZMA	Coastal Zone Management Act of 1972
DC	drilling center
Devon	Devon Energy Production Company, L.P.
DGPS	digital geographic positioning system

DO	dissolved oxygen
DOCD	Development Operations Coordination Document
DOD	Department of Defense
DP	dynamically positioned
DWOP	Deepwater Operations Plan
EA	environmental assessment
EEZ	Exclusive Economic Zone
EFH	essential fish habitat
EIA	environmental impact analysis
EIS	environmental impact statement
EP	Exploration Plan
EPA	Environmental Protection Agency
ESA	Endangered Species Act of 1973
FAA	Federal Aviation Administration
FMP	Fishery Management Plan
FPSO	floating, production, storage and offloading (vessel)
FPU	floating production unit
FRU	fast response unit
FSHR	free standing hybrid riser
FSO	floating, storage, and offloading (vessel)
G&G	geological and geophysical
GEMS	Geoscience Earth and Marine Services, Inc.
GIWW	Gulf Intercoastal Waterway
GLPC	Greater Lafourche Port Commission
GMFMC	Gulf of Mexico Fishery Management Council
GoM	Gulf of Mexico
GULL	gulf lower layer
H_2S	hydrogen sulfide
HAPC	Habitat Area of Particular Concern
HGB	Houston-Galveston-Brazoria
HMS	highly migratory species
HPU	hydraulic power unit
IBT	internal bow thruster
IMRR	Inspection, Maintenance, Repair, and Replace (Plan)
IP	individual permit
IPF	impact producing factor
ISO	International Standards Organization
ITOPF	International Tankers Owners Pollution Federation Limited

IWOC	Intervention and Workover Control
LCRP	Louisiana Coastal Resources Program
LOOP	Louisiana Offshore Oil Port
MARPOL	International Convention for the Prevention of Pollution from Ships
MMPA	Marine Mammal Protection Act of 1972
MMS	Minerals Management Service
MODU	mobile offshore drilling unit
MSA	Metropolitan Statistical Area
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MWA	Military Warning Areas
NAAQS	National Ambient Air Quality Standards
NEP	National Estuary Program
NEPA	National Environmental Policy Act
NERR	National Estuarine Research Reserve
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NORM	naturally occurring radioactive materials
NOW	nonhazardous oilfield waste
NOx	nitrous oxides
NPDES GP	National Pollutant Discharge Elimination System General Permit
NTL	Notice to Lessees and Operators
NVIC	Navigation and Vessel Inspection Circular
NWR	National Wildlife Refuge
OBF	oil-based (drilling) fluid
OCS	Outer Continental Shelf
OESD	Offloading Emergency Shutdown
OIM	offshore installation manager
OPA 90	Oil Pollution Act of 1990
OSRA	Oil Spill Risk Analysis
OSRO	Oil Spill Response Organization
OTC	Offshore Technology Conference
PAH	polynuclear aromatic hydrocarbons
PAI	Petrobras America Inc.
PCBs	polychlorinated biphenyls
PCPT	piezo-cone penetrometer tests
Petrobras	Petróleo Brasileiro S. A.
PLET	pipeline end termination
POM	Princeton Ocean Model

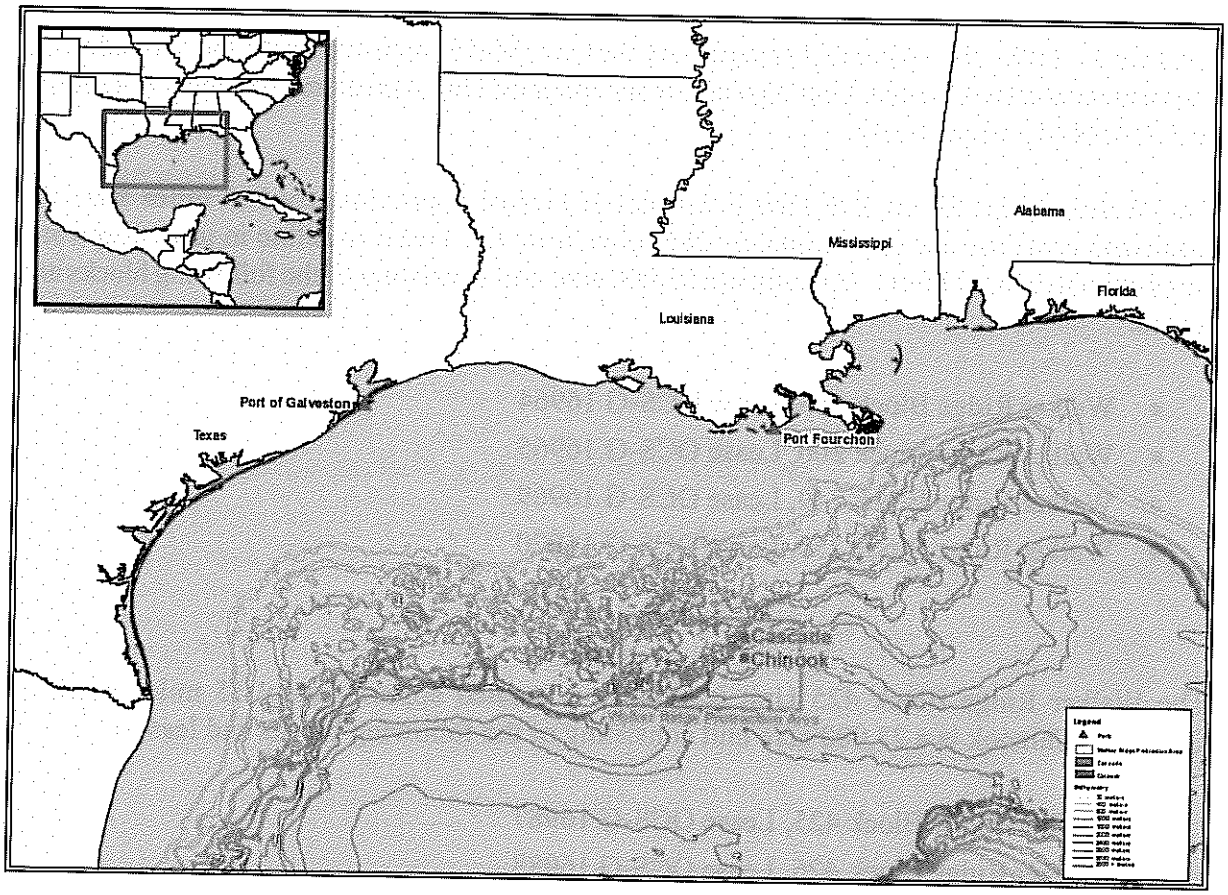
PSD	Prevention of Significant Deterioration
RCRA	Resource Conservation and Recovery Act
RMST	Reservoir Management Side Track
ROC	retention on cuttings
R-OSRP	Regional Oil Spill Response Plan
ROV	remotely operated vehicle
ROW	right of way
SBF	synthetic-based (drilling) fluid
SDS	stern loading system
SOLAS	Safety of Life at Sea
SOP	Suspension of Production
SOPEP	Shipboard Oil Pollution Emergency Plan
SOx	sulfur oxides
SPM	single point mooring
TCMP	Texas Coastal Management Program
TCW	well treatment, completion, and/or workover fluids
TLP	tension leg platform
Total	TOTAL Exploration and Production USA, Inc.
TRW	topography Rossby waves
TSP	total suspended particulates
ULCC	ultra large crude carrier
USCG	United States Coast Guard
USFWS	United States Fish and Wildlife Service
VIV	vortex induced vibration
VLCC	very large crude carrier
VOC	volatile organic compounds
WBF	water-based (drilling) fluid
WCD	Worst Case Discharge
WR	Walker Ridge
WTA	water test area

1 Introduction and Plan Contents

Introduction

Petrobras America Inc. (PAI) proposes to develop the Cascade and Chinook Units located in the Walker Ridge lease protraction area of the Central Gulf of Mexico Outer Continental Shelf (OCS) Planning Area as shown in Figure 1-1.

Figure 1-1 – Location Map



PAI has developed this Development Operations Coordination Document (DOCD) in alignment with 30 CFR 250.241 and associated NTLs per 30 CFR 250.103, including but not limited to:

- NTL 2006 G 14 (*Information Requirements for Exploration Plans and Development Operations Coordination Documents*)

- NTL 2007 G 11 (*Guidance for Submitting Exploration Plans and Development Operations Coordination Documents*)

Lease Background

On July 31, 2006, the Minerals Management Service (MMS) approved both the Cascade Unit Agreement and the Chinook Unit Agreement and assigned Unit Agreement Numbers 754306012 and 754306013 respectively.

The Walker Ridge Block 206 Unit (Cascade) is located approximately 165 miles from the Louisiana coastline and approximately 285 miles from the Texas coastline in ultra deepwater (approximately 8,200 feet). Cascade is a 23,000 acre unit consisting of the following blocks and leases:

- Walker Ridge Block 205, Lease OCS-G 16964
- Walker Ridge Block 206, Lease OCS-G 16965
- Walker Ridge Block 249, Lease OCS-G 16969
- Walker Ridge Block 250, Lease OCS-G 16970

The Walker Ridge Block 425 Unit (Chinook) is located approximately 15 miles south of Cascade. Chinook is a 23,000 acre unit consisting of the following blocks and leases:

- Walker Ridge Block 425, Lease OCS-G 16987
- Walker Ridge Block 426, Lease OCS-G 16988
- Walker Ridge Block 469, Lease OSC-G 16997
- Walker Ridge Block 470, Lease OCS-G 16998

Information regarding ownership and Operatorship of the Cascade and Chinook Units is described below.

Cascade Unit :	
Petrobras America Inc. (Operator)	50%
Devon Energy Production Company, L.P. (Devon)	50%
Chinook Unit :	
Petrobras America Inc. (Operator)	66.67%
TOTAL Exploration and Production USA, Inc.	33.33%

MMS approved a Suspension of Production (SOP) for the Cascade and Chinook Units from August 1, 2006 through November 30, 2007 in accordance with the SOP activity schedule included in Appendix 1.

Field Development Strategy

The tertiary area of the OCS is unknown with unproven reservoirs. There are no production analogs on reservoirs similar to Cascade and Chinook. To date, only the WR758#1 well test (Jack Prospect) has been performed on an analog reservoir in Walker Ridge. Seismic surveys and well data (logs, cores, and fluid samples) provide the present support for the Cascade and Chinook reservoir interpretation. While the available data is insufficient to form the basis for a full field development program, there is sufficient data to implement a phased development plan.

Petróleo Brasileiro S. A. (PAI's parent company; also known as Petrobras) typically uses a phased development approach for its development plans in offshore Brazil. Other major operators have also successfully utilized this approach in other regions of the world. The use of a phased development plan provides for optimization of the facility design and maximization of recoverable hydrocarbons while assuring reservoir conservation. Based upon this experience and the unknowns associated with the tertiary area of the GoM, PAI has decided to utilize a phased development plan for the Cascade / Chinook Development Project.

The Conceptual Plan for the Cascade / Chinook Development Project was submitted to the MMS on September 25, 2006, and was approved by MMS on November 29, 2006. The Conceptual Plan and the associated SOP activity schedule describes Phase 1 of the development plan.

PAI has determined that the optimal approach to develop the Cascade and Chinook Units is to utilize a Floating Production, Storage, and Offloading (FPSO) facility. An FPSO is the preferred development concept for the Phase 1 production facility as there is no product transportation infrastructure in the ultra deep waters of Walker Ridge and FPSOs are by nature an ideal development concept for phased development plans.

The FPSO utilized for Cascade and Chinook may be the first FPSO utilized in the U.S. GoM. PAI will leverage the experience of parent company Petrobras who operates more FPSOs than any other operator in the world and who is considered an industry leader in deepwater technology.

DOCD Scope

This DOCD will only cover Phase 1 of the development plan. As future phases of the development plan mature, PAI will supplement the DOCD as appropriate to cover activities associated with such phases.

The Conceptual Plan and the Deepwater Operating Plan (which was submitted to MMS on May 15, 2007) describe topsides and subsea facilities which have been designed to accommodate production from additional wells outside the scope of the Phase 1 drilling and completion program (i.e. two Cascade wells and one Chinook well). Since the number and locations of the wells included in the Phase 2 drilling and completion program are dependent on the results of Phase 1, the Phase 2 wells will not be covered by this DOCD. However, the topsides and subsea facilities (sized to accommodate production from these future wells) are covered by this DOCD.

The development activities associated with this DOCD reflect simultaneous first oil production from the Cascade and Chinook Units. This strategy is being utilized to reflect the most optimistic PAI execution plan, which provides for first oil from Chinook at a milestone earlier than the SOP activity schedule approved by MMS. As a result, a single Initial DOCD is being developed to cover activities associated with the Cascade and Chinook Units.

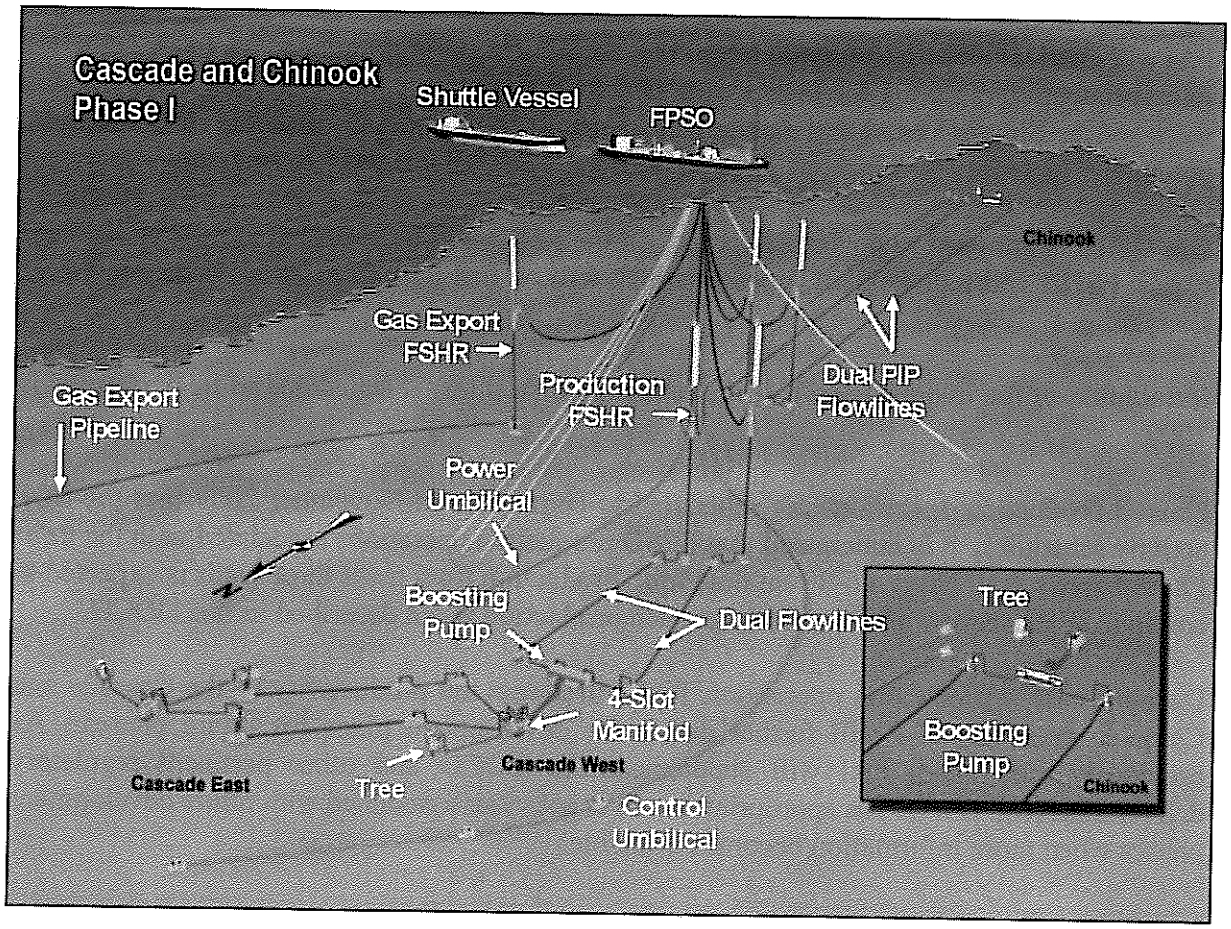
This DOCD is being submitted earlier than required by the regulatory framework (relative to PAI's anticipated commencement of Phase 1 development activities). This strategy will facilitate MMS providing feedback to PAI if a Supplemental EIS will or will not be required for Phase 1 of the development plan prior to Project Sanction.

It is anticipated that PAI will temporarily transfer operatorship of the two Cascade wells to Devon Energy Inc. (i.e. Devon) so that they may be drilled and completed using the Diamond "Ocean Endeavor" (under a Supplemental Exploration Plan to be submitted by Devon, most likely in the 4Q07). Upon completion of the second Cascade well, Devon will transfer operatorship of the two Cascade wells back to PAI. Although the two Cascade wells will be operated by Devon during the drilling and completion program, all three wells will be described by this DOCD since all three wells will be operated by PAI during Phase 1 production operations. This approach will assure a comprehensive NEPA evaluation during the DOCD review process.

Phase 1 – Executive Summary

See Figure 1-2 below for a conceptual representation of the Phase 1 development plan.

Figure 1-2 – Phase 1 Development Plan



Phase 1 will include the drilling and completion of three wells; one well in the Cascade East drill center (WR Block 249), one well in the Cascade West drill center (WR Block 206), and one well in the Chinook drill center (WR Block 425). The drilling and completion program is scheduled to begin in mid 2008 and shall continue through 2009 but is subject to rig availability.

The produced fluids from the three wells will be transported to a common FPSO in WR Block 249 through infield flowlines and four production Free Standing Hybrid Risers (FSHRs). The subsea architecture (including trees, manifolds, booster pumps, PLETs, umbilicals, flying leads, jumpers, etc.) is consistent with existing subsea facilities in the GoM with the exception of the subsea booster pumps which will be used to enhance production when reservoir pressures decrease over time.

Produced oil will be separated, treated, measured, and temporarily stored on the FPSO prior to transportation to market. The usable capacity of the cargo tanks on the FPSO will be approximately 550,000 – 850,000 barrels. The FPSO will have a disconnectable mooring system which will allow it to disconnect and motor away from named storms and hurricanes under her own power, returning for re-connection when it is safe to do so.

Oil transportation to market will be achieved through the use of dedicated Shuttle Vessels that PAI will charter. Shuttle Vessels will be either shuttle tankers or articulated tug barges (ATBs). After production ramp-up, the FPSO will offload oil to a Shuttle Vessel approximately once a week and the Shuttle Vessel will transport the product to the terminals of choice along the GoM, potentially including terminals in Texas, Louisiana, Mississippi, and / or Alabama.

Gas which is not used to power equipment on the FPSO will be exported to market via a gas export FSHR and a gas export pipeline which will be tied into an existing facility in Green Canyon.

Installation of the major Phase 1 development plan facilities is scheduled to be performed in 2009.

Phase I production operations are scheduled to commence in November 2009 (per the SOP activity schedule). It is anticipated that FPSO production operations associated with the three Phase 1 wells shall cover a 6-8 year duration. Production from these three wells is expected to continue in subsequent phases, although such production is not described in this DOCD.

During Phase 1 production operations, PAI will assess the productivity of the Cascade and Chinook reservoirs and will further define the development plans for future phases. As previously mentioned, PAI will supplement the DOCD and other pertinent regulatory deliverables (e.g. DWOP) as appropriate to cover activities associated with future development phases when more information becomes available.

Background on the Use of FPSOs in the GoM

In January 2001, the MMS published an Environmental Impact Statement (EIS) which evaluated the potential environmental effects of using FPSOs in deepwater leases in the Central and Western Planning Areas of the GoM. The FPSO EIS was a programmatic document which generically examined the concept of the proposed use of FPSOs on the OCS.

In general, the FPSO EIS indicated that FPSOs are a viable development concept that could be used on the OCS subject to further review and approval of site specific FPSO proposals by the MMS, USCG, EPA, and Affected States.

The programmatic FPSO EIS was specifically developed to facilitate the concept of tiering to address site specific FPSO proposals which would require National Environmental Policy Act (NEPA) action per 40 CFR 1502.20. The tiering concept would eliminate repetitive discussions regarding the generic concepts of FPSO utilization on the OCS allowing for a more focused evaluation of site specific considerations.

This tiering specifically allows for a site specific FPSO proposal submitted to the MMS to go through a project specific NEPA review via the preparation of an Environmental Assessment (EA) that tiers from the FPSO EIS, provided the site specific FPSO proposal falls within the range of the "base case" FPSO system parameters evaluated within the FPSO EIS.

If the site specific FPSO proposal contains design or operational parameters outside the ranges evaluated in the "base case" FPSO system described in the FPSO EIS, a Supplemental EIS would need to be prepared if the findings of the EA indicated that the potential for site specific significant impacts were not adequately evaluated in the FPSO EIS.

Comparison of Proposed FPSO System to the "Base Case" FPSO System

PAI has developed the FPSO system described in our Conceptual Plan and Deepwater Operating Plan (DWOP) consistent with the "base case" FPSO system described in the FPSO EIS.

PAI has conducted a comprehensive gap analysis between the "base case" FPSO system described in the FPSO EIS and the proposed FPSO system to be utilized in Phase 1 of the Cascade / Chinook Development Project. The purpose of this analysis was to internally assess whether an EA or a Supplemental EIS would likely be required by MMS. Table 1-1 summarizes the comprehensive gap analysis and provides an overview of the significant differences between the FPSO systems (from an environmental impact perspective).

Table 1-1 – Summary of Gap Analysis

Characteristic	Cascade / Chinook Project FPSO System (*)	FPSO EIS "Base Case" FPSO System	Notes
Water Depth	~ 8200 – 8800'	5000'	1
FPSO Hull	Converted Tanker (Foreign Flag)	Purpose Built Vessel (US Flag)	2
FPSO Storage Capacity	550,000 – 850,000 bbls	1,000,000 bbls	3
FPSO Propulsion	Self Propelled	None	4
FPSO Mooring System	Disconnectable Turret Buoy	Permanent Fixed Mooring System	4
Hurricane Mitigation	Disconnect FPSO and motor to safe waters	Evacuate personnel and abandon FPSO	4
FPSO Mooring Lines	Steel or Polyester	Steel	5
FPSO Anchoring System	Suction Piles or Torpedo Piles	Drag Anchors	6
Peak Production (Oil)	80,000 bpd	150,000 bpd	7
Peak Production (Gas)	16 MMscfd	200 MMscfd	7
Peak Production (Water)	16,000 bpd	70,000 bpd	7
Riser System	Free Standing Hybrid Risers (FSHRs)	Steel Wave Risers with Subsea Buoyancy (i.e Lazy S)	8
Subsea Boosting System	Yes	No	9
Shuttle Vessel Type	Tanker or ATB	Tanker	10
Shuttle Vessel Capacity	~ 185,000 – 500,000 bbls	500,000 bbls	11
Offloading Frequency	~ Once per 7 days	Once per 3 days	11
Crude Offloading Rate	20,000 – 37,500 bbls per hour	50,000 bbls per hour	12
Offloading Tug Assistance	Yes; dedicated field vessel	No	13
Flaring	Not part of base case operations	Up to 1 year	14

(*) Based on information contained in DWOP issued May 15, 2007

Notes for Table 1-1 :

1. Deeper water is generally associated with a greater distance from shore. This is a positive difference relative to oil spills (less likelihood of impacting coast), air emissions (less likelihood of impacting coast), and biological organisms (lower likelihood of presence). This is a negative difference related to logistics (oil spill response mobilization time and medical evacuation).
2. No significant difference. USCG has structured alternative compliance regulations for assuring safety and reliability of foreign flagged vessels used on the OCS. International maritime codes are robust, consistent with US regulations, and are generally incorporated by reference by USCG. USCG will evaluate design and operational aspects of the FPSO. Classification Society will be used to verify compliance with the Flag State requirements.
3. No significant difference other than a decreased Worst Case Discharge scenario related to marine considerations (i.e. USCG area of interest). Note that a Worst Case Discharge scenario related to losing the entire cargo of the FPSO has a very low probability so the associated risk is very low. The controls that are used to mitigate oil spills associated with different sized cargo tanks are essentially equivalent.
4. The ability of the Cascade / Chinook FPSO to disconnect from her mooring system and motor under her own propulsion system to safe waters until it is safe to return to the site for re-connection is a major positive difference. Although this feature does introduce technology new to the GoM (which will be further discussed in Section 2(e)), it provides for step change reduction in risk regarding the protection of people, the environment, and assets.
5. No significant difference. Polyester mooring lines have been field proven in the GoM, in Brazil, and in other regions and will be subject to verification by Classification Society and will be covered by an Inspection, Maintenance, Repair, and Replacement (IMRR) Plan. See Section 2(e) for additional discussion of new technology related to polyester mooring components.
6. No significant difference. Torpedo Piles have been field proven in Brazil and will be subject to verification by Classification Society. See Section 2(e) for additional discussion of new technology related to torpedoes Piles.
7. No significant difference other than a decreased Worst Case Discharge scenario (i.e. MMS area of interest). The controls that are used to mitigate oil spills for topsides processing and well control with different production rates are essentially equivalent.
8. Free Standing Hybrid Risers are the preferred design due to water depth, isolation of FPSO motions from the risers, and other factors mentioned in Section 2(e). Although considered technology new to the GoM, they have been used in other regions and are field proven. PAI has demonstrated safety and reliability of this technology to MMS in the DWOP. See Section 2(e) for additional discussion of new technology related to FSHRs. No significant difference.

Notes for Table 1-1, Continued :

9. Subsea Booster Pumps are a preferred design concept (relative to other artificial lifting techniques) because of the water depth, wellbore depth, and low bubble point of the production fluids. Although considered technology new to the GoM, they have been used in other regions and are field proven. PAI has demonstrated safety and reliability of this technology to MMS in the DWOP. See Section 2(e) for additional discussion of new technology related to Subsea Booster Pumps. No significant difference.
10. Articulated Tug Barges may be a preferred option due to limited availability of Jones Act shuttle tankers. Although considered a technology new to the GoM (related to FPSO offloading), ATBs are a field proven technology in product transportation in US waters. Furthermore, the USCG has indicated they are comfortable with ATB performance utilized during recovery efforts associated with the hurricanes of 2005. No significant difference.
11. In general, Shuttle Vessels with lower storage capacity drive more frequent offloading which increases risk of oil spills (due to higher probability). However, the lower storage capacities of the Cascade / Chinook FPSO and Shuttle Vessels provide a risk profile generally consistent with the larger storage capacities of the "base case" FPSO and Shuttle Vessels described in the FPSO EIS. Depending on the actual production profile achieved during Phase 1, the risk profile for the Cascade / Chinook system may be lower due to the lower frequency of offloading. No significant difference.
12. No significant difference as the controls used to mitigate oil spills associated with offloading are essentially the same regardless of the offloading rate.
13. This is a significant positive difference. Although there are minor increases in air emissions, a dedicated field tug which can support offloading (i.e. help Shuttle Vessel keep a safe distance from FPSO) is a significant reduction is risk. The tug also helps mitigate collision risk with other marine vessels that could (possibly) venture into the area.
14. This is a significant positive difference. PAI has decided to install a gas export line which will be available for use just after first oil rather than requesting approval for flaring of low gas volumes for a short period of time.

Table 1-1 and the supporting notes above demonstrate that the proposed FPSO system for the Cascade / Chinook Development Project generally falls within the design and operational parameters that were assessed in the FPSO EIS. Although there are some differences (primarily due to project specific considerations), PAI believes that the differences are inherently positive (i.e. provide less risk to personnel, the environment, and assets).

1(a) Plan Information Form (MMS-137)

See completed Form MMS-137 on following pages.

OCS PLAN INFORMATION FORM

General Information

Type of OCS Plan:		Exploration Plan (EP)	X	Development Operations Coordination Document (DOCD)	
Company Name: Petrobras America Inc.			MMS Operator Number: 1207		
Address: 10777 Westheimer Rd.			Contact Person: Cheryl Saha		
Suite 1200			Phone Number: 713-808-2883		
Houston Texas			E-Mail Address: csaha@petrobras-usa.com		

Lease(s): OCS-G 16964, 16965, 16969, 16970, 16987, 16988, 16997, and 16998.	Area: Walker Ridge	Block(s): 205, 206, 249, 250, 425, 426, 469, and 470.	Project Name (If Applicable): Cascade / Chinook Development Project

Objective(s):	X	Oil	X	Gas		Sulphur		Salt	Onshore Base: Port Fourchon	Distance to Closest Land (Miles): 165	

Description of Proposed Activities (Mark all that apply)

	Exploration drilling	X	Development drilling
X	Well completion		Installation of production platform
X	Well test flaring (for more than 48 hours)	X	Installation of production facilities (FPSO)
	Installation of caisson or platform as well protection structure		Installation of satellite structure
X	Installation of subsea wellheads and/or manifolds	X	Commence production
X	Installation of lease term pipelines	X	Other (Shuttle Vessel)

Have you submitted or do you plan to submit a Conservation Information Document to accompany this plan?	X	Yes		No
Do you propose to use new or unusual technology to conduct your activities?	X	Yes		No
Do you propose any facility that will serve as a host facility for deepwater subsea development?	X	Yes		No
Do you propose any activities that may disturb an MMS-designated high-probability archaeological area?		Yes	X	No
Have all of the surface locations of your proposed activities been previously reviewed and approved by MMS?		Yes	X	No

Tentative Schedule of Proposed Activities (*)

Proposed Activity	Start Date	End Date	No. of Days
Drill and complete three new wells (2 Cascade, 1 Chinook)	Jun 2008	Dec 2009	570
Install Cascade flowlines and gas export pipeline	Jun 2009	Jul 2009	60
Install Chinook flowlines	Aug 2009	Aug 2009	30
Install risers	Jul 2009	Sep 2009	75
Install subsea equipment (heavy lifts and umbilicals / flying leads)	Sep 2009	Oct 2009	60
Install FPSO (mooring system and FPSO connection)	Oct 2009	Nov 2009	60
First Oil Cascade and Chinook	Nov 2009	Nov 2009	0

(*) Dates shown are more optimistic than SOP activity schedule and are for information purposes only

Description of Drilling Rig

	Jackup		Drillship
	Gorilla Jackup		Platform rig
X	Semisubmersible		Submersible
X	DP Semisubmersible		Other (Attach Description)

Drilling Rig Name (If Known):
Ocean Endeavor (semisub) and *Petrorig No. 1* (DP semisub)

Description of Production Platform

	Caisson		Tension leg platform
	Well protector		Compliant tower
	Fixed platform		Guyed tower
	Subsea manifold	X	Floating production system
	Spar		Other (Attach Description)

Description of Lease Term Pipelines

From (Facility/Area/Block)	To (Facility/Area/Block)	Diameter (Inches)	Length (Feet)
Cascade East DC / WR Block 206 (Dual)	Cascade West DC / WR Block 249	9 5/8"	13,578
Cascade West DC / WR Block 249 (Dual)	FPSO Riser Base / WR Block 249	9 5/8"	22,252

MMS **FORM MMS-137** (July 2005 -Supersedes all previous editions of form MMS-137 which may not be used.) Page 1 of 4

OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Cascade West/Development Well No. 3	Subsea Completion			
Anchor Radius (if applicable) in feet: N/A (see preliminary anchor locations below)	X	Yes		No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 16969	PROPRIETARY
Area Name	Walker Ridge Protraction Area	
Block No.	Walker Ridge Block 249	
Blockline Departures (in feet)	1623.00' FEL	
	3984.00' FNL	
Lambert X-Y coordinates	X: 2,453,577.00'	
	Y: 9,705,936.00'	
Latitude/ Longitude	Latitude: 26°43'34.53"	
	Longitude: 90°30'30.24"	

TVD (Feet): PROPRIETARY	MD (Feet): PROPRIETARY	Water Depth (Feet): 8,100

Anchor Locations for Drilling Rig (Preliminary; could be moved due to escarpment)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1	WR	206	2,458,785.18'	9,719,213.84'	TBD
2	WR	206	2,460,776.26'	9,718,115.93'	TBD
3	WR	250	2,464,380.05'	9,699,996.73	TBD
4	WR	250	2,462,839.02'	9,698,123.44'	TBD
5	WR	249	2,448,068.7'	9,695,284.52'	TBD
6	WR	249	2,446,078.57'	9,696,382.57'	TBD
7	WR	205	2,442,574.17'	9,714,617.15'	TBD
8	WR	205	2,444,014.89'	9,716,374.77'	TBD
9	WR	206	2,461,503.57'	9,715,615.97'	TBD
10	WR	250	2,464,028.55'	9,702,472.1'	TBD
11	WR	249	2,445,352.21'	9,698,882.65'	TBD
12	WR	205	2,442,827.24'	9,712,026.51'	TBD

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OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Cascade East/Development Well No. 4	Subsea Completion			
Anchor Radius (if applicable) in feet: N/A (see preliminary anchor locations below)	X	Yes		No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 16965	PROPRIETARY
Area Name	Walker Ridge Protraction Area	
Block No.	Walker Ridge Block 206	
Blockline Departures (in feet)	2440.00' FSL	
	3289.00' FWL	
Lambert X-Y coordinates	X: 2,458,489.00'	
	Y: 9,712,360.00'	
Latitude/ Longitude	Latitude: 26°44'37.17"	
	Longitude: 90°29'35.77"	

TVD (Feet): PROPRIETARY	MD (Feet): PROPRIETARY	Water Depth (Feet): 8,160

Anchor Locations for Drilling Rig (Preliminary; could be moved due to escarpment)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1	WR	249	2,446,600.33'	9,706,975.29'	TBD
2	WR	249	2,445,851.20'	9,709,122.06'	TBD
3	WR	206	2,455,417.84'	9,725,036.31'	TBD
4	WR	206	2,457,664.76'	9,725,382.26	TBD
5	WR	206	2,470,555.70'	9,717,633.38	TBD
6	WR	206	2,471,304.04'	9,715,487.14'	TBD
7	WR	250	2,461,737.43'	9,699,572.97'	TBD
8	WR	250	2,459,491.35'	9,699,226.53'	TBD
9	WR	205	2,446,979.01'	9,711,468.72'	TBD
10	WR	205	2,453,875.61'	9,722,939.27'	TBD
11	WR	206	2,470,175.43'	9,713,141.03'	TBD
12	WR	250	2,463,278.83'	9,701,670.48'	TBD

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OCS PLAN INFORMATION FORM (CONTINUED)

Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): Chinook/Development Well No. 2	Subsea Completion			
Anchor Radius (if applicable) in feet: Not Applicable - DP Drilling Rig	X	Yes		No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 16987	PROPRIETARY
Area Name	Walker Ridge Protraction Area	
Block No.	Walker Ridge Block 469	
Blockline Departures (in feet)	7310.00' FEL	
	32.00' FNL	
Lambert X-Y coordinates	X: 2,447,890.00'	
	Y: 9,630,688.00'	
Latitude/ Longitude	Latitude: 26°31'10.78"	
	Longitude: 90°31'48.95"	
	TVD (Feet): PROPRIETARY	MD (Feet): PROPRIETARY
		Water Depth (Feet): 8,800

Anchor Locations for Drilling Rig

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
N/A	N/A	N/A	N/A	N/A	N/A

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OCS PLAN INFORMATION FORM (CONTINUED)
Include one copy of this page for each proposed well/structure

Proposed Well/Structure Location

Well or Structure Name/Number (If renaming well or structure, reference previous name): FPSO	Subsea Completion			
Anchor Radius (if applicable) in feet: N/A (see preliminary anchor pattern below)		Yes		No

	Surface Location	Bottom-Hole Location (For Wells)
Lease No.	OCS-G 16969	N/A
Area Name	Walker Ridge Protraction Area	N/A
Block No.	Walker Ridge Block 249	N/A
Blockline Departures (in feet)	927.00' FSL	N/A
	1402.26 FEL	N/A
Lambert X-Y coordinates	X: 2,453,797.74'	N/A
	Y: 9,695,007.00'	N/A
Latitude/ Longitude	Latitude: 26°41'46.315"	N/A
	Longitude: 90°30'30.165"	N/A
	TVD (Feet): N/A	MD (Feet): N/A
		Water Depth (Feet): 8,800

Anchor Locations for FPSO (Preliminary; could change due to furrows)

Anchor Name or No.	Area	Block	X Coordinate	Y Coordinate	Length of Anchor Chain on Seafloor
1	WR	250	2,456,804.95'	9,704,537.25'	TBD
2	WR	250	2,457,689.18	9,704,079.38'	TBD
3	WR	250	2,458,418.28'	9,703,879.42'	TBD
4	WR	294	2,461,513.05'	9,688,638.22'	TBD
5	WR	294	2,460,977.20'	9,687,863.24'	TBD
6	WR	294	2,460,298.60'	9,687,388.94'	TBD
7	WR	293	2,445,008.84'	9,690,229.89'	TBD
8	WR	293	2,444,617.99'	9,691,009.41'	TBD
9	WR	293	2,444,305.48'	9,691,823.91'	TBD

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1(b) Location

The overall field layout for Phase 1 of the development plan is presented in Figure 1-3 at a scale which allows a review of all facilities. Figures 1-4, 1-5, 1-6, 1-7, and 1-8 present the facilities at a scale which provides a greater level of detail.

Figure 1-3 – Field Layout

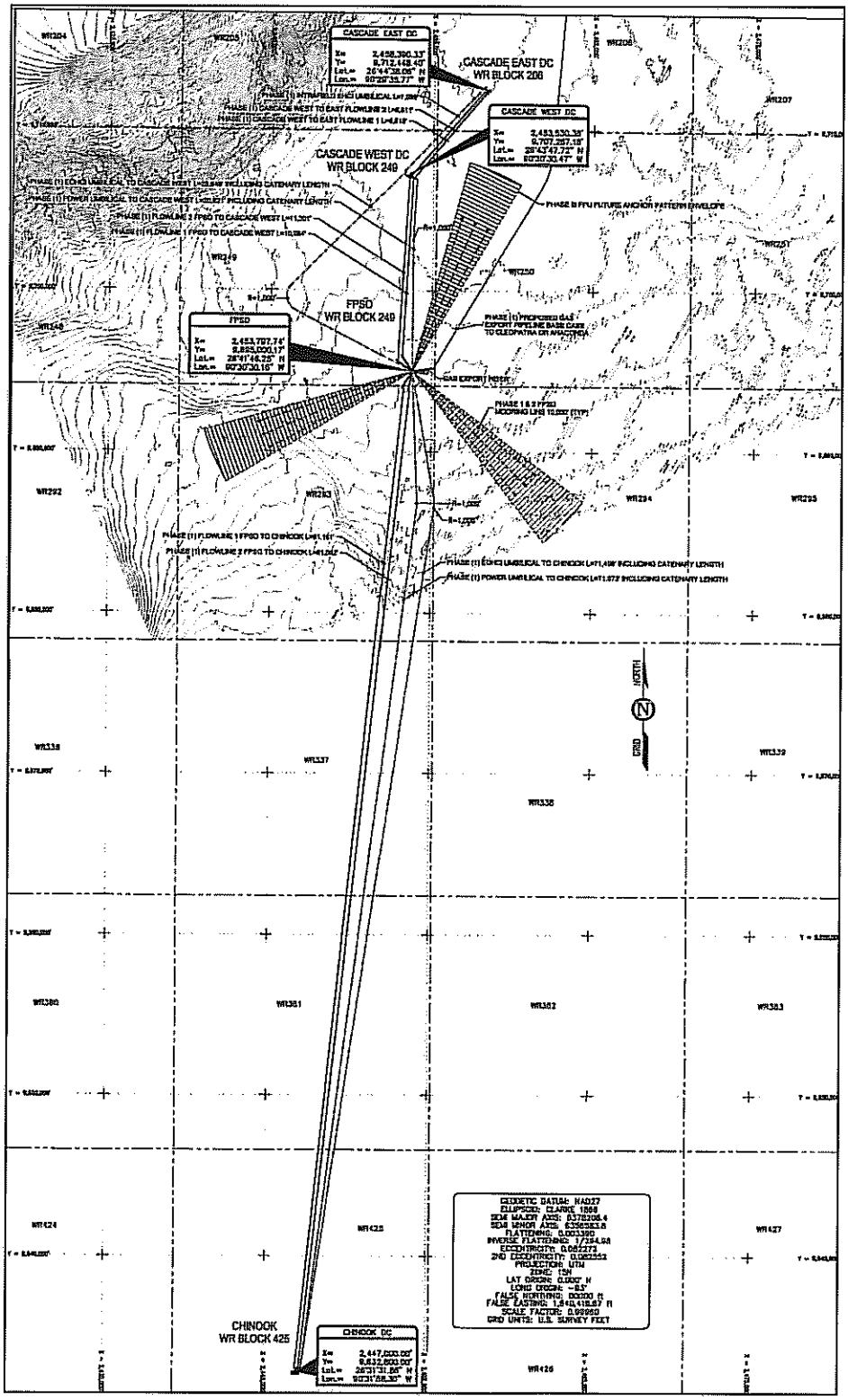
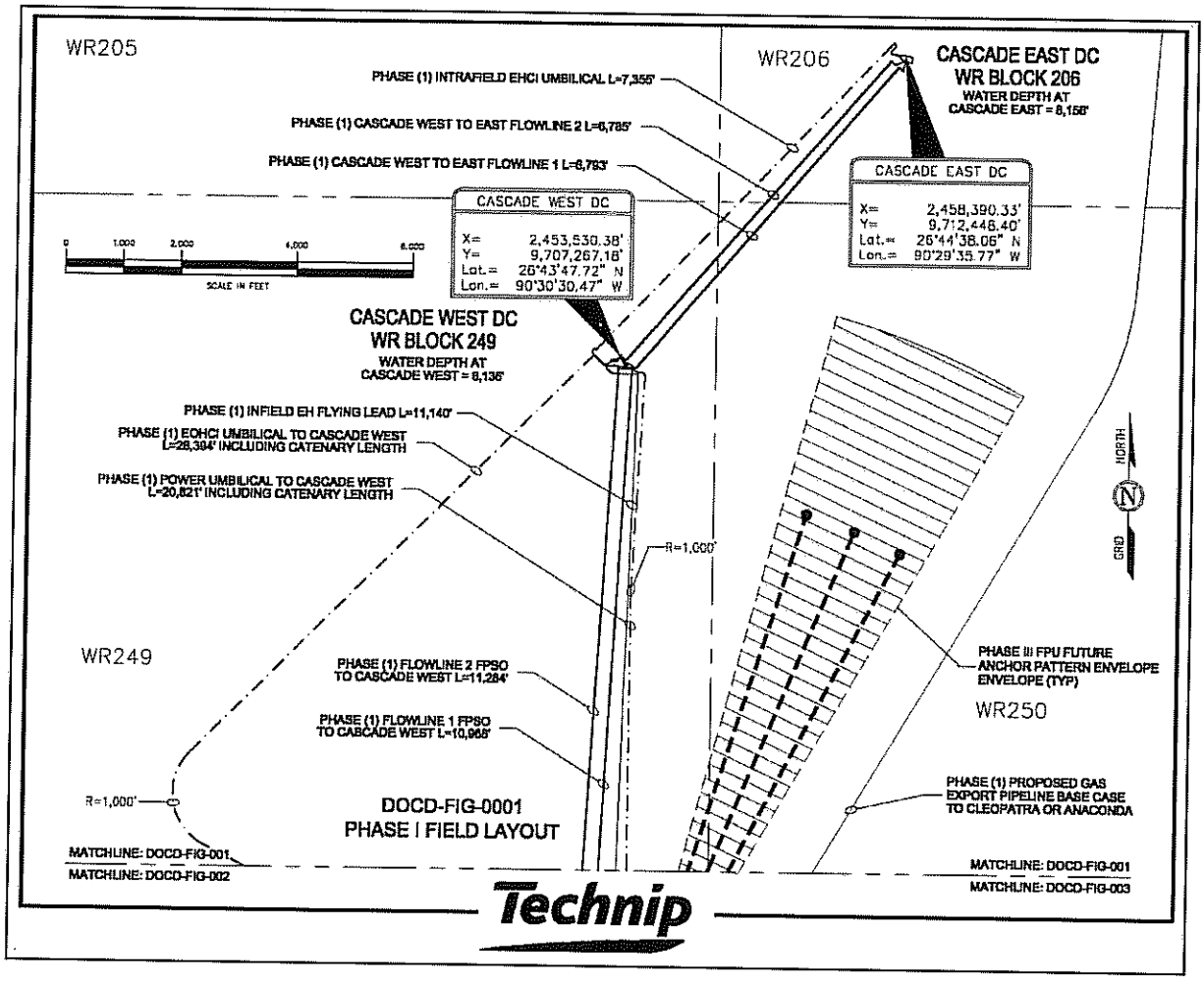
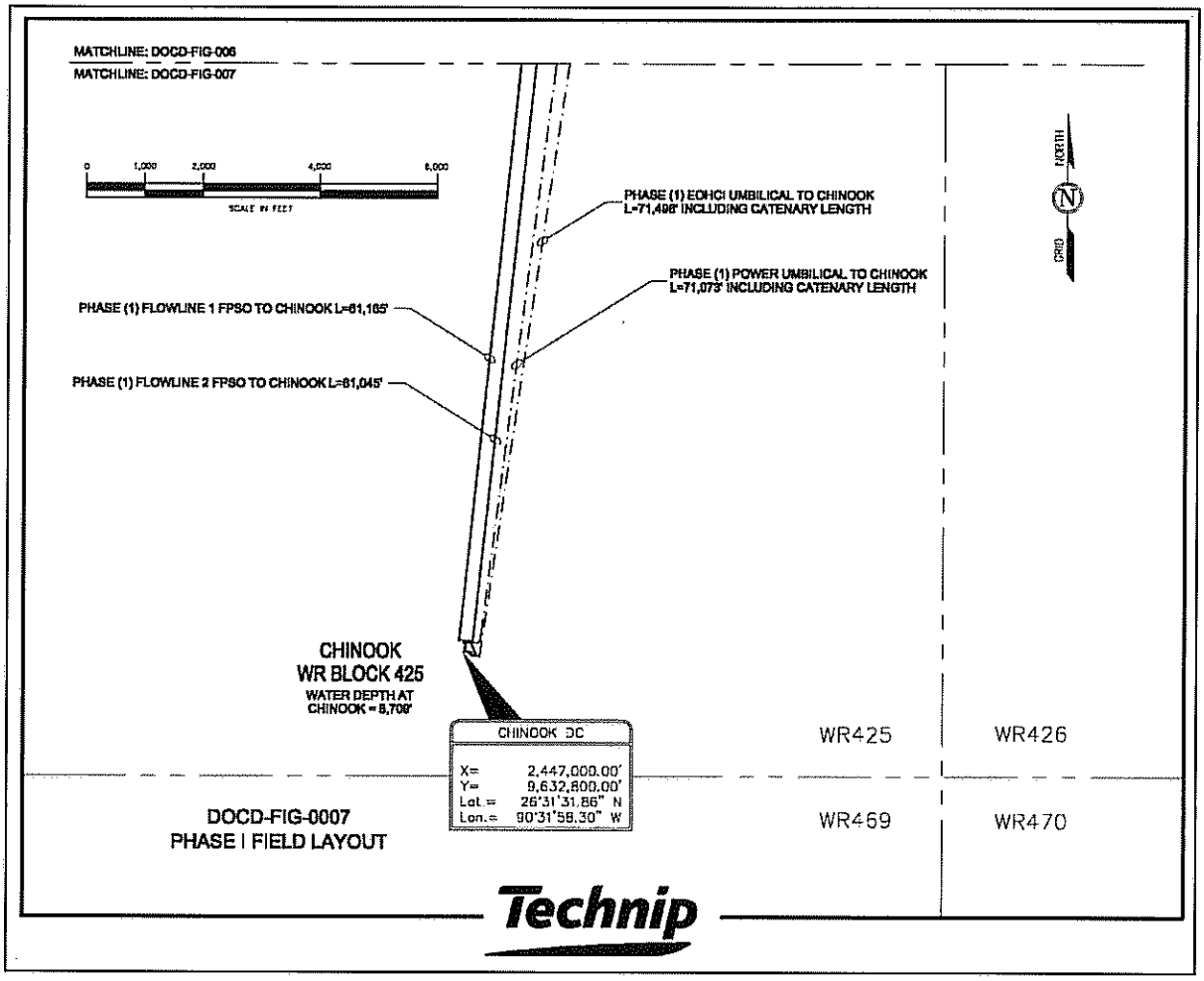


Figure 1-4 – Cascade East and West Field Layout



See Figures 14-4 and 14-5 in Section 14(a) for additional detail for the Cascade East and West drill centers, respectively.

Figure 1-5 – Chinook Field Layout



See Figure 14-6 in Section 14(a) for additional detail for the Chinook drill center.

Figure 1-6 – FPSO Field Layout 1

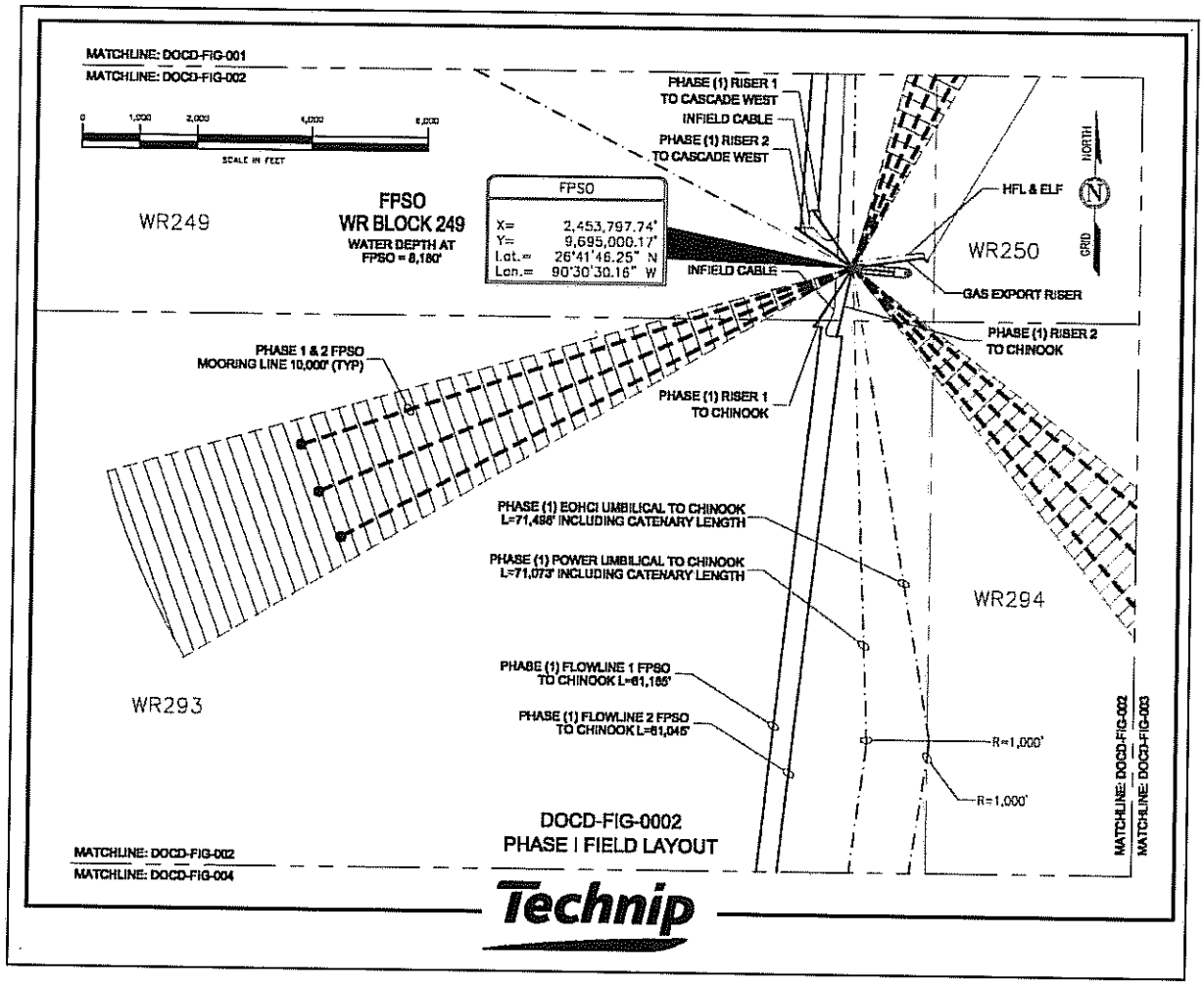


Figure 1-7 – FPSO Field Layout 2

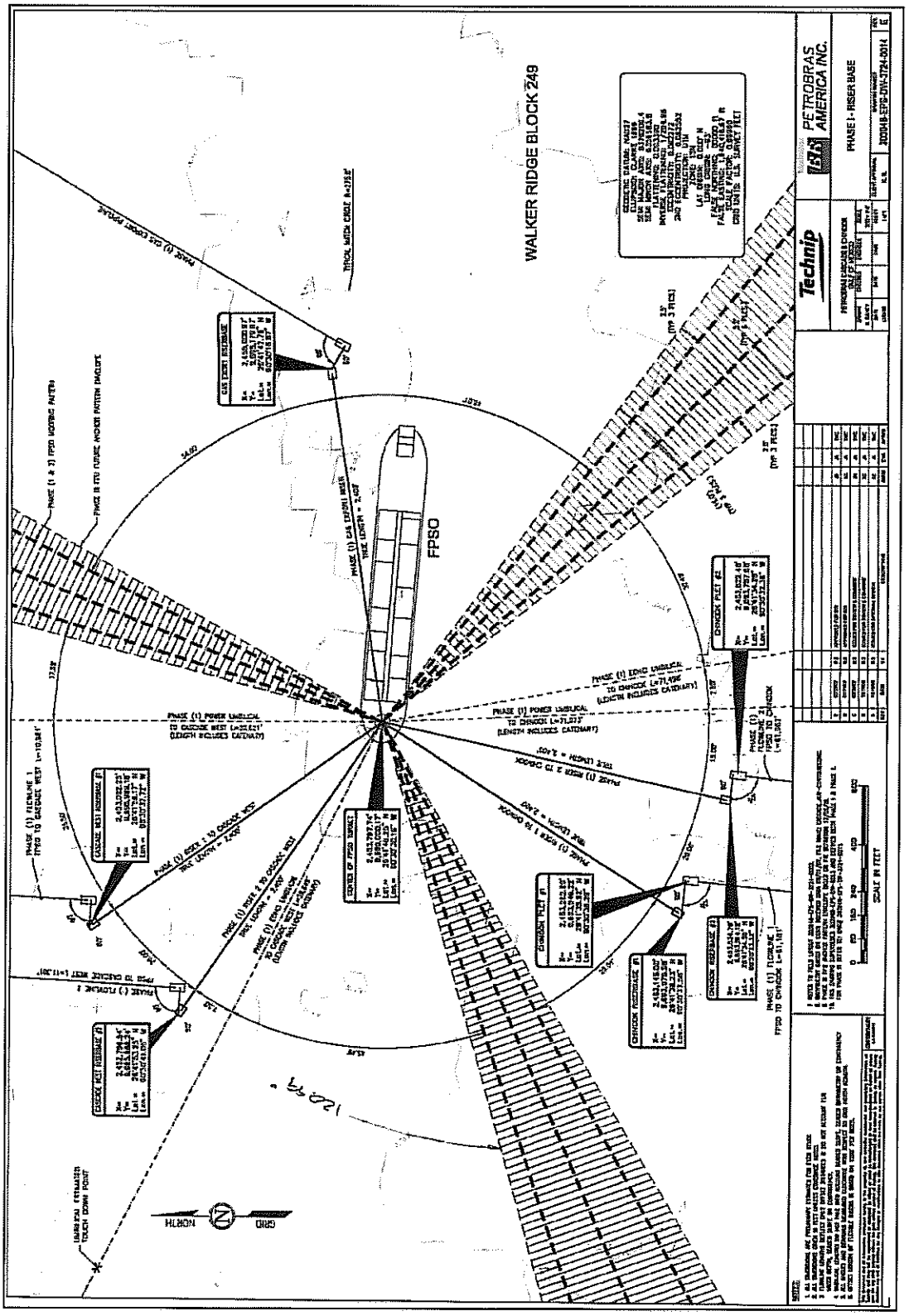


Figure 1-8 – FPSO / Rig Mooring Arrangements

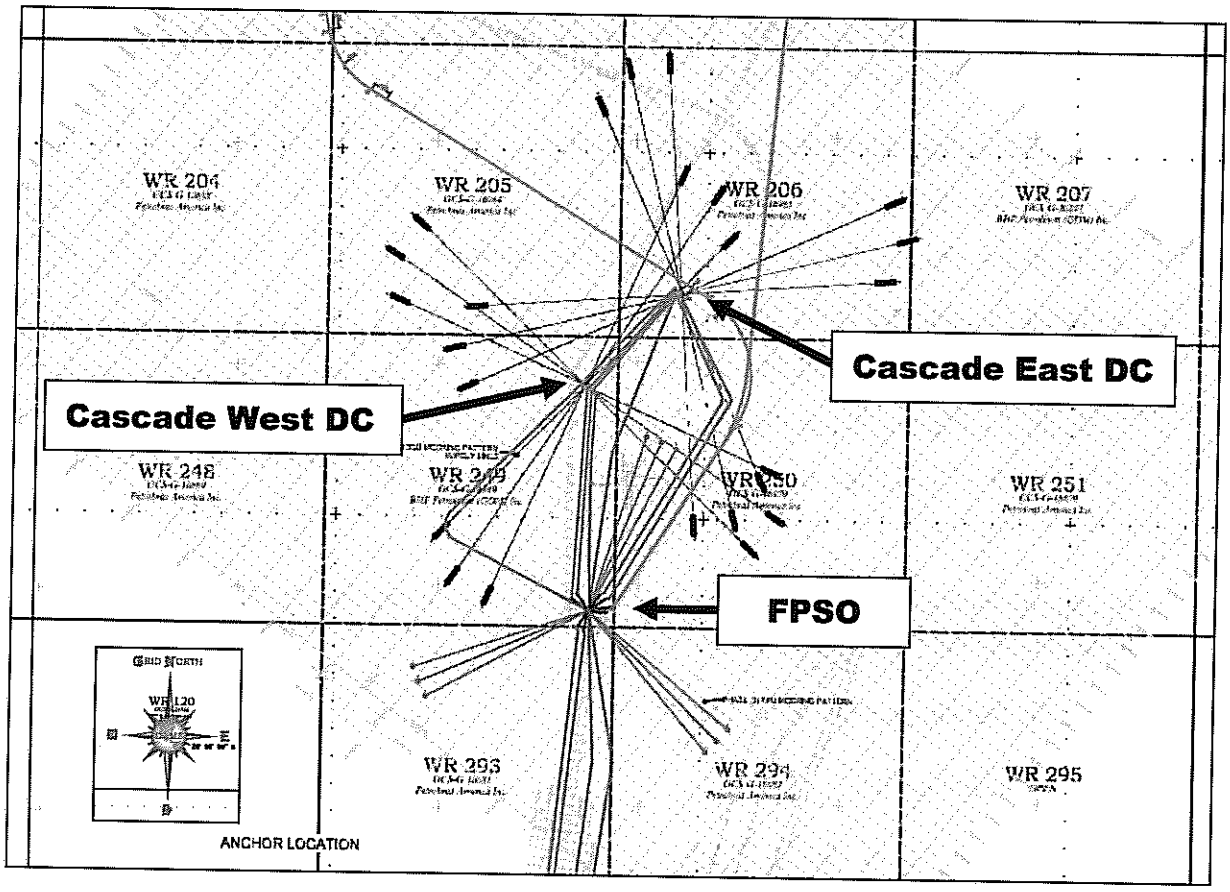


Figure 1-8 shows the locations of the preliminary MODU anchor patterns at the Cascade West and Cascade East drill centers relative to the preliminary FPSO anchor pattern. Chinook will be drilled with a DP drilling rig.

1(c) Safety and Pollution Prevention Features

PAI will comply with the MMS safety and pollution prevention requirements described in the following subparts of 30 CFR 250, as well as supporting NTLs :

- Subpart C – Pollution Prevention and Control
- Subpart D – Oil and Gas Drilling Operations
- Subpart E – Oil and Gas Well Completion Operations
- Subpart H – Oil and Gas Production Safety Systems
- Subpart I – Platforms and Structures
- Subpart J – Pipelines and Pipelines Rights-of-Way
- Subpart O – Well Control and Production Safety Training

PAI will comply with the USCG safety and pollution prevention requirements for US and foreign flagged vessels (as appropriate) described in :

- 33 CFR Subchapter O – Pollution
- USCG Policy Letters
- Oil Pollution Act of 1990 (OPA90)
- International Convention for the Prevention of Pollution from Ships (MARPOL 73/78) with amendments, including Annex I, Annex II, Annex IV, Annex V, and Annex VI (*)
- SOLAS 1974 (*)

(*) For foreign flagged FPSO

PAI will comply with the EPA regulations regarding the disposal of oil and gas operational wastes, including :

- 40 CFR 55 – OCS Air Regulations
- 40 CFR 112 – Oil Pollution Prevention
- 40 CFR 122 - National Pollutant Discharge Elimination System (NPDES)
- Resource Conservation and Recovery Act (RCRA)
- Clean Water Act

See Section 1(f) to review the additional safety and pollution prevention features that PAI will utilize to mitigate hazards associated with Phase 1 of the development plan.

1(d) Storage Tanks and Production Vessels

Table 1-2 provides information on the tanks and production vessels that store 25 barrels or more of hydrocarbons during Phase 1 of the development plan.

Table 1-2 – Storage Tanks and Production Vessels

Type of Facility	Type of Storage Tank	Tank Capacity (Barrels)	Number of Tanks	Total Capacity (Barrels)	Fluid Gravity (API) or Specific Gravity (sg)
FPSO Topsides	1st Phase Separator #1	750	1	750	17-29
	1st Phase Separator #2	750	1	750	17-29
	2nd Phase Separator #1	1650	1	1650	17-29
	2nd Phase Separator #2	1650	1	1650	17-29
	Test Separator	250	1	250	17-29
	Methanol Storage Tank	885	1	885	0.79 sg
	Hydraulic Fluid Storage Tank	75	1	75	0.87 sg
FPSO Cargo Tanks, Fuel Tanks, and Misc Oil Tanks	Crude Oil	42,500 (average)	20	850,000	17-29
	Fuel Oil (HFO)	2,500 (average)	8	20,000	0.98 sg
	Fuel Oil (DO)	500 (average)	4	2,000	0.90 sg
	Misc Oil (LO)	150 (average)	8	1,200	0.90 sg
Shuttle Vessel Cargo Tanks, Fuel Tanks, and Lube Oil Tanks	Crude Oil	26,250 (average)	12	315,000	17-29
	Fuel Oil (HFO)	1,575 (average)	4	6,300	0.98 sg
	Fuel Oil (LS HFO)	600 (average)	3	1,800	0.98 sg
	MGO	300 (average)	4	1,200	0.90 sg
	LDO	80 (average)	3	240	0.85 sg
	LO	100 (average)	6	600	0.90 sg
Ocean Endeavor (MODU)	Fuel Oil	6,861	1	6,861	50
	Base Oil	3,200	1	3,200	45
Petrorig I (MODU)	Fuel Oil	21,260	1	21,260	50
	Base Oil	4,780	1	4,780	45

DO = Diesel Oil, HFO = Heavy Fuel Oil, LS HFO = Low Sulfur Heavy Fuel Oil, MGO = Marine Gas Oil, LDO = Light Diesel Oil, LO = Lube Oil

1(e) Pollution Prevention Measures

Florida is not an Affected State for the Cascade / Chinook Development Project. As a result, a discussion of the measures to prevent the discharge of oils and greases from drilling rigs or platforms during rainfall and routine operations is not required per NTL 2006 G14.

1(f) Additional Safety and Pollution Prevention Measures

This section summarizes the additional safety and pollution prevention features that PAI would like to highlight or are otherwise beyond the requirements of 30 CFR 250. These features will be utilized to mitigate hazards associated with Phase 1 of the development plan, focusing on technologies new to the GoM and project specific considerations which require additional mitigation. See Section 2(e) for descriptions of technologies new to the GoM and Sections 14(a), 14(b), and 14(c) for descriptions of the operational facilities utilized in Phase 1 of the development plan.

Subsea Booster Pumps (Technology New to GoM)

- Subsea booster pumps will be mounted on skids rather than downhole, which is inherently safer and provides easier access for maintenance or replacement (if needed)
- Petrobras has performed onshore testing of skid mounted electrical submersible pumps in Brazil to verify safety and reliability
- Seals on the subsea booster pumps will not be open to seawater per design. In the horizontal electrical submersible pump design, the pump is encapsulated in a casing. In the standard centrifugal pump design, the pumps shaft seals are designed to allow some leakage from the barrier fluid system to the process, but no leakage from the process to the barrier fluid system (in case of a seal failure, hydrocarbons will be contained in the barrier fluid system). Therefore, there is no leakage to the environment in the event of a seal failure for both options.
- Interlocks and a safety instrumentation system within the booster pump system design will shut down the pumps before the system reaches the design pressure, eliminating the potential for overpressuring of the system if the centrifugal pumps are allowed to run with their discharge shut (i.e. a valve is closed or there is a hydrate blockage downstream of the pump)

- Controls and instrumentation for the booster pump system will comply with API RP 14C and will be available for alert, interlock, and shutdown functions for certain conditions (e.g. seal failure, loss of communications, high and low pressure); testing for controls and instrumentation will be performed per regulatory requirements

- Barrier fluids for booster pump system will be EPA approved

- Hydrocarbons will not enter the motor if a broken seal occurred on a centrifugal booster pump as the barrier fluid system is designed to always operate above the process flowing pressure. Seals are designed to allow some leakage from the barrier fluid system to the process, but no leakage from the process to the barrier fluid system (i.e. the seals will be designed for the system shut-in pressure). However, in the event of a seal failure, hydrocarbons will enter the motor but will be contained in the motor casing / barrier fluid system.

- Design of booster pumps allows for isolation of each pump from the control system on the FPSO or through ROV intervention (if maintenance or repair is needed)

Free Standing Hybrid Risers (Technology New to GoM)

- The design, fabrication, and installation of the FSHRs will be reviewed and approved by a Certified Verification Agent (CVA) per newly published NTL 2007 G14

- Model testing will be performed to verify no clashes between the FSHRs with the FPSO mooring lines and umbilicals (which are also connected to the FPSO turret buoy) in the FPSO-connected and FPSO-disconnected conditions

- A monitoring system will be utilized to detect potential leaks between the structural layers on the flexible jumpers and fittings; a carcass bleed header will be utilized to direct any leakage to a safe venting location

- FPSO will be outfitted with CCTV allowing surveillance of critical connection system devices in the turret, including the flexible jumper connection points

- FSHRs will be outfitted with a tension monitoring system (i.e. load cell) to provide assurance of the integrity of the buoyancy can up-thrust

- The connection integrity of the flexible jumpers will be verified after each FPSO re-connection before exposure to service conditions

- The riser-to-foundation connectors on the FSHRs will be outfitted with secondary locking mechanisms to prevent disconnection in the event of loss of tension

- The buoyancy cans will include one or more contingency compartments

- FSHRs (which along with the mooring system and umbilicals are connected to the FPSO turret buoy) will remain in a submerged condition when the FPSO disconnects and leaves the site; the length of the flexible jumpers will allow accommodation to the neutrally buoyant depth (maximum 75 meters below the surface) of the FPSO turret buoy, mitigating hazards related to hurricanes, near surface currents, and marine traffic

- The FSHRs will be designed per API RP 2RD

- The top of the FSHR buoyancy cans will be approximately 200 meters below the surface in the FPSO-connected and FPSO-disconnected conditions, mitigating hazards related to hurricanes, near surface currents, and marine traffic

- An exclusion zone will be established around the FPSO marine spread to further mitigate marine traffic; the exclusion zone will be large enough to address the lengths of the FPSO + hawser + Shuttle Vessel + tug line + tug + safety buffer (including a "far condition" assuming a damaged mooring line) multiplied by two due to weathervaning, subject to USCG approval

- For planned FPSO disconnection scenarios (i.e. named storms which originate outside of the GoM), the FSHRs (and flowlines) will be depressurized and displaced with diesel for flow assurance reasons prior to disconnection

- For unplanned FPSO disconnection scenarios (i.e. named storms which originate in the GoM), the FSHRs (and flowlines) will only be depressurized prior to disconnection with the potential consequences of hydrate formation being addressed at FPSO re-connection

Flowlines

- Due to the presence of the deepwater "furrows" (i.e. irregular seabed undulations of unclear origin with a typical trough to crest spacing on the order of 50-300', amplitudes on the order of 10-30', and slopes in the range of 5-20 degrees from horizontal) along most of the Chinook flowline route to the FSHR riser base near the FPSO, special span remediation measures will be taken (if needed, to be determined in detailed design) to ensure that the pipe stresses and strains are controlled within the allowable limits

FPSO – General (Technology New to GoM)

- FPSO will have a single point mooring (SPM) system with a disconnectable feature which will allow her to disconnect and motor away from named storms and hurricanes under her own power, returning for re-connection when it is safe to do so; this provides a step change reduction in risk regarding the protection of people, the environment, and assets (see FPSO – Single Point Mooring System heading below for more specific safety and spill prevention measures related to this feature)

- A Hurricane Avoidance Plan will be developed to describe the operational aspects of hurricane avoidance including considerations related to watch circles, disconnection and re-connection criteria, voyage planning, etc.

- See FPSO – Offloading to Shuttle Vessels heading below for more specific safety and spill prevention measures related to offloading

- See FPSO – Torpedo Piles heading below for more specific safety and spill prevention measures related to torpedo piles (stationkeeping focus)

- See FPSO – Polyester Mooring System heading below for more specific safety and spill prevention measures related to polyester mooring (stationkeeping focus)

- A Conversion Survey will be performed to identify work scope needed for 1.) vessel life extension and 2.) achievement of the no "dry docking objective" for the duration of the established term of production operations; an In-Service Inspection Plan will be utilized for in-situ inspections in lieu of dry docking

- USCG to issue a Certificate of Compliance (COC) for the foreign flagged FPSO prior to first production to certify readiness

- Classification Society to verify requirements of Flag State are satisfied

- Structures CVA (i.e. the Classification Society) will verify the acceptability of design, fabrication, and installation for any new or modified components

- FPSO will have a double hull (sides and bottom) in keeping with OPA90 requirements; hull is outfitted with segregated cargo tanks

- FPSO outfitted with a Cargo Monitoring System

- FPSO outfitted with an Inert Gas System

- FPSO outfitted with a Crude Oil Washing System for cargo tanks

- FPSO outfitted with a Ballast Monitoring System
- An Operations Manual will be developed to manage diesel and other fluid transfers from supply vessels to the FPSO
- A comprehensive motion analysis will be performed for the topsides production facilities to verify the design accommodates dynamic conditions to be encountered on the FPSO
- PAI will utilize a two tiered FPSO acceptance testing process to verify readiness and compliance with technical specifications / regulations prior to mobilization of the FPSO to the lease
- Use of a Shipboard Oil Pollution Emergency Plan (SOPEP) bridged into the PAI Regional Oil Spill Response Plan

FPSO - Single Point Mooring System (Technology New to GoM)

- Model testing will be performed to 1.) verify no clashes between the turret buoy, mooring lines, FSHRs, and umbilicals in the FPSO-connected and FPSO-disconnected conditions, 2.) verify the Single Point Mooring (SPM) system will have the ability to withstand the various wind, wave and current profiles in the FPSO-connected and FPSO disconnected scenarios, 3.) simulate the FPSO re-connection process using the established criteria for environmental conditions, and 4.) verify the motions of the connected FPSO
- For planned FPSO disconnection scenarios (i.e. named storms which originate outside the GoM), the duration of the complete disconnection process including any preparation work related to flow assurance mitigation will be approximately 24 hours
- For unplanned FPSO disconnection scenarios (i.e. named storms which originate in the GoM), the duration of the complete disconnection process which does not including any preparation work related to flow assurance mitigation will be approximately 10 hours
- Planned and unplanned FPSO disconnections will be able to be performed with no hydrocarbon release to the environment; each hydrocarbon connection between the turret and turret buoy will be equipped with two valves and the means to isolate and purge the connection prior to release of the turret buoy

- A dedicated turret hydraulic power unit (HPU) and / or accumulator bank will be provided for operating the connection devices; the HPU will have its own redundant charging system in case of pump failure and will have the ability to monitor the accumulator header pressure and automatically recharge the bank to its desired working pressure

- Planned and unplanned FPSO disconnections will be able to be performed in a "blackout" scenario (i.e. no electrical power to dedicated turret HPU from FPSO main power generators) via the FPSO emergency generator

- The connection system shall be fully tested prior to incorporation into the SPM system onboard the FPSO and will allow for monthly in-situ testing of the connector without disconnecting the buoy

- The turret-to-buoy connection will have a double isolation (barrier) capability; the buoy-side valve will be a failsafe to close valve and is considered a boarding shutdown valve which will be periodically leak tested in compliance with regulations

- All swivel components in the swivel assembly shall satisfy the appropriate hazardous area classification requirements

- The interface between the turret and turret buoy will include a sealing capability; all external seals will be suitable for continuous service in a marine environment

- A leak detection and recovery system will be installed in the swivel for safe recovery of any leaks

- The turret / turret buoy connection device will not require local manual intervention for the final disconnect operation; the device will be controlled remotely

- Turret will be designed with the appropriate systems and facilities to accommodate periodic human occupation (ventilation, lighting, access walkways / ladders, two independent escape routes, firefighting, etc.)

- The turret buoy retrieval equipment (i.e. winch) will be designed to haul in the turret buoy within the established environmental conditions with the turret buoy intact or with one of its compartments flooded (i.e. damage condition)

- A means will be provided for determining whether the turret buoy connector device is properly presented for re-connection (i.e. position indicator)

- After each FPSO re-connection and prior to the introduction of pressurized fluids, the integrity of connections will be verified (i.e. leak testing or another approved method)

- CCTV will be located to view critical connection system devices while the turret is flooded

- All retrieval lines left floating on the surface to facilitate turret buoy retrieval operations will have marking / signaling devices

FPSO - Polyester Mooring System (Technology New to GoM)

- Life cycle management of the polyester components of the mooring system will be managed through a comprehensive Inspection, Maintenance, Repair, and Replacement (IMRR) Plan

- New polyester ropes will be qualified and tested according to ISO 18692 or API RP2 SM and approved by the Classification Society

- A full ROV survey of the polyester mooring system will be performed before the FPSO commences production and thereafter once per year

- Short rope inserts will be incorporated into the upper part of the string to accommodate periodic analysis of the residual strength of the polyester mooring system; ropes will be pulled and tested after major events (i.e. hurricanes) and at specified intervals per API requirements

- Polyester ropes will not be allowed to be laid on the seafloor during or after installation

- Polyester ropes will have filters to minimize the chance of damage by the ingress of soil and organisms

- Fiber work ropes (instead of wire ropes) will be used to mitigate damages to polyester mooring lines during installation

- A complete spare mooring line will be kept at all times

- FPSO mooring system will be designed to withstand the forces of the FPSO and Shuttle Vessel in a tandem offloading configuration

- Polyester mooring system will be designed for survival requirements in line with the FSHR environmental criteria

FPSO - Torpedo Piles (Technology New to GoM)

- During the geotechnical design phase, the minimal acceptance criteria for penetration and inclination considerations to be achieved during installation of the torpedo piles is defined by comparing the required design load against the mechanical and strength properties of the soil foundation
- Actual penetration and inclination results achieved during installation is compared against the minimal acceptance criteria to determine acceptability by the Classification Society

Shuttle Vessels (Technology New to GoM)

- PAI has defined the maximum age limit of Shuttle Vessels to be no more than 20 years old at any time during the term of operations; the only exception is for the "bridge vessel" (i.e. initial vessel that could be used for up to two years due to Jones Act fleet market constraints), but such a vessel would be subject to a more in-depth technical assessment to verify acceptability prior to utilization
- Perform a comprehensive Condition Survey of the Shuttle Vessels prior to utilization
- Utilize dedicated Shuttle Vessels
- USCG to issue a Certificate of Inspection (COI) for the US flagged vessels prior to utilization to certify readiness
- Classification Society (ABS) to verify requirements of Flag State (USA) are satisfied
- Shuttle Vessel will have a double hull (sides and bottom) in keeping with requirements of OPA90; hull is outfitted with segregated cargo tanks
- Shuttle Vessel cargo tanks outfitted with an Inert Gas System
- Shuttle Vessel outfitted with a Ballast Monitoring System
- Shuttle Vessel outfitted with a Crude Oil Washing System for cargo tanks
- Shuttle Vessel cargo system will be pressure tested during drydocking
- Use of a Shipboard Oil Pollution Emergency Plan (SOPEP) bridged to the PAI Regional Oil Spill Response Plan

- Shuttle Vessels will discharge crude oil at terminals per existing regulatory requirements for tankers and per requirements of terminal operators

FPSO - Offloading to Shuttle Vessels (Technology New to GoM)

- Key personnel on the FPSO and Shuttle Vessels will witness offloading operations in Brazil and will be trained on offloading simulators
- Utilize a formal surveillance (i.e. watchkeeping) procedure from FPSO and Shuttle Vessel during offoading
- Develop communications procedures between the FPSO and Shuttle Vessel for approach, mooring, offloading, and departure
- Shuttle Vessel will be outfitted with a Controllable Pitch Propeller (CPP) and an Internal Bow Thruster (IBT) to increase stationkeeping, maneuverability, and control during offloading
- Shuttle Vessel will be outfitted with a Bow Loading System (BLS) which minimizes the need for "hands-on" human intervention
- FPSO will be outfitted with a Stern Discharge System (SDS) which minimizes the need for "hands-on" human intervention
- Shuttle Vessel will weathervane with the FPSO (acting as one "system") in a tandem mooring configuration
- A 150 meter hawser (i.e. mooring line between FPSO and Shuttle Vessel) will be used to maintain a safe distance between the FPSO and the Shuttle Vessel
- A dedicated field standby tug shall assist the Shuttle Vessel during offloading
- Develop a comprehensive Offloading Manual (one procedure used by FPSO and Shuttle Vessels) approved by USCG
- Define environmental criteria for approach, mooring, and offloading
- Utilize an Offloading Telemetry System between the FPSO and Shuttle Vessel to verify when all offloading controls are in "green-line" status (i.e. safe to offload)
- Utilize an Offloading Emergency Shut Down system (OESD1 and OESD2)

- Periodic testing of the OESD1 and OESD1 systems
- Use of operational "sectors" (e.g. green, yellow, and red) to maintain a safe orientation (i.e. relative angles) between the FPSO and the Shuttle Vessel during offloading
- Utilize a hawser tension monitoring system
- Utilize a hawser / hose emergency disconnection system
- Utilize a double carcass offloading hose
- Utilize a retractable offloading hose which is stored on FPSO when not in use
- Test offloading hose before each use
- Clean offloading hose after each use
- Utilize an alternate offloading hose (midship) when primary hose is not functional due to damage or maintenance
- Utilize CCTV to support spill detection during offloading
- Utilize infrared leak detection during offloading

2 General Information

2(a) Applications and Permits

No individual or site specific applications or permits will be required for Phase 1 of the development plan beyond those required by 30 CFR 250 (e.g. Surface Safety Application, Application to Drill Permit, ROW Pipeline Permit) or the USCG (e.g. Certificate of Compliance for foreign flagged FPSO, Certificate of Inspection for Shuttle Vessels). Per NTL 2006 G14, coverage under the National Pollutant Discharge Elimination System (NPDES) General Permit or Core of Engineers (COE) permits are not described in this section.

2(b) Drilling Fluids

Phase 1 of the development plan will include the drilling and completion of three new wells (two wells in Cascade Unit and one well in Chinook Unit). Table 2-1 shows the types and amounts of drilling fluids that would be used to drill the three wells.

Table 2-1 – Drilling Fluids

Type of Drilling Fluid	Chemical Constituents	Estimated Volume of Fluid to be Used / Discharged per Well (barrels)
Water based	Seawater, freshwater, barite	16,000 / 16,000
Synthetic based	Internal olefin	8,500 / 750
Oil based	Diesel, mineral oil	0 / 0

2(c) Production

Table 2-2 depicts information about production rates that are anticipated for Phase 1 of the development plan.

Table 2-2 – Production Rates

Type	Phase 1 Average Production Rate (1)	Phase 1 Peak Production Rate (1)	Peak Production Rate (2)	Duration of Phase 1 Production Operations (3)
Oil	Proprietary	Proprietary	Proprietary	6-8 years
Gas	Proprietary	Proprietary	Proprietary	6-8 years

Notes :

1. Production rates for Phase 1 are based upon 3 producing wells. Although PAI anticipates additional wells to be drilled during the 6-8 years of Phase 1 production operations, the number and location of the wells to be drilled in subsequent phases is currently unknown. PAI will submit a Supplemental DOCD which will reflect production from all wells operated during Phase 1 production operations when more information becomes available regarding the post Phase 1 drilling and completion program.

2. The information shown in this column reflects the design capacity of the FPSO. PAI anticipates production rates which will approach or meet the design capacity of the FPSO after approximately 4 years of production operations. Note that such production rates assume additional wells (outside the scope of Phase 1) will be producing.

3. The standard column heading "Life of Reservoir" does not accurately portray the Phase 1 development plan. The life of the reservoirs in Cascade and Chinook will be verified during Phase 1 and communicated in the Supplemental DOCD that will be submitted to cover future phases.

2(d) Oils Characteristics

Table 2-3 describes the chemical and physical characteristics of the produced oil from the Cascade and Chinook reservoirs.

Table 2-3 – Oils Characteristics

Area / Block	WR Block 250	WR Block 425
MMS Platform ID #	N/A	N/A
Field / Unit	Cascade Unit 206	Chinook Unit 425
Sample Date	(1)	(2)
Sample #	(1)	(2)
Well #	WR206#1, WR206#1bp1, WR206#2, WR250#2ST1	WR469#1
Storage Tank ID #	N/A	N/A
Gravity (API)	17 - 26	22 - 29
Flash Point (°C)	Unknown	Unknown
Pour Point (°C)	-16 to -24	-6 to -12
Dynamic Viscosity (Centipoise at 16°C)	29 - 600	63 - 132
Dynamic Viscosity (Centipoise at 38°C)	18 - 221	1 -2
Wax Content (wt %)	1.7 - 4.1	2.8 - 4.9
Asphaltene Content (wt %)	4.7 - 22.2	5.1 - 12.6
Resin Content (wt %)	20.4 - 36.1	15.3 - 25.8
Sulphur (wt %)	3.5	3.5

(1) 164 samples from April 15, 2002 to December 18, 2005 [information above is representative]
(2) 28 samples from May 16-18, 2003 [information above is representative]

The information included in Table 2-3 represents the chemical and physical characteristics of oil that could be spilled in the largest volume spill during Phase 1 of the development plan.

2(e) New or Unusual Technology

The Conceptual Plan previously approved by the MMS identified six components of the Phase 1 development plan that are considered technologies new to the GoM. Although MMS considers these components "new or unusual" technology, Petrobras (PAI's parent company) and other major operators have successfully used these technologies in other regions of the world.

These technologies new to the GoM include :

- Principal facility is a Floating Production, Storage, and Offloading (FPSO) vessel which utilizes a disconnectable single point mooring system
- Mooring system may use polyester mooring legs
- Torpedo Piles may be used to attach the FPSO mooring lines or other selected subsea facilities to the seabed
- Shuttle Vessels will be used to transport crude from the FPSO to market
- Free Standing Hybrid Risers (FSHRs) will be used to 1.) transport production fluids from the seabed to the FPSO and to 2.) transport gas from the FPSO to the export pipeline system
- Subsea booster pumps located on the seabed near the wells will be used to enhance production rates

PAI has met with the MMS Technical Assessment and Operations Support (TAOS) Section during the conceptual design phase to demonstrate the safety and reliability of the technologies new to the GoM. PAI has also facilitated high level discussions regarding the technologies new to the GoM with the MMS Plans and MMS Pipeline Sections. Each of the following sections will provide a summary description of each technology new to the GoM and the rationale for selection.

The most important safety and pollution prevention features that will be used to mitigate hazards related to technologies new to the GoM are described in Section 1(f).

FPSO

FPSOs are the most widely used floating production systems worldwide and have been in use since 1977. As of August 2006, 106 FPSOs were in service worldwide and another 21 were under construction or being converted (Nutter and Albaugh 2006). In 1999, there were 71 FPSOs in service (the latest data presented in the FPSO EIS), which shows the rapid increase in the use of this type of deepwater production system (MMS 2001).

Table 2-4 provides an overview of the number of FPSOs being utilized in the world in 2006.

Table 2-4 - FPSOs Worldwide

Country	Number
Brazil	15
China	13
United Kingdom	13
Australia	10
Nigeria	10
Angola	6
Indonesia	6
Norway	5
Vietnam	5
Equatorial Guinea	3
Total	87

Source: Nutter and Albaugh 2006

Petrobras is the primary oil and gas operator in Brazil and utilizes FPSOs and other Floating Production Units (FPUs) extensively in the deep waters of Brazil. Table 2-5 below provides an overview of the number of FPUs (FPSOs, FSOs, and Semi-Submersibles) that Petrobras has utilized over the past 30 years in Brazil. Petrobras also has six FPSOs under construction and another one under bid that are not represented in the table.

Table 2-5 – Petrobras Floating Production Units

Unit	Type	Field	Water Depth (m)	Oil Capacity (bpd)	Start	End
SEDCO-135D	SS	Enchova	120	30,000	1977	1980
PP MORAES	FPSO	Garoupa/Namorado	120	40,000	1979	1985
PENROD 72	SS	Enchova Leste	111	30,000	1979	1983
SEDCO-135E	SS	North Garoupa	113	10,000	1979	1982
SEDCO-135D	SS	Pampo	117	30,000	1980	1981
TRANSWORLD 61	SS	Pampo/Linguado	105	20,000	1980	1983
SEDCO-135D	SS	Bicudo	135	30,000	1982	1988
SEDCO-135E	SS	Garoupinha	113	10,000	1982	1986
PENROD 71	SS	Bonito	190	45,000	1982	1984
STAFLO	SS	South Pampo	117	50,000	1983	1988
TRANSWORLD 61	SS	Trilha	100	20,000	1983	1989
P-09	SS	Corvina	225	40,000	1983	-
P-15	SS	Pirauna/Marimbá	244	45,000	1983	-
P-12	SS	Linguado	100	38,000	1984	-
OCEAN ZEPHIR-I	SS	Viola	127	25,000	1985	2001
PENTAGONE 7	SS	Parati/Anequim	99	25,000	1985	1989
P-22	SS	Moreia	114	10,000	1986	2003
PP MORAES	FPSO	Albacora	224	60,000	1987	1993
P-07	SS	Bicudo	209	50,000	1988	1995
P-21	SS	Badejo/Trilha	100	40,000	1989	1997
SEDCO-135D	SS	Enchova	120	30,000	1989	1999
P-13	SS	Marlim	640	25,000	1991	1992
P-20	SS	Marlim	625	50,000	1992	-
P-24	SS	Albacora	230	60,000	1993	2002
P-08	SS	Pirauna/Marimbá	429	60,000	1993	2000
P-13	SS	Bijupira/Salema	625	25,000	1993	2000
P-18	SS	Marlim	910	100,000	1994	-
P-25	SS	Albacora	575	100,000	1996	-
P-19	SS	Marlim	770	100,000	1997	-
P-26	SS	Marlim	990	100,000	1997	-
P-34	FPSO	Barracuda	840	45,000	1997	2002
P-32	FPSO	Marlim	160	130,000	1998	-
P-31	FPSO	Albacora	330	100,000	1998	-
P-33	FPSO	Marlim	780	50,000	1998	-
P-27	SS	Voador	533	43,000	1998	-
P-21	SS	Marimbá Leste	700	21,000	1998	2002
Alagoas	FSO	Caravelas	550	N/A	2001	-
Avaré	FSO	Marimbá Leste	550	N/A	1998	2002
SEILLEAN	FPSO	Roncador	1,853	20,000	1999	2002
P-35	FPSO	Marlim	850	100,000	1999	-
FPSO II	FPSO	Marlim Sul	1,420	20,000	1997	1998
	FPSO	Marlim Sul	1,215	20,000	1999	2002
P-36	SS	Roncador	1,340	180,000	2000	2001
P-47	FSO	Roncador	815	N/A	2000	2001
ESPADARTE FPSO	FPSO	Espadarte	950	100,000	2000	-
P-37	FPSO	Marlim	905	150,000	2000	-
P-38	FSO	Marlim Sul	1,020	N/A	2001	-
P-40	SS	Marlim Sul	1,080	150,000	2001	-
SEILLEAN	FPSO	Jubarte	1,450	20,000	2002	-
SEDCO-135D	SS	Enchova	120	65,000	2002	-
FPSO BRASIL	FPSO	Roncador	1,350	90,000	2002	-

Unit	Type	Field	Water Depth (m)	Oil Capacity (bpd)	Start	End
FPSO MARLIM SUL	FPSO	Marlim Sul	1,250	100,000	2002	-
P-43	FPSO	Barracuda	800	150,000	2004	-
P-48	FPSO	Caratinga	1,040	150,000	2005	-
P-50	FPSO	Albacora Leste	1,240	180,000	2006	-
P-51	SS	Marlim Sul	1,255	180,000	2007	-
P-52	SS	Roncador	1,800	180,000	2006	-
P-47	FPSO	Marlim	189	125,000	2005	-
P-53	FPSO	Marlim Leste	1200	180,000	2007	-
P-54	FPSO	Roncador	1250	180,000	2006	-
P-34-JK	FPSO	Jubarte	1280	60,000	2006	-
CAPIXABA	FPSO	Golfinho	1300	100,000	2006	-
RIO DE JANEIRO	FPSO	Espadarte	980	100,000	2006	-
CIDADE DE VITORIA	FPSO	Golfinho	1350	100,000	2006	-
PRA-MB	FSO	PRA	190	500,000	2006	-
P-55	SS	Roncador	1850	200,000	2008	-
P-57	FPSO	Jubarte	1300	300,000	2008	-
SIRI	FPSO	Siri	220	30,000	2008	-
EPS	FPSO	Generic	500Max	30,000	2008	-
Jabuti	FPSO	Jabuti	1000	100,000	2008	-

FPSO = Floating Production Storage and Offloading facility

FSO = Floating Storage and Offloading facility

SS = Semi-Submersible facility

Based on this experience, Petrobras is considered by many in industry as a leader in deepwater technology. PAI will leverage the extensive deepwater and FPSO experience of Petrobras for Phase 1 of the development plan.

PAI is proposing to utilize an FPSO for Phase 1 of the development plan because 1.) there is no existing product transportation infrastructure in Walker Ridge and 2.) FPSOs are by nature an ideal development concept for phased development plans.

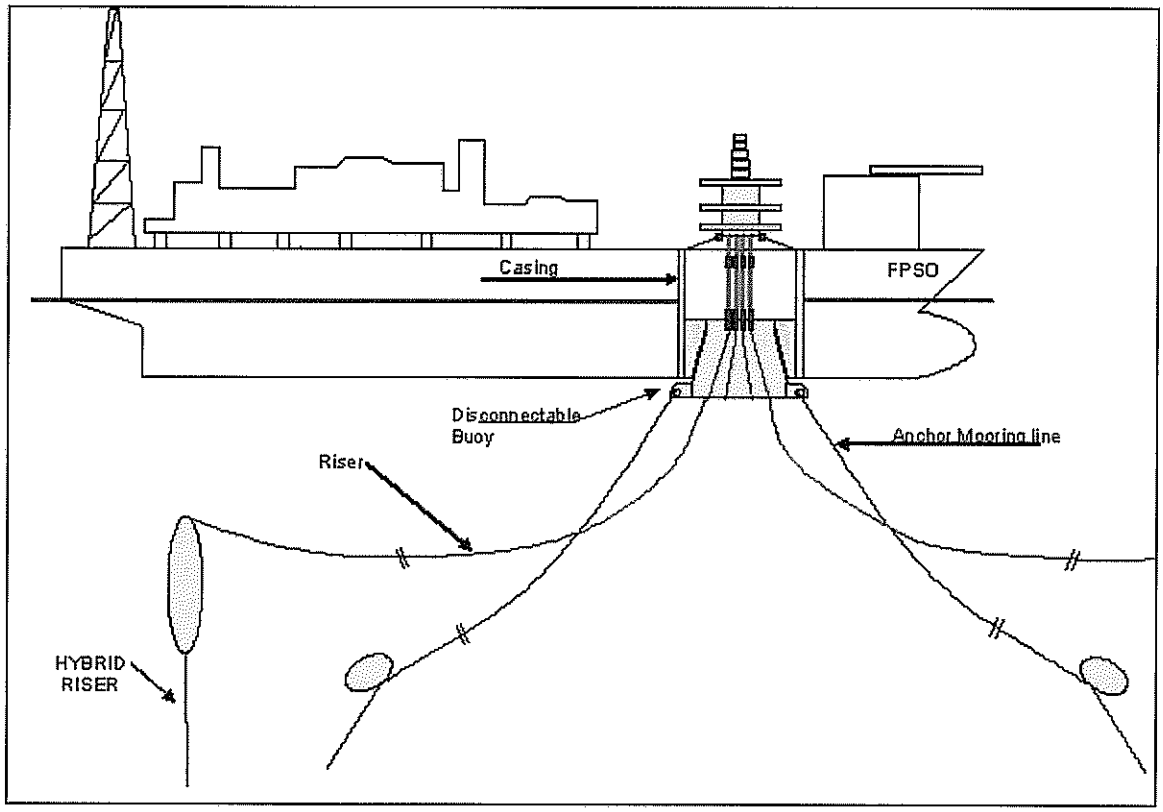
The development plan for Phase 1 includes the use of a ship shaped FPSO as the host production facility. Produced oil from Cascade and Chinook will be separated, treated, measured, and temporarily stored on the FPSO prior to transportation to market via Shuttle Vessels.

The FPSO will be an existing converted tanker modified for use in GoM. The FPSO will be a foreign flagged vessel which will be given a Certificate of Compliance by the USCG prior to first oil production. The Certificate of Compliance will demonstrate that the FPSO satisfies all of the requirements of the flag state, which will be generally consistent with USCG regulations for US flagged vessels. A foreign flagged vessel is the preferred option as there are no existing Jones Act tankers available for conversion which meet the project requirements.

The FPSO will be double hulled with segregated cargo and ballast tanks. The FPSO will have a cargo tank capacity of 550,000 – 850,000 barrels.

The FPSO will have a single point mooring (SPM) system which will allow for full passive weathervaning. The SPM will have a disconnectable feature which will allow the FPSO to disconnect and motor away from named storms and hurricanes under her own power, returning for re-connection when it is safe to do so. The disconnectable feature provides a step change reduction in risk regarding the protection of people, the environment, and assets in areas where hurricanes (or typhoons) are a possibility. The extraordinary damages to the GoM oil and gas infrastructure due to the severe hurricanes of 2005 are a testament to the need for development concepts which can avoid exposure to hurricanes in the GoM. See Figure 2-1 to review an illustration showing the disconnectable single point mooring system concept.

Figure 2-1 – Disconnectable Single Point Mooring System



To date, a number (PAI knows of 16) of disconnectable systems have been installed in the world and have been proven safe and reliable. Most of these systems are in typhoon prone areas such as Western Australia and the South China Sea. Two disconnectable systems have been installed off the Canadian / Newfoundland coast for iceberg avoidance.

The FPSO will be designed to remain on station for 1.) a 100 year return winter storm with a 1 year return loop current and 2.) a 100 year return loop current with a 1 year return winter storm, and 3) in alignment with regulatory and classing requirements. The FPSO will disconnect for names storms and hurricanes, with no hydrocarbon release to the environment. After disconnection, the turret buoy (which is attached to the mooring lines, FSHRs, and umbilicals) will be left behind in a submerged condition out of harms way of the environment conditions at the surface. See Figure 2-2 to review a conceptual representation of the FPSO in her connected and disconnected conditions.

Figure 2-2 – FPSO in Connected and Disconnected Conditions

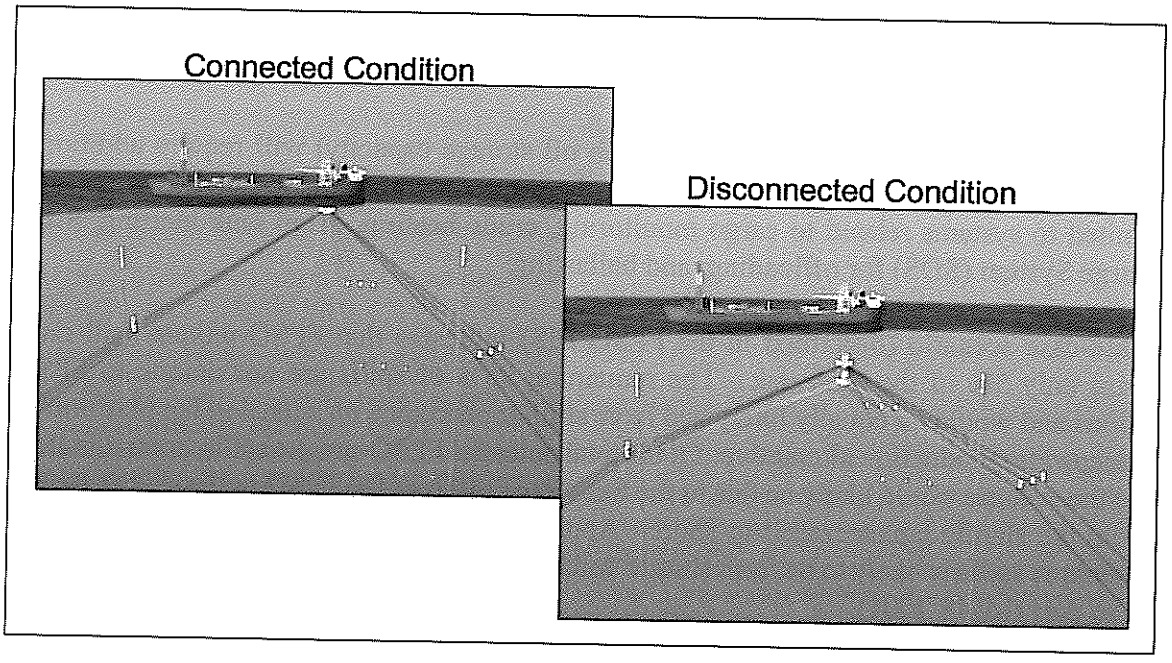


Table 2-6 describes the design capacities of the topsides facilities on the FPSO :

Table 2-6 – FPSO Topsides Design Capacity

Capacity	Maximum
Oil	80,000 bpd
Produced Water	16,000 bpd
Total Fluids	80,000 bpd
Gas	16 MMscfd

The process facilities will be located topsides on the FPSO and will be similar to process facilities utilized in existing deepwater facilities in the GoM, except that 1.) the design will consider motion analysis due to the dynamic environment to be encountered with a ship shaped FPSO hull and 2.) the process system will have special features in the turret (e.g. swivel) to accommodate weathervaning.

The nature of an FPSO (i.e. marine vessel with oil storage capacity) will require additional systems over and above those utilized in existing deepwater facilities in the GoM, including but not limited to systems related to cargo monitoring, crude heating, cargo tank inerting, Stern Discharge System (SDS) for offloading, and ballasting.

The base-case scenario (described in the FPSO EIS) indicates that FPSO-unique spill risks comprise only 5% of the total risk. The remaining 95% of spills are not unique to FPSO operations and would be equally likely and have similar outcomes on a tension leg platform or other deepwater production alternative. Of the total potential FPSO-unique spills, approximately 94% of the volume would likely be due to the transfer of oil from the FPSO to the shuttle tanker and from the shuttle tanker transit to shore. Approximately 54% of the volume of potential FPSO-unique spills is likely to be from shuttle tankers near port and 39% from shuttle tankers in transit to port (MMS 2001).

Advancing technology and increased environmental standards required of the oil and gas industry have lead to an overall decrease in accidental oil releases, particularly from tankers (International Tankers Owners Pollution Federation Limited [ITOPF] 2006). Interestingly, since oil releases have been decreasing over the years, the funding to track such events worldwide has also been decreasing.

Data provided by Petrobras on their FPSO developments in Brazil through December 2006 show no oil spills with environmental impact. Their overall record with FPSOs includes 3,500 operations and 2.2 billion barrels oil offloaded by FPSO by that time. The current average number of offloading operations is approximately 500 per year, with a similar performance record.

Polyester Mooring System

Petrobras has over 20 years of extensive experience with moorings incorporating polyester fiber ropes in the deep waters of offshore Brazil and is considered by many to be an industry leader in the use of polyester mooring systems.

To date, Petrobras has utilized polyester mooring lines in over 20 mooring systems for FPUs; another 7 units have been designed and will be installed in the near future.

The combination of design criteria, procedures, and life cycle management routines by Petrobras has resulted in no failures to date of polyester mooring lines.

PAI may utilize a polyester mooring system for the FPSO for Phase 1 of the development plan. If utilized, PAI will leverage Petrobras' extensive experience with polyester mooring systems. The rationale for choosing this option is that the technology has been proven safe and reliable while being more flexible and cost effective relative to steel mooring systems. Furthermore, the utilization of a polyester mooring system will allow the use of a significantly smaller turret buoy (due to less loads being sustained by the turret buoy) which will provide for enhanced safety and project viability.

The proposed single point mooring system for the FPSO will consist of a disconnectable turret buoy which is connected to the seabed via polyester ropes in a taut leg configuration with anchors capable of withstanding vertical uplift forces.

The mooring system will be designed to withstand the forces of the FPSO and Shuttle Vessel in a tandem offloading configuration. The mooring system will be designed to hold the FPSO and Shuttle Vessel on station in a 100 year return winter storm.

Mooring analysis will be performed using a computer program approved by the Classification Society and will be compared to the results of model testing.

The mooring system will comply with the requirements of API RP 2SK, API RP 2FPS, and the Classification Society. Polyester rope segments will be supplied, qualified, and tested according to ISO 18692 (2007) - Fibre Ropes for Offshore Stationkeeping (PAI preferred) or API RP 2SM (2001).

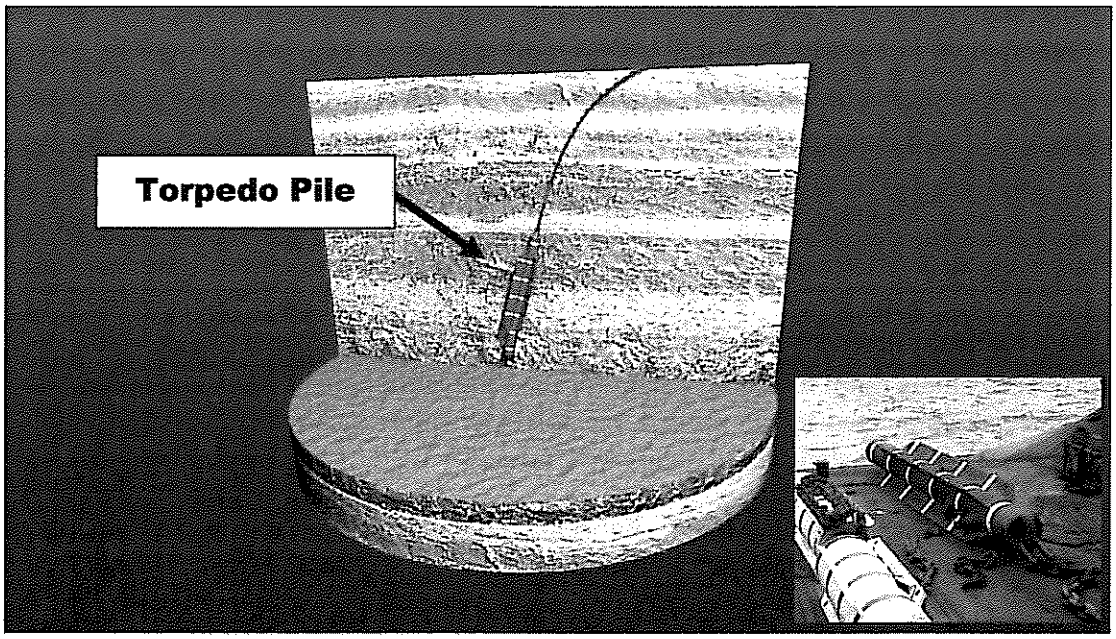
An Inspection, Maintenance, Repair, and Replacement (IMRR) Plan will be developed to manage life cycle considerations of the polyester mooring system.

Torpedo Piles

Petrobras originated and patented the torpedo pile anchoring system used in offshore Brazil in the late 1990s. Currently, more than 400 torpedo piles have been designed and installed for risers. Since 2000, torpedo piles have also been used on several MODUs. To date, 68 torpedo piles have been installed on FPUs.

Torpedo Piles function similar to suction piles and provide mooring points on the seabed with high horizontal and vertical holding capacity, thus eliminating the long, dead chain sections usually found in conventional catenary anchor leg systems. The dead chain section is a necessary feature of conventional anchor systems in order to prevent anchor lift. This is also a distinct advantage of Torpedo Piles in that the environmental impact on the seafloor is considerably less than suction piles. See Figure 2-3.

Figure 2-3 – Torpedo Piles



The design of torpedo piles in Brazil has been validated and optimized through extensive laboratory and in-situ testing. All torpedo piles installed in Brazil have been certified by the Classification Societies.

PAI may utilize torpedo piles during Phase 1 of the development plan. If utilized, PAI will leverage Petrobras' extensive experience with torpedo piles for Phase 1 of the development plan. The rationale for choosing this option is that the technology has been proven safe and reliable while being more cost effective and easier to design, fabricate, and install relative to suction piles.

Torpedo piles will be launched from a construction vessel during installation (from about 300 feet above the seabed). Their weight and momentum will be sufficient to drive the pile 70-100 feet into the seabed, providing the required vertical-load resistance. Torpedo piles will be installed with a high degree of accuracy.

During the geotechnical design phase, the minimal acceptance criteria for penetration and inclination considerations to be achieved during installation of the torpedo piles will be defined by comparing the required design load against the mechanical and strength properties of the soil foundation. Actual penetration and inclination results achieved during installation will be compared against the minimal acceptance criteria to determine acceptability by the Classification Society.

Shuttle Vessels

Petrobras operates one of the largest Shuttle Vessel fleets in the world and is currently performing approximately 500 offloadings a year in Brazil.

PAI will leverage Petrobras' extensive experience with Shuttle Vessels for Phase 1 of the development plan. The rationale for choosing this option is there is no existing product transportation infrastructure in Walker Ridge and the use of Shuttle Vessels will provide a safe and reliable alternative to pipelines. Furthermore, the FPSO EIS indicated that the risk of oil spills for Shuttle Vessel transport is comparable to and arguably better than pipeline transport.

PAI is proposing to charter two dedicated Shuttle Vessels for use during Phase 1 of the development plan. The Shuttle Vessels will be Jones Act OPA 90 compliant vessels and will have double hulls with segregated cargo tanks with a total capacity from 185,000 – 500,000 barrels. Existing vessels (modified to meet project requirements) or newbuild vessels may be utilized, depending on availability of the Jones Act fleet. The Shuttle Vessels will be either shuttle tankers or articulated tug barges (ATBs).

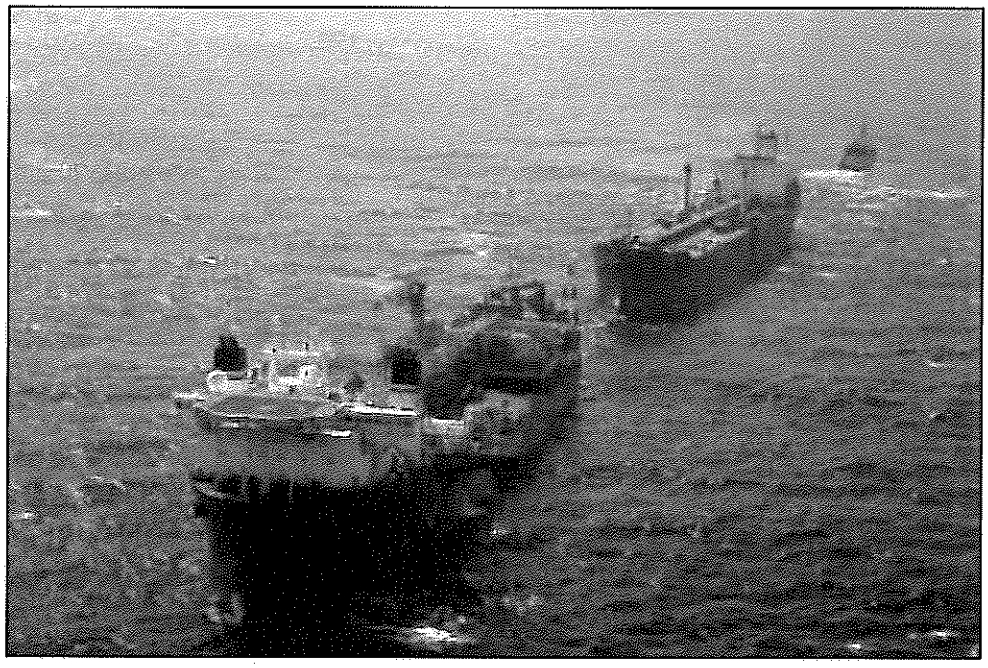
ATBs are currently used in the Jones Act fleet for production transportation in certain applications. ATB designs include a barge with a large, powerful twin screw tug positioned in a notch in the stern of the barge. The ATB has an articulated or "hinged" connection system between the tug and barge that allows movement in one axis, or plane, in the critical area of fore and aft pitch. Recent events in the GoM have proven the safety and reliability of ATBs with product loading and transportation on the OCS. When hurricanes damaged pipelines in 2005, at least four companies received waivers from the USCG to use ATBs to transport product from their platforms and bring it to shore. USCG has indicated they found no problems with the maneuverability of ATBs and the transfer and transportation operations have gone very smoothly, with no spills recorded. The newest generation of ATB's, such as those being considered by PAI, are designed with a hinged connection system that allows the tug to change vertical position relative to the barge without disconnecting or in any way jeopardizing full control of the barge. Additionally, ATB's chartered by PAI will have additional safety and firefighting systems onboard the barge which are not normally found on existing vessels in service. See Figure 2-4.

Figure 2-4 – Articulated Tug Barge

Shuttle Vessels will be similar to existing shuttle tankers utilized for lightering operations in the GoM. However, they will be outfitted with a Bow Loading System (BLS) to support offloading from the FPSO (which will be outfitted with a Stern Discharge System) as well as Controllable Pitch Propellers (CPPs) and Internal Bow Thrusters (IBTs) to enhance maneuverability for offloading operations.

During offloading, Shuttle Vessels will be connected to the FPSO via a hawser system (i.e. mooring line) and offloading hose between the bow of the Shuttle Vessel and the stern of the FPSO in a tandem offloading configuration. The Shuttle Tanker will weathervane in a similar manner as the FPSO (i.e. both vessels will react to the environmental conditions as one "system"). A dedicated field support tug will be utilized to support offloading. See Figure 2-5 to review and example of the tandem offloading configuration that will be utilized.

Figure 2-5 – Tandem Offloading Configuration



PAI will likely utilize one Shuttle Vessel to perform one offloading every two weeks in the first year of production operations (i.e. during production ramp-up). PAI will likely utilize two Shuttle Vessels (on a staggered schedule) to perform one offloading every week in subsequent years of production operations for Phase 1 of the development plan. The frequency of offloading will evolve over time as the frequency is driven by the size / speed / number of the Shuttle Vessels relative to the production profile of the reservoirs. Offloading from the FPSO to the Shuttle Vessel will take approximately 24 hours. This time frame also does not include approach, mooring, or disconnecting.

PAI has defined more conservative environmental operating criteria for FPSO offloading relative to the maximum operational conditions for GoM lightering operations as specified in 33 CFR 156.320. Parameters for shuttle approach and connection as well as offloading are summarized in Table 2-7.

Table 2-7 – Shuttle Vessel Environmental Operating Parameters

Activity	Description	Worst Acceptable Operating Condition
Shuttle Vessel Approach and Mooring	Wind	20 knots (*)
	Wave height	2.5 m Hs (*)
	Peak Period of wave	9 sec (*)
	Current	1.1 m/sec (*)
	Power Generation and Propulsion	80% of the power generation and propulsion in a continuous base.
	Visibility <1 nm	Approach and mooring can begin providing : • The visibility is more than 1000 meters ahead of the SV bow • The radar is operating correctly • The SV Captain and FPSO OOW agree it is safe to do so
	Visibility < 1000 m	Approach and mooring can begin providing : • The radar is operating correctly • The SV Captain, SBV Captain and FPSO OOW will together evaluate and agree upon whether safe conditions exists
FPSO Offloading to Shuttle Vessel	Wind	25 Knots (*)
	Wave height	3.4 m Hs (*)
	Peak Period of wave	9 sec (*)
	Current	1.5 m/sec (*)

(*) These operating conditions will be finalized based on studies and analyses performed during detailed design.

PAI will utilize a number of safety and pollution prevention controls to mitigate hazards associated with offloading; see Section 1(f) for details.

In general, the use of Shuttle Vessels to transport produced oil from the FPSO to terminals along the GoM coast does not provide any incremental oil spill exposure at terminals. The rationale is that the terminals are generally operating at full capacity; if a Shuttle Vessel associated with the Phase 1 development plan would not transport oil to a terminal that has available capacity, the available capacity will likely be filled by a "traditional" tanker loaded with oil from another source (US or foreign).

Shuttle Vessel product discharging operations at terminals will be managed under the terminal operator's established procedures for tankers. Shuttle Vessel discharging operations are not considered new or unusual technology and are subject to robust regulatory and terminal operator requirements.

Free Standing Hybrid Risers

The Free Standing Hybrid Risers (FSHR) concept is a proven solution for deepwater floating production systems and has been utilized in the deepwaters of West Africa on several major FPSO projects (e.g. Girassol, Kizomba A, Kizomba B). FSHRs are also currently being designed for use in the Angola Block 18 development in West Africa (Petrobras is a partner) and for the Petrobras Roncador Field in Brazil. A variation of the FSHR concept has also been used in the GoM on Placid's Green Canyon development and later in Ensearch's Garden Banks development. Although there are no existing FSHRs in the GoM, individual components used in the FSHR system are currently being used for similar applications in the GoM.

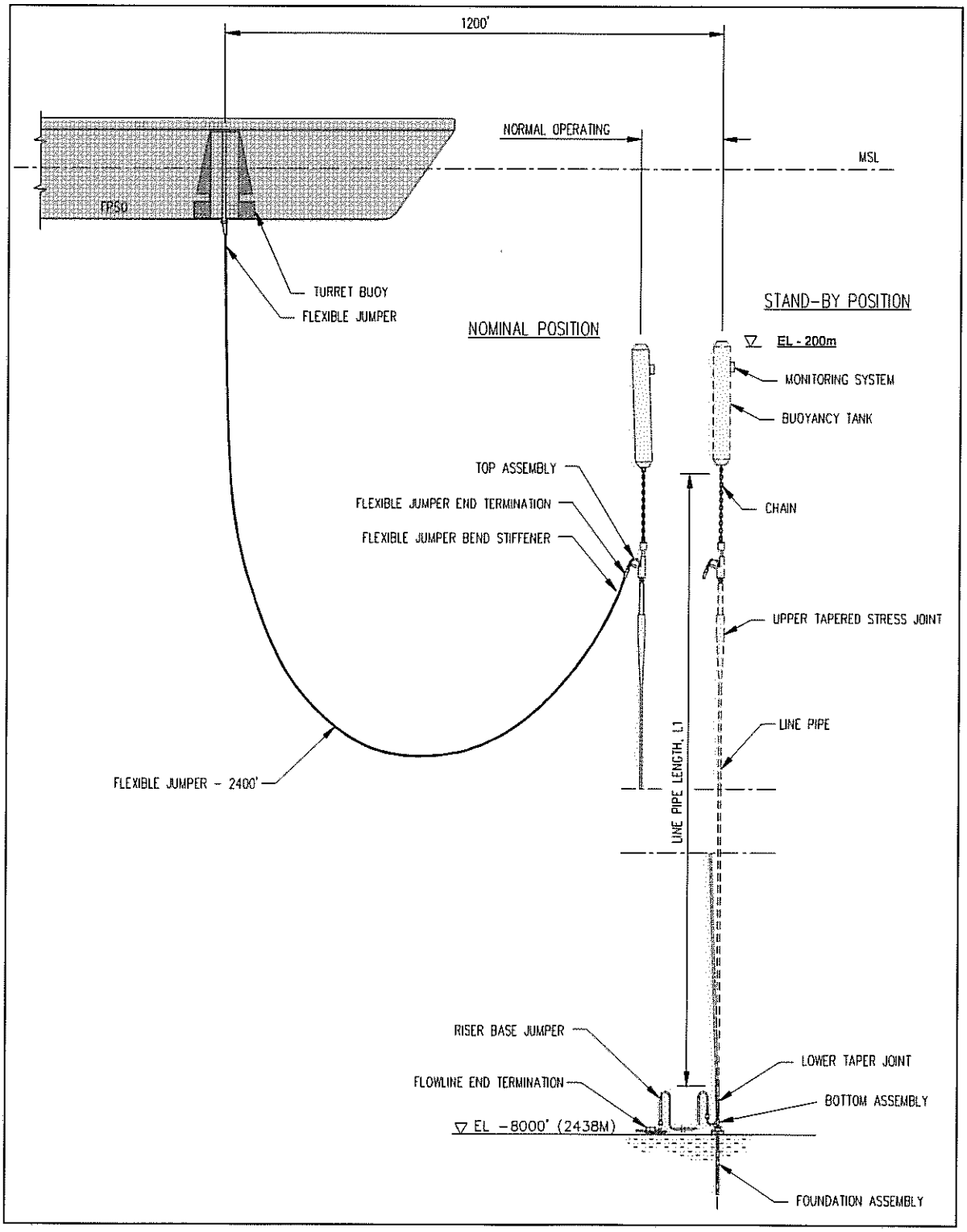
PAI will leverage Petrobras' experience with FSHRs for Phase 1 of the development plan. The rationale for choosing this option is based upon the following :

- Isolation from FPSO motions. The utilization of flexible jumpers effectively isolates the riser from the fatigue inducing motions of the FPSO
- Load reduction on FPSO turret buoy. The FPSO only needs to support the load of the flexible jumper from the vertical riser to the turret, compared with supporting the entire load a steel catenary riser in 8200 foot water depth
- Installation flexibility. An FSHR can be installed by a number of vessel types providing for flexibility
  - Retrievability. If required, an FSHR can be isolated and retrieved after installation without impacting production through the other FSHRs
  - Disconnectable turret. FSHRs are a good fit for utilization with a single point mooring system with a disconnectable feature

The development plan for Phase 1 includes four production FSHRs and one gas export FSHR, each located approximately 1200 feet from the FPSO in approximately 8200 foot water depth.

The free standing vertical riser design consists of a section of vertical line pipe (anchored to the seabed by a deep foundation) which is tensioned at the top by a buoyancy can. The free standing vertical riser is connected to the FPSO turret buoy by a flexible jumper. See Figure 2-6 for FSHR details.

Figure 2-6 – Free Standing Hybrid Riser Configuration



The top of the FSHR buoyancy cans will be approximately 200 meters below the surface when the FPSO is connected or disconnected.

FSHRs (which along with the mooring system and umbilicals are connected to the FPSO turret buoy) will remain in a submerged condition when the FPSO disconnects and leaves the site. The length of the flexible jumpers (approximately 2400 feet) will allow accommodation to the neutrally buoyant depth (approximately 75 meters below the surface) of the FPSO turret buoy.

For planned FPSO disconnection scenarios (i.e. named storms which originate outside of the GoM), the FSHRs (and flowlines) will be depressurized and displaced with diesel prior to disconnection to avoid hydrate formation. For unplanned FPSO disconnection scenarios (i.e. named storms which originate in the GoM), the FSHRs (and flowlines) will only be depressurized prior to disconnection with the potential consequences of hydrate formation being addressed at FPSO re-connection.

See Figure 2-2 for a conceptual representation of the condition of the FSHRs during the FPSO-connected and FPSO-disconnected conditions.

Subsea Booster Pumps

Due to the water depth, wellbore depth, and low bubble point of the production fluids, the hydrostatic pressure losses in the system are expected to be significant. Therefore, some form of artificial lift is required to enhance the production flow rates.

PAI has decided to utilize subsea booster pumps during Phase 1 of the development plan for enhancement of production flow rates. Other artificial lift options either do not meet field life boosting requirements (e.g. gas lift) or are not sufficiently proven or practical for high subsea flow rates. Although subsea booster pumps may not be needed in the early stages of Phase 1, the boosting system will be used to test various scenarios on the boosting pump operating curve as well as to assure that production rates remain high enough to avoid flow assurance issues (hydrate formation / wax deposition).

PAI is considering two options for subsea booster pumps; 1.) multiphase centrifugal pumps or 2.) electrical submersible pumps. Both options are mounted on skids installed on the seabed. See Figure 2-7 for a conceptual representation of the multiphase centrifugal pumps. See Figure 2-8 for a conceptual representation of the electrical submersible pumps.

Figure 2-7 - Multiphase Centrifugal Pumps

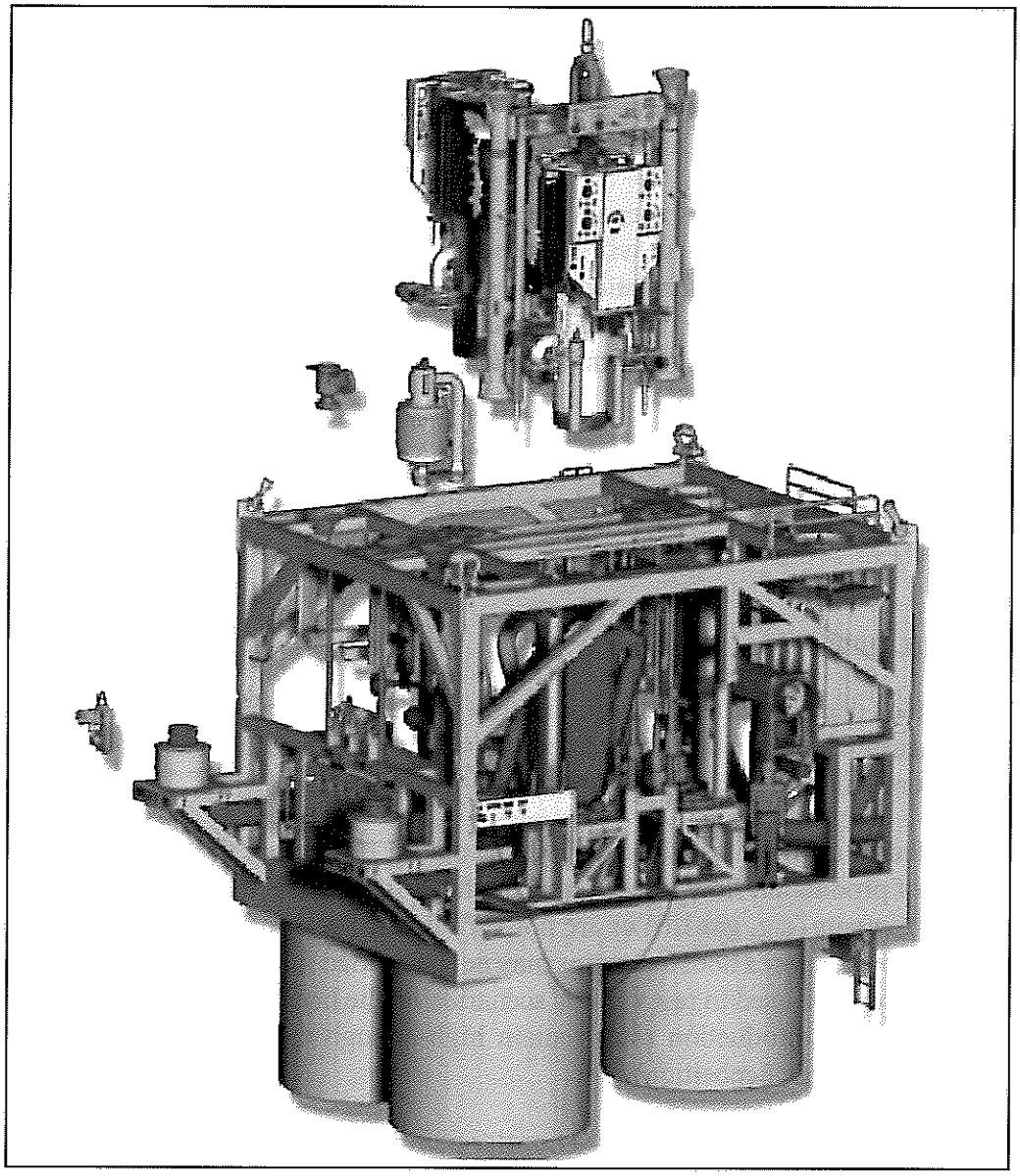
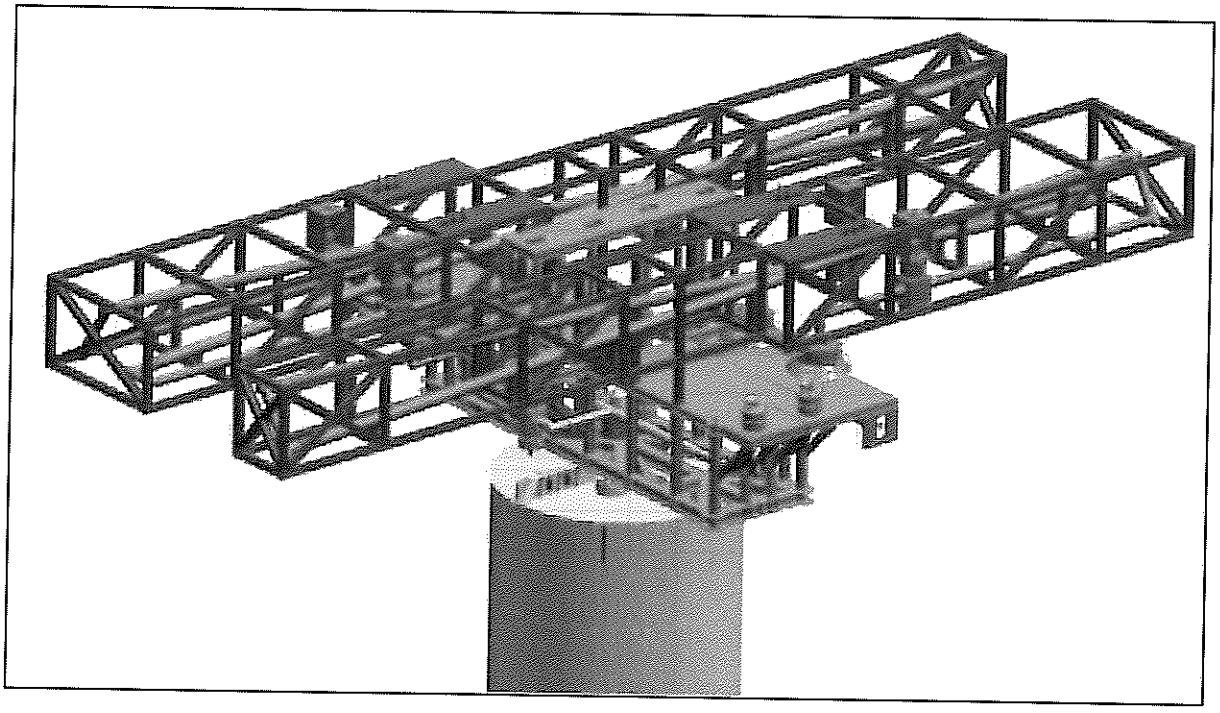


Figure 2-8 - Electrical Submersible Pumps



Both subsea booster pump options would utilize pump cartridges which could be removed from the seabed mounted skids for maintenance or replacement without disrupting production. This design is especially useful for electrical submersible pumps, which typically require periodic maintenance. Subsea electrical pumps have previously been utilized extensively downhole (i.e. in the wellbore), so this "new" packaging will allow for enhanced safety and economics by removing the need for intervention via a drilling rig.

Table 2-8 summarizes Petrobras' experience with subsea boosting systems. Petrobras is currently developing its Jubarte and Golfinho fields in Brazil using subsea boosting technology similar to the technology proposed for Cascade and Chinook.

Table 2-8 – Petrobras Experience with Booster Pumps

Subsea Boosting and Processing	Field	Water depth (meters)	Year of installation
First subsea boosting pump	Carapeba	90	1994
First deepwater subsea pump with horizontal tree	Albacora Leste	1109	1998
Vertical Annular Separation and Pumping System	Bonito	200	2001
Boosting pump on top of Christmas tree	Jubarte	1400	2004
1200 hp boosting pump on horizontal tree	Jubarte	1400	2005
Boosting pump on dummy well	Jubarte	1400	June 2006
Subsea Multiphase Boosting System	Marlim	600	To be installed
Raw Water Injection	Albacora	800	To be installed
Helico-axial Multiphase Pump	Barracuda	600	To be installed
Seabed mounted pump	Espadarte	1400	To be installed
Subsea Centrifugal Pumping System	Roncador	1800	To be installed
Subsea 3 phase separation	Marlim	800	To be installed

Source: PAI 2006

2(f) Bonding Statement

The bond requirements for the activities and facilities proposed in this DOCD are satisfied by an area wide bond, furnished and maintained in accordance with 30 CFR Part 256, Subpart and NTL 2000 G16 "*Guidelines for General Lease Surety Bonds*," and NTL 2003 N06 "*Supplemental Bond Procedures*."

2(g) Oil Spill Financial Responsibility

PAI (MMS Operator #1207) has demonstrated oil spill financial responsibility for the facilities proposed in this DOCD in accordance with 30 CFR Part 253 and NTL 99 N01 "*Guidelines for Oil Spill Financial Responsibility for Covered Facilities*."

2(h) Deepwater Well Control Statement

PAI (MMS Operator #1207) has the financial capability to drill a relief well and conduct other emergency well control operations.

2(i) Suspension of Production

In accordance with the PAI's Suspension of Production, which was approved by MMS letter dated July 31, 2006, PAI has committed to begin producing the Cascade Unit by November 2009 and the Chinook Unit by April 2011. The SOP activity schedule is included in Appendix 1.

2(j) Blowout Scenario

The following two worst case scenarios have been identified for Phase 1 of the development plan. The scenarios assume that the mechanical barriers to flow have failed, which would allow the well to flow uncontrolled at the sea floor. In both cases, the ability to intervene before this occurs is good assuming that the subsea wellhead connector profile is undamaged. A blowout preventer stack or isolation assembly could be positioned and latched on the profile and the well brought under control. This operation would take 3-10 days, excluding the time required to mobilize the rig. PAI anticipates no problems with mobilization of a drilling rig.

Estimated time to drill a relief well would be approximately 35 days including a 7 day mobilization. The chances of the well bridging over would be reasonably likely in an exploration well (see Table 2-9 and Figure 2-9), although the compressive strengths of the Wilcox group (Eocene-Paleocene), a prolific hydrocarbon producing sediment, make it more difficult.

The chances of a well bridging over in a completed well are very unlikely as shown in Table 2-10 and Figure 2-10.

Table 2-9 – Exploration Well

Estimated Flow Rate and Total Estimated Volume	Discharge	Reservoir	Notes
[redacted] bopd @ 10 days = [redacted] barrels	12 ¼" open hole annular flow around drill pipe SSWH 3700 psi hydrostatic column	Unstimulated 20 md permeability 500 ft. formation open	Results of Nodal analysis assuming uncontrolled blowout around drill pipe in an unstimulated reservoir w/o sand control.

Note: This is the estimated flow from an exploration well without stimulation. This assumes that there is an uncontrolled flow at the sea floor up the 12¼-inch hole, around drill pipe, with 500 feet of pay drilled.

Figure 2-9 – Exploration Well

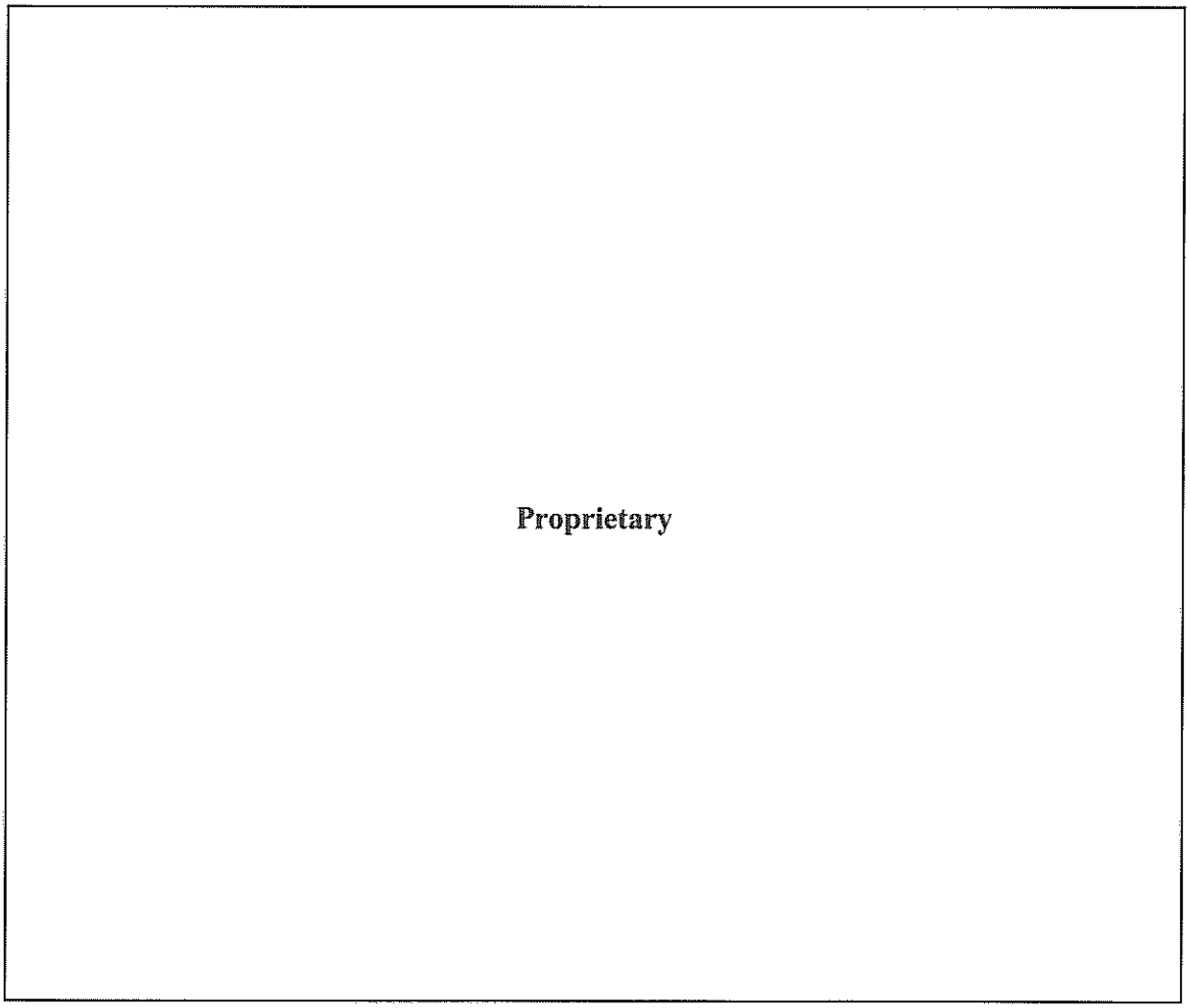
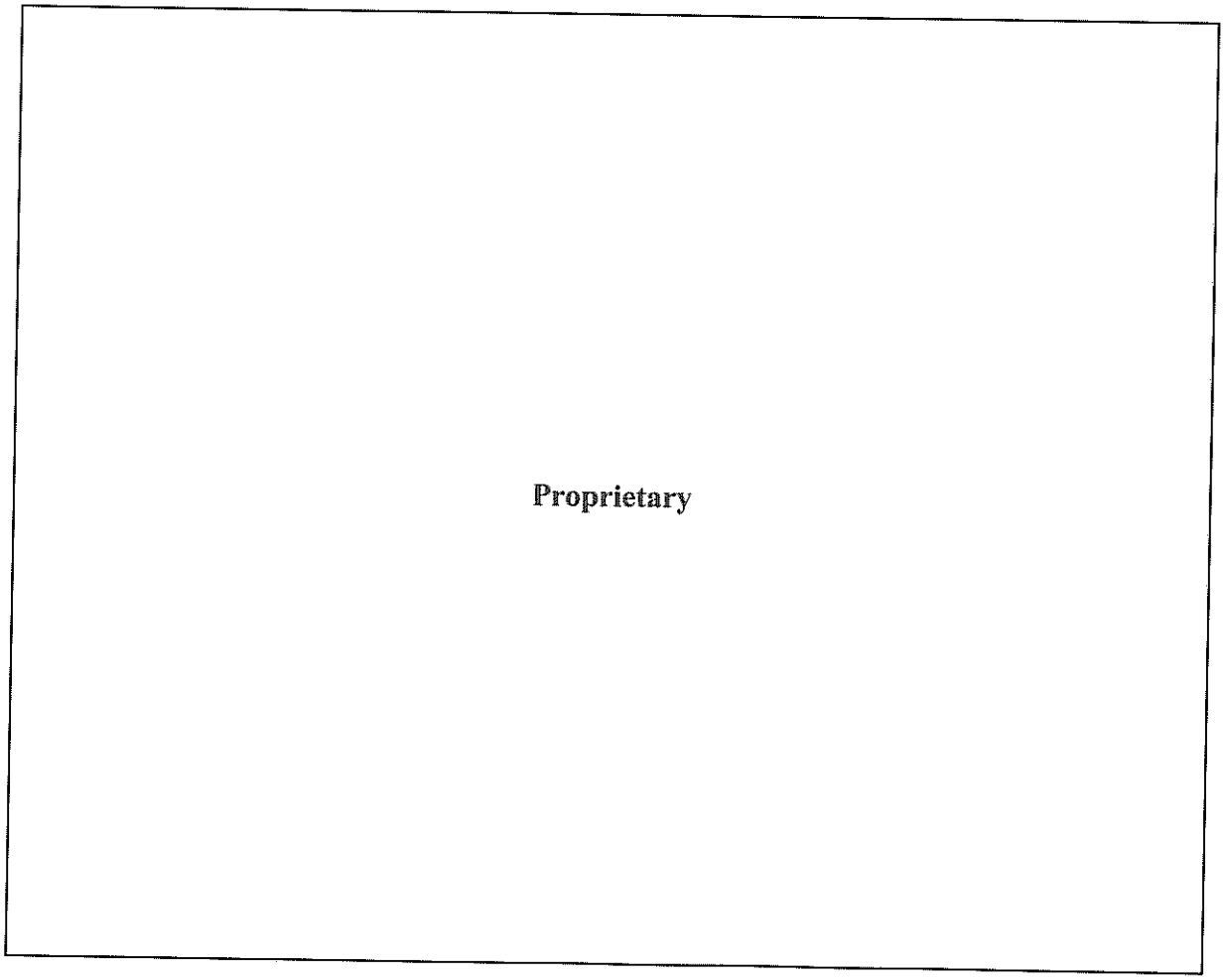


Table 2-10 – Completed Well

Estimated Flow Rate and Total Estimated Volume	Discharge	Reservoir	Notes
[redacted] bopd @ 10 days = [redacted] barrels	4½-inch tubing at subsea tree with 3,700 psi hydrostatic column	200-foot frac ½ length 800 md-ft conductivity 500-foot formation perf'd	Results from Nodal Analysis are from a stimulated wellbore, completed with sand control, flowing up 4½ inches tbg. To the sea floor.

Note: Although a very unlikely case, this discharge could result in the flows estimated above assuming the surface controlled subsea safety valve and the subsea tree valves fail to close.

Figure 2-10 – Completed Well



2(k) Chemical Products

Per NTL 2006 G14, information regarding chemical products is not required for DOCDs submitted of the MMS GoM region.

3 Geological and Geophysical (G&G) Information

3(a) Geological Description

Proprietary

Figure 3-1 – Cascade and Chinook Reservoirs

Proprietary

Proprietary

3(b) Structure Maps

Proprietary

Figure 3-2 – Cascade Structure Map

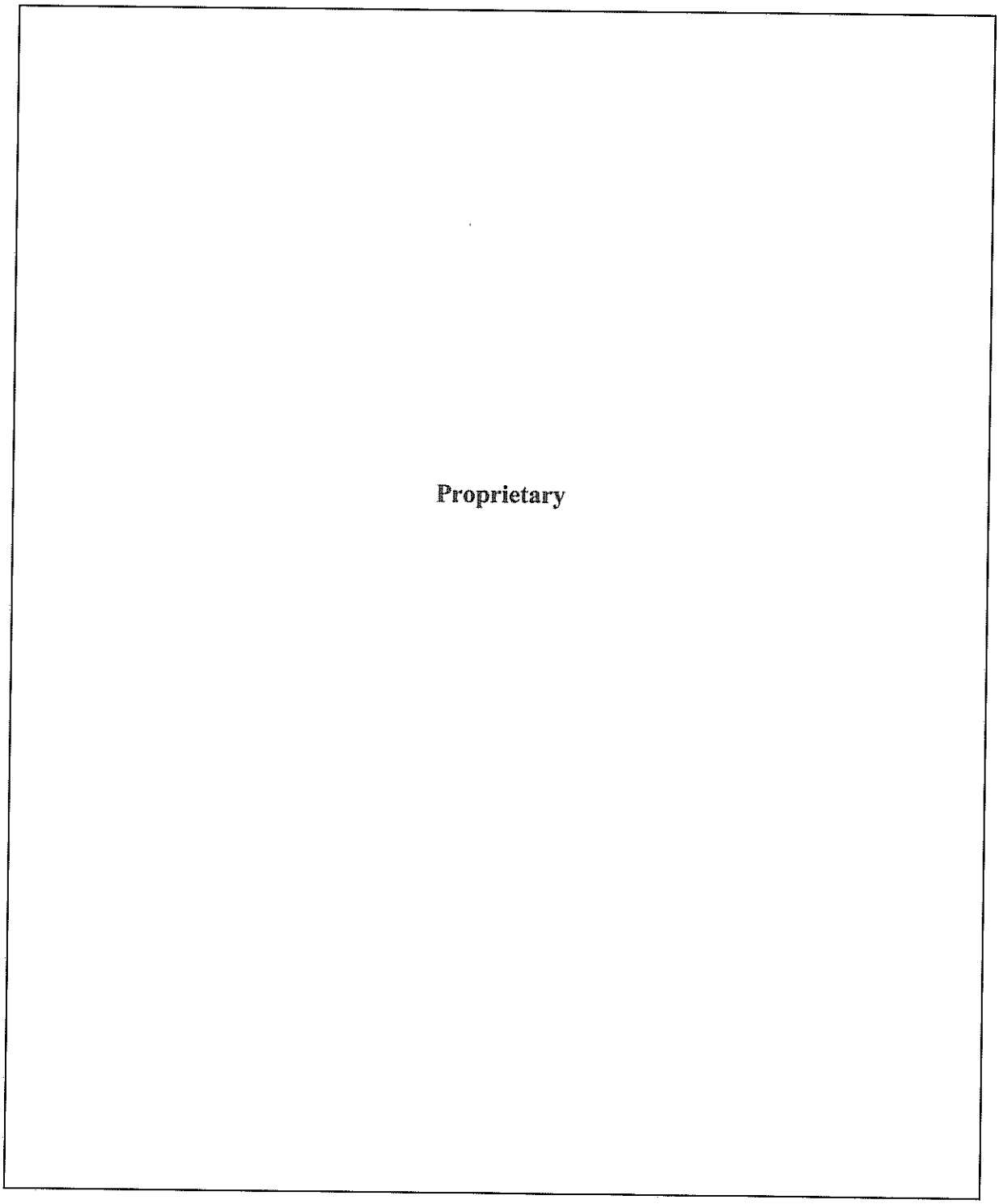
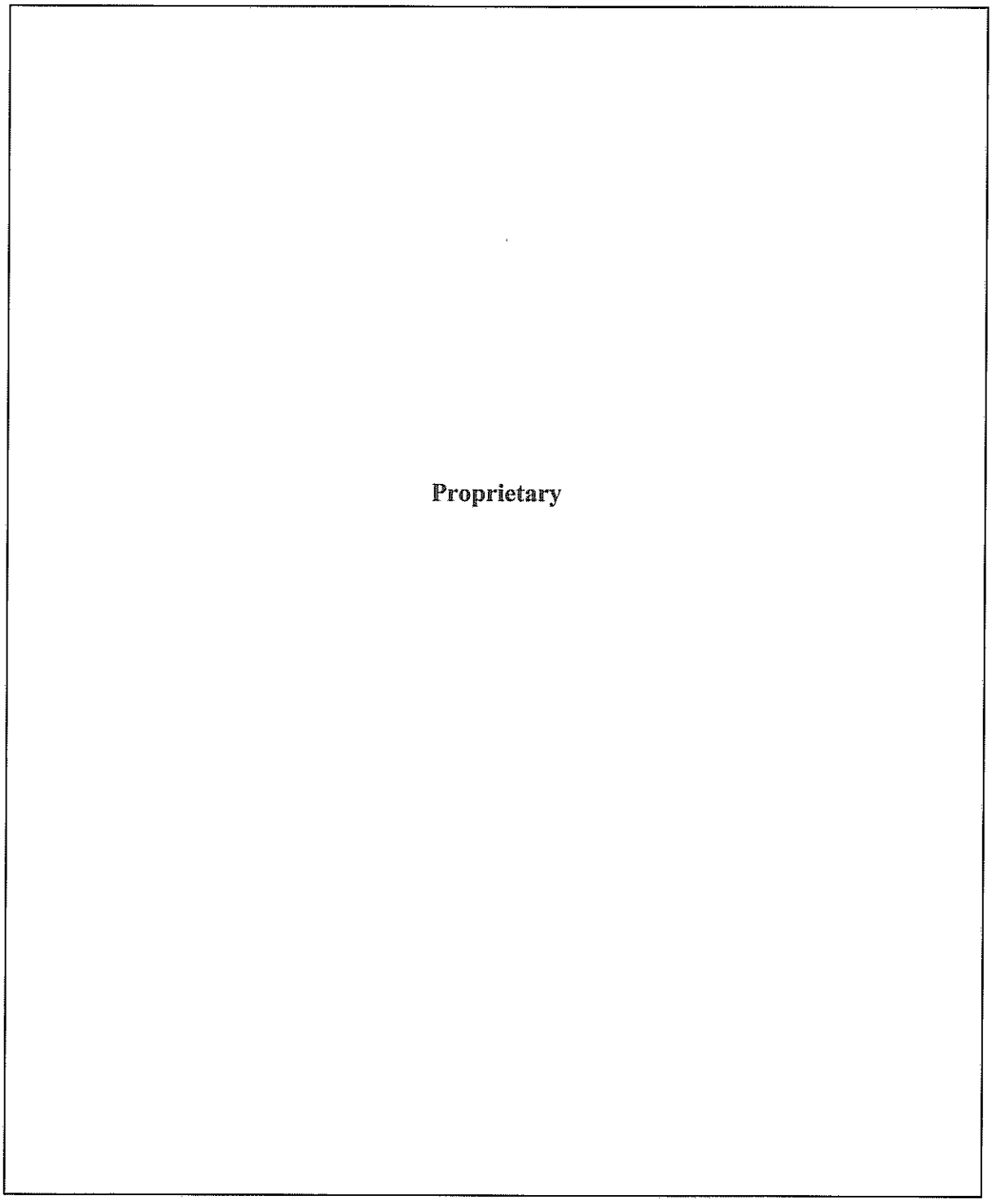


Figure 3-3 – Chinook Structure Map



3(c) Interpreted 2-Dimensional and or 3-Dimensional Seismic Lines

Proprietary

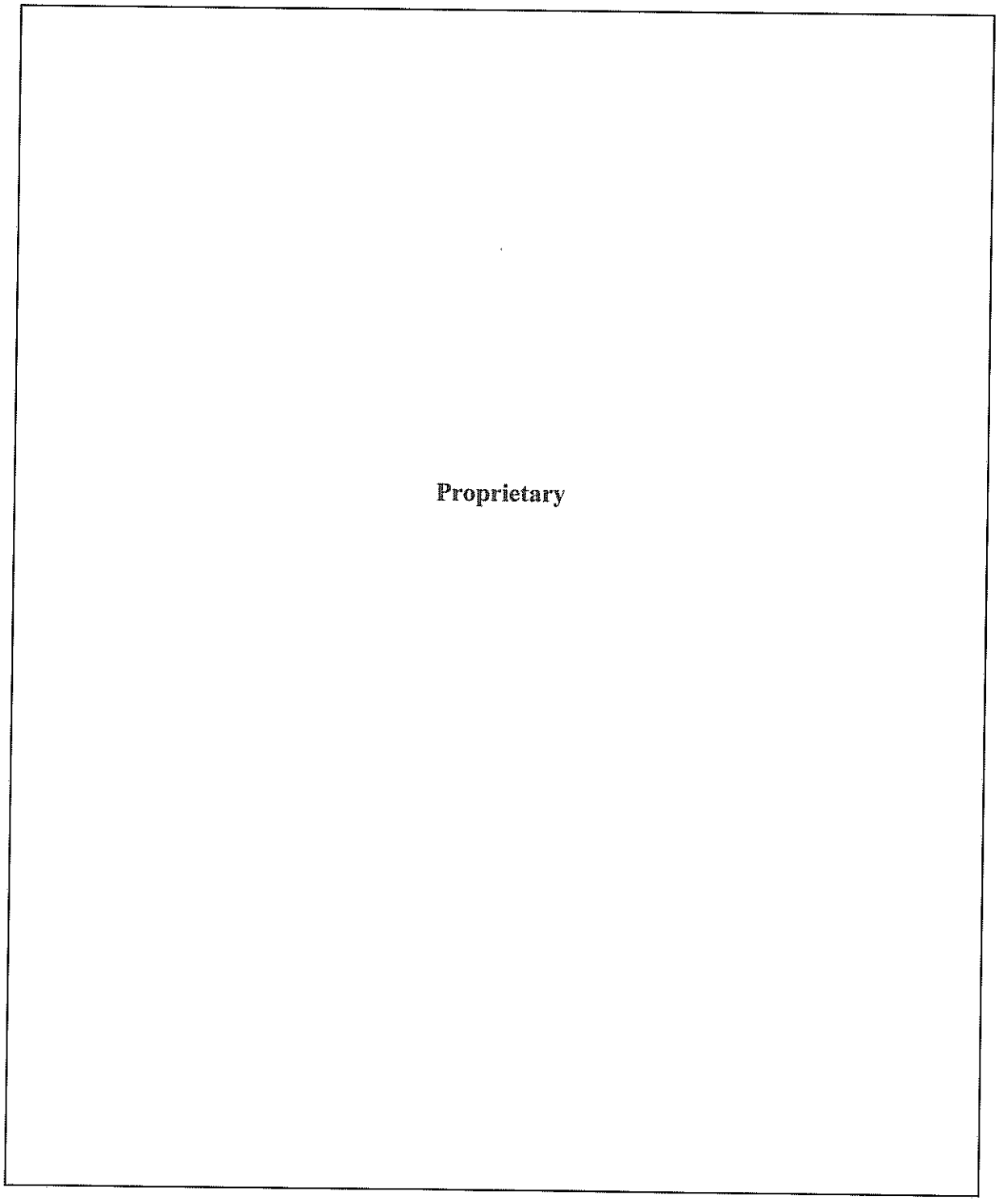
3(d) Geologic Structural Cross-Sections

Proprietary

Figure 3-4 – Cascade Cross Section

Proprietary

Figure 3-5 – Chinook Cross Section



3(e) Shallow Hazards Report

PAI performed high resolution, shallow geophysical, and geotechnical surveys which evaluated the locations of facilities associated with Phase 1 of the development plan that will disturb the seabed, including :

- FPSO anchors
- MODU anchors for wells located in Cascade East and West and muds / cuttings discharge areas for wells located in Cascade East, Cascade West, and Chinook
- Subsea facilities (Trees, Manifolds, Booster Pumps, PLETS, Umbilicals, Jumpers, Flying Leads, etc.)
- Free Standing Hybrid Risers (FSHR) riser bases
- ROW and Lease Term Pipeline routes; to be included in future pipeline permit applications

PAI has contracted Geoscience Earth & Marine Services (GEMS) to interpret the data acquired from the surveys to :

- assess shallow hazards for facilities
- re-assess the shallow hazards for well site locations [see 3(f) below]
- assess archeological resources / hazards
- assess live bottom / chemosynthic community resources

The data was acquired and interpreted per the requirements of NTL 2007 G01.

See Appendix 2 to review the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook. The GEMS Shallow Hazards Report for Facilities provides comprehensive information relative to environmental and engineering considerations. The GEMS Summary of Environmental Conditions for Cascade / Chinook provides summary information relative to environmental considerations only. PAI will submit in the future a comprehensive (i.e. environmental and engineering considerations) Shallow Hazards Report for Gas Export Pipeline with the pipeline application.

3(f) Shallow Hazards Assessment

Proprietary

3(g) High-Resolution Seismic Lines

Proprietary

3(h) Stratigraphic Column

Per NTL 2006 G14, biostratigraphic / lithostratiographic column information is not required for DOCDs.

3(i) Time vs. Depth Tables

Per NTL 2006 G14, this information is required only for Exploration Plans where there is no well control. As a result, this information is not provided in this DOCD.

3(j) Geochemical Information

Per NTL 2006 G14, geochemical information is not required for DOCDs submitted in the MMS GoM region.

3(k) Future G&G Activities

Per NTL 2006 G14, information related to future geological and geophysical activities is not required to be included in DOCDs submitted to the MMS GoM region.

4 Hydrogen Sulfide (H_2S) Information

4(a) Concentration

Samples from the Cascade and Chinook Units indicate that the estimated concentration of H_2S is approximately 0.6 parts per million by volume (ppmv). Simulations indicate a maximum H_2S concentration of 10.3 ppmv at arrival conditions. The pressure-volume-temperature analyses performed did not show any presence of H_2S.

4(b) Classification

Based on estimated concentration of H_2S described in 4(a), PAI requests that MMS classify the Cascade and Chinook Units as H_2S Absent based on the requirements of 30 CFR 250.490. Supporting data is provided in Appendix 3.

4(c) H_2S Contingency Plan

An H_2S contingency plan is not necessary, subject to MMS approval of the H_2S Absent classification.

4(d) Modeling Report

An H_2S contingency plan is not necessary, subject to MMS approval of the H_2S Absent classification.

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5 Mineral Resource Conservation Information

5(a) Technology and Reservoir Engineering Practices / Procedures

Due to the water depth, wellbore depth, and low bubble point of the production fluids, the hydrostatic pressure losses in the system are expected to be significant. Therefore, some form of artificial lift is required to enhance the production flow rates.

PAI has decided to utilize subsea booster pumps during Phase 1 of the development plan for enhancement of production flow rates. Other artificial lift options either do not meet field life boosting requirements (e.g. gas lift) or are not sufficiently proven or practical for high subsea flow rates. Although subsea booster pumps may not be needed in the early stages of Phase 1 of the development plan, the boosting system will be used to test various scenarios on the boosting pump operating curve as well as to assure that production rates remain high enough to avoid flow assurance issues (hydrate formation / wax deposition).

PAI is considering two options for subsea booster pumps; 1.) multiphase centrifugal pumps or 2.) electrical submersible pumps. See Section 2(e) for more information on the subsea booster pumps which are considered technology new to the GoM by MMS.

Since there is indication of a large aquifer in both the Cascade and Chinook fields, the base scenario assumes water influx as the recovery drive for long term reservoir planning. During Phase 1 of the development plan, the reservoir performance will be monitored to evaluate the degree of pressure maintenance and the aquifer's strength. Depending on the observed results during Phase 1, the recovery mechanism for the future phases will be selected. At this time, PAI considers water injection (if needed) to likely be the best alternative among the options for enhanced recovery methods for future phases of the development plan. Recovery methods to be utilized in future phases of the development plan will be further defined in a Supplemental DOCD.

5(b) Technology and Recovery Practices / Procedures and Reservoir Information

Drilling and Completion

The Cascade discovery well WR Block 206 #1 was spudded on January 31, 2002 and reached total depth of [redacted] feet on April 14, 2002. The Chinook discovery well WR Block 469 #1 was spudded on January 13, 2003 and reached total depth of [redacted] feet on June 19, 2003.

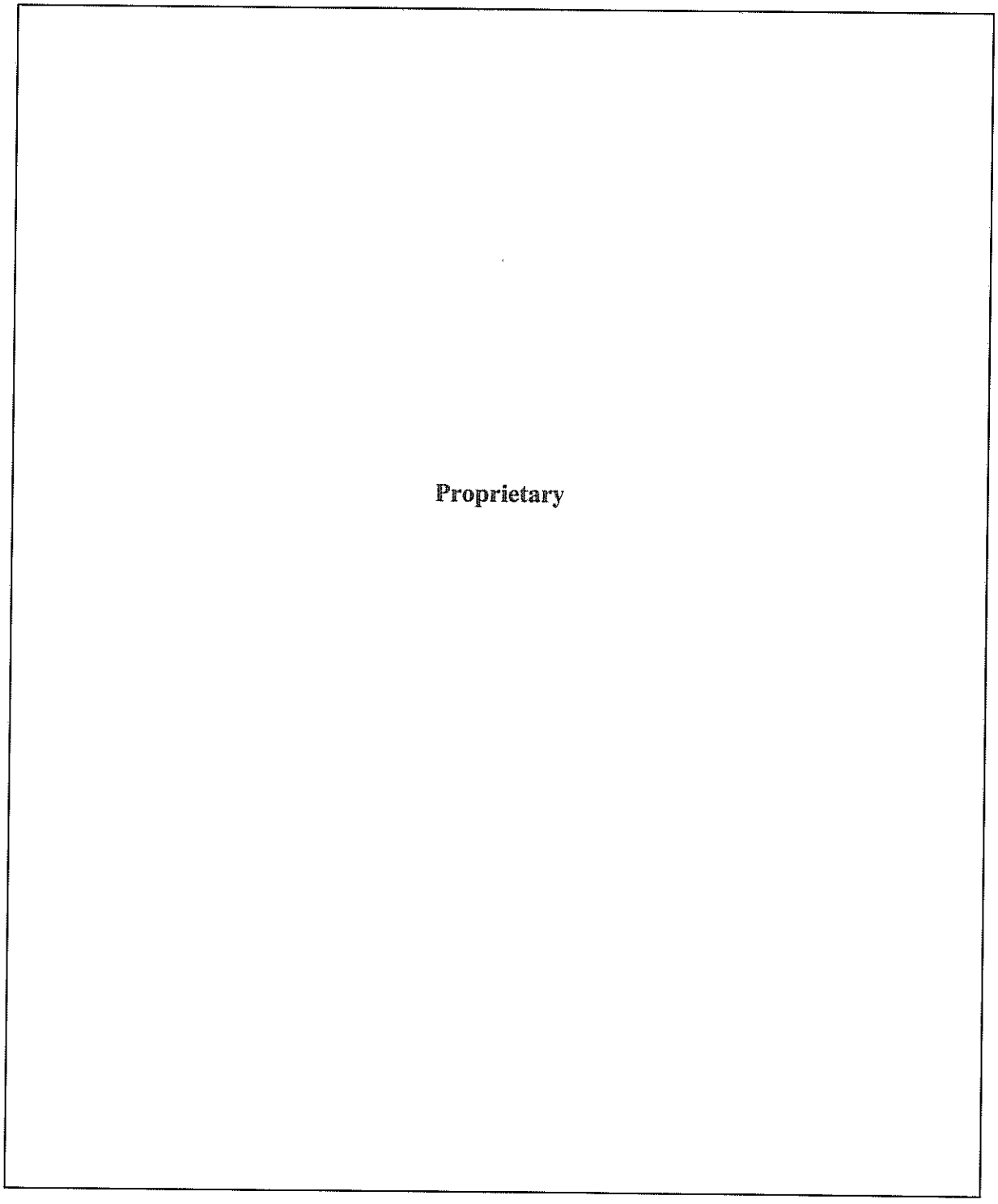
Phase 1 of the development plan will include the drilling and completion of three new wells; one well in the Cascade East drill center (WR Block 249), one well in the Cascade West drill center (WR Block 206), and one well in the Chinook drill center (WR Block 425). The locations of the new wells are provided in MMS Form 137 in Section 1.

Wells will be drilled and completed applying standard GoM best practices and technologies. The objective of Phase 1 is to gather sufficient information about the reservoir and well productivity to enable the optimization of future development phases, including :

- number and type of wells
- completion design
- production system capacity and type
- subsea layout and boosting system
- potential secondary recovery

Figure 5-1 illustrates the anticipated casing program to be utilized in Phase 1 of the development plan.

Figure 5-1 – Casing Program



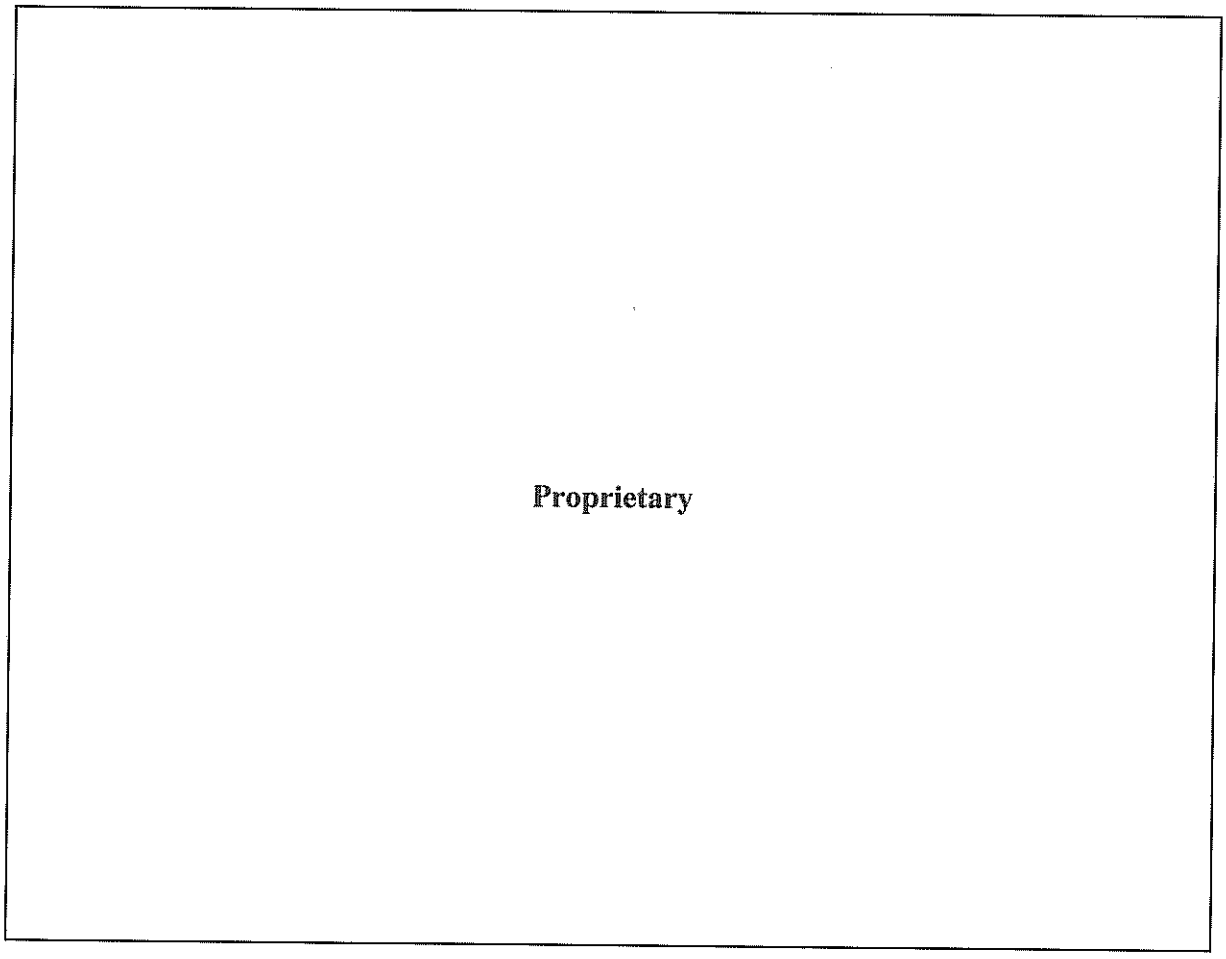
Given the challenging reservoir characteristics of low permeability (between 5-100md) and low oil gravity (around 20° API), the completion of the wells must include reservoir (near wellbore) stimulation techniques. The stimulation design must incorporate hydraulic fracturing to improve conductivity and improve flow rates.

Due to uncertainties regarding the sand production potential and in order to achieve greater levels of depletion prior to final abandonment, a fit-for-purpose Sand Control Frac-Pack completion is the preferred choice in Phase 1. Different technologies for formation fracturing / proppant packing are currently being evaluated. However, to address the geological and lithological challenges presented by the need for both stimulation and sand control, frac-packs with several stages in each well will ultimately dictate the effectiveness of the stimulation job.

Due to operational risks and current technology, multi-trip / multi-stage frac-pack systems have been selected as the "base case" for Phase 1 of the development plan. As operational risks are directly associated with the number of frac intervals in a multi-trip stage system, and this being the current option of choice, the maximum number of stages will likely be limited to three.

Since the Cascade and Chinook reservoir depletion mechanisms are not yet fully understood, a downhole remote flow control and monitoring system ("intelligent completion") is being evaluated for the upper completion. This provides an interventionless solution for selective interval monitoring and control, isolation, minimizing cross-flow among intervals, and managing real-time reservoir data. All intelligent completion hardware will be installed above the sand face, providing reservoir and production management capabilities from two "intervals", regardless of the number of frac-pack intervals completed in the lower completion. See Figure 5-2 for a conceptual representation of a completion schematic for the downhole completion (upper and lower).

Figure 5-2 – Completion Schematic



Flow Assurance

The key flow assurance issues for the Cascade and Chinook Units are driven by unique fluid properties (low bubble point and high viscosity).

Flow assurance analysis has established that subsea equipment design, operating, and maintenance procedures would have to include a number of mitigation measures to maximize productivity and reserve recovery. These measures include :

- Subsea boosting of the production stream is likely to provide a significant benefit to in terms of recoverable reserves
- Hydrate inhibition through subsea flowline insulation, chemical injection, and operating procedures

- Dual piggable flowlines will be utilized
- Provision is planned for chemical injection to mitigate the precipitation of wax and asphaltenes
- Formation of emulsion is anticipated with increased water production in later field life (i.e. post Phase 1); provision is planned for injecting demulsifier at the subsea trees
- Utilize appropriate materials for erosion / corrosion management
- Provision for downhole sand control methods
- For planned FPSO disconnection scenarios (i.e. named storms which originate outside of the GoM), the FSHRs and flowlines will be depressurized and displaced with diesel for flow assurance mitigation prior to disconnection; methanol will be injected into selected components (e.g. trees, pumps, manifolds) to prevent hydrate formation
- For unplanned FPSO disconnection scenarios (i.e. named storms which originate in the GoM), the FSHRs and flowlines will only be depressurized prior to disconnection with the consequences of hydrate formation being addressed at FPSO re-connection

Reservoir Information

Exploratory well results from the Cascade and Chinook Units are summarized in Table 5-1.

Table 5-1 – Exploratory Well Results

Proprietary

MMS has provided guidance to PAI that a unit specific Conservation Information Document (CID) must be developed for the Cascade Unit and for the Chinook Unit. Per NTL 2007 G21, PAI has requested (under separate cover) a departure under 30 CFR 250.142 to request approval to submit the CIDs at a future date. As described in the departure request letter, PAI anticipates submittal of the Cascade Unit CID in the 4Q07 and the Chinook Unit CID in the 1Q08. It is anticipated that these submittal dates will allow MMS to receive the CIDs prior to the commencement of the drilling and completion programs for the Cascade and Chinook Units.

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6 Biological, Physical, and Socioeconomic Information

6(a) Chemosynthetic Communities Report

PAI, in conjunction with Geoscience Earth and Marine Services, Inc. (GEMS), designed both the geophysical and geotechnical data acquisition programs for Chinook, Cascade, and the Cascade Gas Export Routes.

A primary concern in the development of any field is the avoidance by the field architecture of biologically sensitive areas. In the deepwater GoM, the primary concern is the protection of chemosynthetic organisms and fragile benthic habitats.

There is precedent to employ the use of 3D seabed peak seismic amplitude data to infer the presence of conditions that may be conducive to chemosynthetic communities and sensitive benthic habitats. GEMS has reviewed the 3D seismic coverage provide by PAI. However, GEMS defers to the available High-Resolution 2D data.

The High-Resolution geophysical data consists of multibeam bathymetry (3m bins), side-scan sonar, and chirp subbottom profiler data. These data provide information on the character of seabed reflectance which is inferred to be soil type or soil hardness. This is excellent for identifying areas of potential harder substrate that may be an indication of the presence of chemosynthetic organisms or sensitive habitat. The subbottom profiler provides further evidence for harder substrate, or, hydrocarbon indicators necessary as the source for chemosynthetic communities. The multibeam bathymetry also provides indirect evidence for hydrocarbon mounds or organic mounds from the topography of the seafloor. Used in combination, these data provide the best geophysical means to identify and define areas where there is potential for chemosynthetic communities to occur and forms the basis for the assessment of the seabed and shallow conditions with respect to the protection of these sensitive benthic communities.

Summaries of the findings are shown below. See Appendix 2 for additional details in the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook.

Discharges and Moorings Related to Drilling Cascade East and Cascade West Wells

Features or areas that could support high-density chemosynthetic communities are not located within 1,500 feet of the proposed muds and cuttings discharge locations for these wells located in WR Blocks 206 and 249. The preliminary anchor pattern for the moored drilling rig "Ocean Endeavor" is known (provided in MMS Form 137 in Section 1) and features or areas that could support high-density chemosynthetic communities would not be located within 250 feet of any seafloor disturbances resulting from the use of the anchors.

Discharges Related to Drilling Chinook Well

Features or areas that could support high-density chemosynthetic communities are not located within 1,500 feet of the proposed muds and cuttings discharge locations for this well located in WR Block 469. "Petrorig 1" is DP drilling rig. As such, high-density chemosynthetic communities would not be affected by seafloor disturbances due to anchors.

Proposed Gas Export Pipeline

Features or areas that could support high-density chemosynthetic communities are not located within 500 feet of any seafloor disturbances resulting from the proposed pipeline construction activities for routing Option 1 (Cleopatra, GC Block 829). PAI will utilize an ROV survey to verify that potential features or areas that could support high-density chemosynthetic communities are not located within 500 feet of any seafloor disturbances resulting from the proposed pipeline construction activities for routing Option 2 (Anaconda, GC Block 606) if this option is chosen. The gas export line will be installed with a DP Pipelay vessel. As such, high-density chemosynthetic communities would not be affected by seafloor disturbances due to anchors.

FPSO Discharges and FPSO Mooring

Features or areas that could support high-density chemosynthetic communities are not located within 1,500 feet of the ocean discharges from the FPSO that would be located in WR Block 249. The preliminary anchor pattern is known (provided in MMS Form 137 in Section 1) and features or areas that could support high-density chemosynthetic communities would not be located within 250 feet of any seafloor disturbances resulting from the use of the anchors.

Subsea Facilities

Features or areas that could support high-density chemosynthetic communities are not located within 500 feet of any seafloor disturbances resulting from installation of the proposed subsea facilities (e.g. trees, manifolds, booster pumps, PLETS, umbilicals, jumpers, flying leads) located in WR Blocks 206, 249, 293, and 425.

6(b) Topographic Features Map

Per NTL 2006-G14, the information required in this section pertains to activities occurring within 1000 feet of a "No Activity Zone" of an identified topographic feature. The facilities associated with Phase 1 of the development plan are located in a water depth of over 8000 feet and are not located near a "No Activity Zone". Shuttle Vessels and marine support vessels could cross over "No Activity Zones" but disturbances to these features are not anticipated.

6(c) Topographic Features Statement (Shunting)

Per NTL 2006 G14, this information is not required for DOCDs.

6(d) Live Bottoms (Pinnacle Trend) Map

Per NTL 2006-G14, the information required in this section pertains to activities occurring within 200 feet of a Live Bottom (Pinnacle Trend). The facilities associated with Phase 1 of the development plan are not located near a Live Bottom (Pinnicle Trend).

6(e) Live Bottoms (Low Relief) Map

Per NTL 2006-G14, the information required in this section pertains to activities occurring within 100 feet of a Live Bottom (Low Relief). The facilities associated with Phase 1 of the development plan are not located near a Live Bottom (Low Relief).

6(f) Potentially Sensitive Biological Features

Per NTL 2006-G14, the information required in this section pertains to activities occurring within 100 feet of a Sensitive Biological Feature. The facilities associated with Phase 1 of the development plan are not located near a Sensitive Biological Feature.

6(g) Remotely Operated Vehicle (ROV) Monitoring Survey Plan

PAI is familiar with the ROV survey and the reporting provisions described in NTL 2003 G03, *Remotely Operated Vehicle Surveys in Deepwater*. PAI will submit the ROV survey plan prior to mobilization of the first drilling rig (2Q08 or 3Q08) and thereafter will perform a pre-spud survey and a post-drilling survey per the established requirements.

6(h) Threatened and Endangered Species Information

Florida is not an Affected State for Phase 1 of the development plan. As a result, this information is not provided per NTL 2006 G14. However, threatened and endangered species information for the Affected States (Texas, Louisiana, Mississippi, and Alabama) is provided in the *Environmental Impact Analysis* located in Section 19.

6(i) Archeological Report

Archeological considerations are included in the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook in Appendix 2. During the survey, a shipwreck (sunken modern barge) was identified along the gas export route for one of the gas export options outside of the Cascade area. The shipwreck was reported to MMS within 24 hours per established requirements. The location of the shipwreck will not impact the routing of the gas export line. If PAI chooses this gas export routing option, there is adequate space in the corridor to deviate from the required 1000 feet around the shipwreck. See 19(b).15 and Figure 19-2 for more information.

6(j) Air and Water Quality Information

Florida is not an Affected State for Phase 1 of the development plan. As a result, this information is not provided per NTL 2006 G14. However, air and water quality information for the Affected States (Texas, Louisiana, Mississippi, and Alabama) is provided in the *Environmental Impact Analysis* located in Section 19.

6(k) Socioeconomic Information

Florida is not an Affected State for Phase 1 of the development plan. As a result, this information is not provided per NTL 2006 G14. However, socioeconomic information for the Affected States (Texas, Louisiana, Mississippi, and Alabama) is provided in the *Environmental Impact Analysis* located in Section 19.

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7 Waste and Discharge Information

7(a) Projected Generated Wastes

Table 7-1 indicates expected solid and liquid wastes likely to be generated by drilling and completion operations for Phase 1 (three wells) of the development plan.

Table 7-1 – Solid and Liquid Wastes (Drilling & Completions Operations)

Type of Waste	Composition	Projected Amount
Water Based Drilling Fluids	Continuous phase and suspending medium for solids is water miscible fluid	16,000 barrels per well
Drill Cuttings - Water Based Drilling Fluids	Particles generated by drilling into geologic formations adhering to water based drilling fluids	2,000 barrels per well
Synthetic Based Drilling Fluids	Continuous phase of the drilling fluid is a synthetic material	750 barrels per well
Drill Cuttings - Synthetic Based Drilling Fluids	Particles generated by drilling into geologic formations adhering to synthetic based drilling fluids	7,200 barrels per well
Mud, Cuttings, and Cement at the Seabed	Discharges that occur at seabed prior to installation of marine riser	35,000 barrels per well
Completion Fluids (Well Test)	Salt solutions, weighted brines, polymers, and various additives	9,000 barrels per well
Solid Wastes	Solid waste trash	1 standard container per week
Sanitary Wastes	Human body waste from toilets and urinals	30 gallons per day per person
Domestic Wastes	Discharge from galleys, sinks, and showers	50 gallons per day per person
Uncontaminated Seawater	Seawater returned to sea without addition of chemicals	As needed
Uncontaminated Bilge Water	Bilge water returned to sea without addition of chemicals	As needed
Uncontaminated Ballast Water	Ballast water returned to sea without addition of chemicals	As needed
Desalinization Unit Water Maker	Chemically treated seawater associated with making fresh water from seawater	0-80 barrels per day
Deck Drainage	Deck washing, rainwater	Dependent on rainfall
Waste Oil	Lube oils (maintenance)	1-3 barrels per month

Table 7-2 indicates expected solid and liquid wastes likely to be generated by FPSO production operations for Phase 1 of the development plan.

Table 7-2 - Solid and Liquid Wastes (FPSO Production Operations)

Type of Waste	Composition	Projected Amount
Produced Water	Formation water containing scale inhibitors and methanol	16,000 barrels per day
Hydrostatic (Pipelines)	Seawater used to pressure test new piping and pipelines	23,000 barrels total
Solid Wastes	Solid waste trash	1 standard container per week
Sanitary Wastes	Human body waste from toilets and urinals	30 gallons per day per person
Domestic Wastes	Discharge from galleys, sinks, and showers (gray water)	50 gallons per day per person
Uncontaminated Seawater	Seawater returned to sea without addition of chemicals	120 barrels per day
Uncontaminated Bilge Water	Bilge water returned to sea without addition of chemicals	110 barrels per day
Uncontaminated Ballast Water	Ballast water returned to sea without addition of chemicals	47,000 barrels per day
Desalinization Unit Water Maker discharge	Chemically treated seawater associated with making fresh water from seawater	30 barrels per day
Deck Drainage	Deck washing, rainwater (dependent on rainfall)	560 barrels per day
Waste Oil	Lube oils (maintenance)	10 barrels per month

Table 7-3 indicates expected solid and liquid wastes likely to be generated by Shuttle Vessel operations for Phase 1 of the development plan. This data is provided for information purposes to accommodate the NEPA review process. Waste generated by Shuttle Vessel operations will fall under USCG requirements and will not be covered under the NPDES General Permit.

Table 7-3 - Solid and Liquid Wastes (Shuttle Vessel Operations)

Type of Waste	Composition	Projected Amount
Solid Wastes	Solid waste trash	1 standard container per week
Sanitary Wastes	Human body waste from toilets and urinals	30 gallons per day per person
Domestic Wastes	Discharge from galleys, sinks, and showers (gray water)	50 gallons per day per person
Uncontaminated Seawater	Seawater returned to sea without addition of chemicals	3,600 barrels per month
Uncontaminated Bilge Water	Bilge water returned to sea without addition of chemicals	3,300 barrels per month
Uncontaminated Ballast Water	Ballast water returned to sea without addition of chemicals	1,410,000 barrels per month
Deck Drainage	Deck washing, rainwater	17,000 barrels per month
Waste Oil	Lube oils (maintenance)	1 barrel per month

Plans for Treating, Storing, or Disposal

Solid and liquid wastes generated by the FPSO, Drilling Rigs, and Shuttle Vessels will be temporarily stored onboard the vessels until transported to onshore facilities for disposal (approximately weekly). Supply boats will be used for the FPSO and Drilling Rigs, whereas the Shuttle Vessels will have solid and liquid wastes offloaded at terminals or otherwise while idle at quayside. The FPSO, Drilling Rigs, and Shuttle Vessels will be contracted or chartered to PAI and their respective solid and liquid wastes that they are responsible for will be transported onshore for disposal. PAI anticipates that the vessel owners will utilize existing onshore disposal facilities (with no need for expansions) that are consistent with those onshore disposal facilities that PAI currently utilizes. See 15(d) and 16(d) for additional information on solid and liquid waste disposal.

Sanitary wastes associated with the FPSO, Drilling Rigs, or Shuttle Vessels would be treated by an approved USCG Marine Sanitation Device and discharged overboard with no floating solids.

All other wastes generated on the FPSO and Drilling Rigs will be treated (as required) and discharged per Region 6 NPDES General Permit requirements. All other wastes generated on the Shuttle Vessels will be discharged per USCG requirements.

7(b) Projected Ocean Discharges

Table 7-4 indicates expected ocean discharges of solid and liquid wastes associated with drilling and completion operations for Phase 1 (three wells) of the development plan.

Table 7-4 – Ocean Discharges (Drilling & Completions Operations)

Type of Waste	Total Amount to be Discharged	Discharge Rate	Discharge Method
Water Based Drilling Fluids	16,000 barrels per well	500 barrels per hour	Discharged overboard with or at seabed (prior to marine riser installation); no free oil
Drill Cuttings - Water Based Drilling Fluids	6,000 barrels	15 barrels per hour	Discharged overboard or at seabed (prior to marine riser installation); no free oil
Drill Cuttings - Synthetic Based Drilling Fluids	7,200 barrels per well	15 barrels per hour	Discharged overboard line from cuttings dryer; no free oil
Mud, Cuttings, and Cement at the Seabed	35,000 barrels per well	400 barrels per hour	Discharged at seabed (prior to marine riser installation); no free oil
Completion Fluids (Well Test)	9,000 barrels per well	200 barrels per hour	Oily water discharge then discharge overboard; no free oil
Sanitary Wastes	126,000 barrels per month	30 gallons per day per person	Discharge overboard; no floating solids
Domestic Wastes	210,000 barrels per month	50 gallons per day per person	Discharge overboard; no floating solids
Uncontaminated Seawater	90,000 barrels per month	125 barrels per hour	Discharge overboard; no free oil
Uncontaminated Bilge Water	2,000 barrels per month	10 barrels per hour	Oily water discharge then discharge overboard; no free oil
Uncontaminated Ballast Water	45,000 barrels per month	1,000 barrels per hour	Discharge overboard; no free oil
Desalinization Unit Water Maker	145,000 barrels per month	< 100 barrels per day (dependent on use)	Discharge overboard; no free oil
Deck Drainage	3,000 barrels per month	100 barrels per day (dependent on rainfall)	Discharge overboard; no free oil

Assume 140 average POB on Drilling Rigs

Table 7-5 indicates expected ocean discharges of solid and liquid wastes associated with FPSO production operations for Phase 1 of the development plan.

Table 7-5 - Ocean Discharges (FPSO Production Operations)

Type of Waste	Total Amount to be Discharged	Discharge Rate	Discharge Method
Produced Water	480,000 barrels per month	16,000 barrels per day	Hydrocyclone then discharge overboard; no free oil
Hydrostatic	23,000 barrels	250 barrels per hour	Discharge overboard; no free oil
Sanitary Wastes	36,000 barrels per month	30 gallons per day per person	Discharge overboard; no floating solids
Domestic Wastes	60,000 barrels per month	50 gallons per day per person	Discharge overboard; no floating solids
Uncontaminated Seawater	3,600 barrels per month	120 barrels per day	Discharge overboard; no free oil
Uncontaminated Bilge Water	3,300 barrels per month	110 barrels per day	Oily water discharge then discharge overboard; no free oil
Uncontaminated Ballast Water	1,410,000 barrels per month	47,000 barrels per day	Discharge overboard; no free oil
Desalinization Unit Water Maker discharge	900 barrels per month	30 barrels per day	Discharge overboard; no free oil
Deck Drainage	17,000 barrels per month	560 barrels per day (dependent on rainfall)	Oily water discharge then discharge overboard; no free oil

Assume 40 average POB on FPSO

Table 7-6 indicates expected ocean discharges of solid and liquid wastes associated with Shuttle Vessel operations for Phase 1 of the development plan. This data is provided for information purposes to accommodate the NEPA review process. Waste generated by Shuttle Vessel operations will fall under USCG requirements and will not be covered under the NPDES General Permit.

Table 7-6 - Ocean Discharges (Shuttle Vessel Operations)

Type of Waste	Total Amount to be Discharged	Discharge Rate	Discharge Method
Sanitary Wastes	22,500 barrels per month	30 gallons per day per person	Discharge overboard; no floating solids
Domestic Wastes	37,500 barrels per month	50 gallons per day per person	Discharge overboard; no floating solids
Uncontaminated Seawater	3,600 barrels per month	120 barrels per day	Discharge overboard; no free oil
Uncontaminated Bilge Water	3,300 barrels per month	110 barrels per day	Oily water discharge then discharge overboard; no free oil
Uncontaminated Ballast Water	1,410,000 barrels per month	47,000 barrels per day	Discharge overboard; no free oil
Desalinization Unit Water Maker	900 barrels per month	30 barrels per day	Discharge overboard; no free oil
Deck Drainage	17,000 barrels per month	560 barrels per day (Dependent on rainfall)	Discharge overboard; no free oil

Assume 25 average POB on Shuttle Vessel

7(c) Modeling Report

PAI will request coverage under EPA Region 6 NPDES General Permit for discharges associated with Phase 1 of the development plan. As a result, modeling is not required per NTL 2006 G14.

7(d) NPDES Permits

Per NTL 2006 G14, information regarding NPDES permits is not required for DOCDs submitted in the MMS GoM region.

7(e) Cooling Water Intakes

Per NTL 2006 G14, information regarding cooling water intake structures is not required to accompany DOCDs submitted in the MMS GoM region.

8 Air Emissions Information

8(a) Complex and Plan Emissions

The Complex Total Emissions are the same as Plan Emissions for Phase 1 of the development plan as there are no existing facilities or activities co-located with our currently proposed activities.

8(b) Screening Questions

	Yes	No
Is any calculated Complex Total (CT) Emission amount (tons) associated with your proposed development and production activities more than 90% of the amounts calculated using the following formulas: CT = 34002/3 for CO, and CT = 33.3D for the other air pollutants (where D = distance to shore in miles)?		X
Do your emission calculations include any emission reduction measures or modified emission factors?	X	
Does or will the facility complex associated with your proposed development and production activities process production from eight or more wells?		X
Do you expect to encounter H2S at concentrations greater than 20 parts per million (ppm)?		X
Do you propose to flare or vent natural gas in excess of the criteria set forth under § 250.1105(a)(2) and (3)?		X
Do you propose to burn produced hydrocarbon liquids?		X
Are your proposed development and production activities located within 25 miles (40 kilometers) from shore?		X
Are your proposed development and production activities located within 124 miles (200 kilometers) of the Breton Wilderness Area?		X

8(c) Worksheets

Air emissions worksheets Phase 1 of the development plan are included in Appendix 4.

8(d) Contact Information

For questions regarding calculations of the projected Plan Emissions, contact :

Mike D. Bigler
Corporate Health, Safety and Environment Coordinator
Petrobras America Inc.
10777 Westheimer Road, Houston, TX 77042
Room 1271
Office: 713-808-2495

8(e) Emissions Reduction Measures

The Plan Emissions do not include emissions reductions measures as the Plan Emissions are below the Exemption threshold.

8(f) Verification of Non-Default Emissions Factors

The air emissions worksheets in Appendix 4 include descriptions of the rationale for operating assumptions (i.e. fuel consumption) related to certain facilities and marine equipment used for Phase 1 of the development plan in the notes of each worksheet.

8(g) Non Exempt Activities

The Plan Emissions are below the Exemption threshold.

8(h) Modeling Report

Modeling will not be required as the Plan Emissions are below the Exemption threshold.

9 Oil Spills Information

9(a) Oil Spill Response Planning

Regional Oil Spill Response Information

All the proposed activities in this DOCD will be covered by the PAI (MMS operator #1207) Regional Oil Spill Response Plan (R-OSRP) filed in accordance with 30 CFR 254.

The current R-OSRP was submitted to MMS on 7/26/05 and was approved by MMS on 8/10/05. PAI will submit a newly updated R-OSRP to MMS in order to achieve the bi-annual updating requirement prior to expiration by 7/31/07 per requirements of 30 CFR 254 and NTL 2006 G21.

PAI will submit a new "Greater Than 10 Mile From Shore Worst Case Discharge Scenario" to MMS prior to commencement of activities covered by this DOCD (anticipated June 2008 at the earliest) to reflect the new Worst Case Discharge information discussed below.

Spill Response Sites

PAI is currently a member of Clean Gulf Associates (CGA) and Clean Caribbean & Americas (CCA).

PAI's primary spill response equipment is provided by CGA as described in the current R-OSRP. Table 9-1 indicates the locations of PAI's primary spill response equipment and the locations of the planned staging areas.

Table 9-1 – CGA Oil Spill Response Equipment & Staging Areas

Primary Response Equipment Locations (CGA)	Preplanned Staging Locations (CGA)
Ingleside, TX	Fourchon, LA
Galveston, TX	Venice, LA
Lake Charles, LA	Houma, LA
Houma, LA	
Venice, LA	

PAI's also has access to spill response equipment provided by CCA. Table 9-2 indicates the locations of CCA's spill response equipment and the locations of the planned staging areas.

Table 9-2 - CCA Oil Spill Response Equipment & Staging Areas

Response Equipment Locations (MSRC GoM)	Preplanned Staging Locations (MSRC GoM)
Fort Lauderdale, FL	Fourchon, LA
	Venice, LA
	Houma, LA

OSRO Information

PAI is currently a member of Clean Gulf Associates (CGA) and Clean Caribbean & Americas (CCA). The de-rated (i.e. 20% of equipment name plate per manufacturer specification) daily mechanical recovery capabilities for each OSRO is described in Table 9-3.

Table 9-3 – OSRO Mechanical Recovery Capabilities

OSRO	De-Rated Daily Recovery Capability (barrels per day)
Clean Gulf Associates	110,000
Clean Caribbean & Americas	48,000
TOTAL	158,000

PAI will also utilize dispersants as an alternative response strategy in certain circumstances when approved by regulatory authorities. The available dispersant inventories are described in Table 9-4.

Table 9-4 – Dispersant Inventories

OSRO	Dispersant Inventory (gallons)
Clean Gulf Associates	67,665
Clean Caribbean & Americas	30,360
TOTAL	98,025

PAI also utilizes other complimentary specialist OSROs as appropriate, including but not limited to AMPOL, Garner Environmental Services, Industrial Cleanup, Oil Mop, and PSC Industrial Services. See the current R-OSRP for a complete listing.

Worst Case Scenario Determination

WCD Scenario for MMS Areas of Interest :

Table 9-5 provides a comparison of the Worst Case Discharge scenarios from PAI's approved R-OSRP with the Worst Case Discharge scenario from the proposed activities covered by this DOCD. As shown below, the Worst Case Discharge scenario from the proposed activities in this DOCD are greater than those described in PAI's approved R-OSRP. PAI will therefore submit a new "Greater Than 10 Mile From Shore Worst Case Discharge Scenario" to MMS prior to commencement of activities covered by this DOCD (anticipated June 2008 at the earliest) to reflect the new Worst Case Discharge scenario.

Table 9-5 – Worst Case Discharge (MMS Areas of Interest)

Category	R-OSRP (Far Shore WCD)	DOCD
Type of Activity	Subsea Production Tie-Back to EC Block 373	Subsea Production Produced to FPSO
Facility Location(s)	GB Block 244 OCS-G 15860	WR Block 205 OCS-G 16964 WR Block 206 OCS-G 16965 WR Block 249 OCS-G 16969 WR Block 250 OCS-G 16970 WR Block 425 OCS-G 16987 WR Block 426 OCS-G 16988 WR Block 469 OCS-G 16997 WR Block 470 OCS-G 16998
Facility Designation	Subsea Wells #002 and #003ST01	FPSO and Subsea Wells Cascade #3, Cascade #4, and Chinook #1
Distance to Nearest Shoreline (Miles)	134	166
Volume (barrels) :		
Storage Tanks (total)	N/A (1)	[redacted] (2)
On-facility Flowlines	N/A (1)	[redacted] (3)
Lease Term Pipelines	N/A (1)	[redacted] (4)
Uncontrolled Blowout (volume per day)	18,000	[redacted] (5)
Total Volume	18,000	32,134
Type of Oil (e.g. Crude, Condensate, Diesel)	Crude	Crude
API Gravity	32	23 (6)

(Notes for Table 9-5 on following page)

Notes :

(1) W&T is the operator of EC Block 373; on-facility volumes are not applicable

(2) Includes FPSO Topsides Tanks only; does not include FPSO Cargo or Fuel Tanks; see 1(d) for storage tank details and 9(c) below for additional discussion

(3) On-facility Flowlines includes Processing Piping (including Turret systems)

(4) Includes Cascade East DC-to-Cascade West DC (Dual) and Cascade West DC-to-FSHR Riser Base near FPSO (Dual) and FSHRs

(5) See section 2(j) Blowout Scenario for details

(6) API Gravity 23 is used for planning purposes; actual range is 17-29

Additional notes for MMS WCD Scenario :

- PAI is proposing to perform well testing for each of the three new wells covered by this DOCD. PAI is proposing to discharge the well completion fluids (which will not include EPA defined "priority pollutants") per NPDES requirements.

- PAI is not proposing to use oil-based drilling fluids. PAI is proposing to use water-based and synthetic-based drilling fluids for each of the three new wells covered by this DOCD.

9(b) Oil Spill Response Discussion - MMS Areas of Interest

Organization

PAI Qualified Individuals utilize a contract Spill Management Team, The O'Briens Group, to manage oil spill response. Clean Gulf Associates and other complimentary specialist OSROs provide access to oil spill response equipment and personnel as described in the PAI R-OSRP.

WCD Planning Volume for NEPA Review

PAI is capable of responding to the Worst Case Discharge (WCD) scenario described in 9(a) which is focused on MMS areas of interest (i.e. 30 CFR 254.26) related to well blowouts, topsides facilities, and lease term pipelines. For the oil spill response discussion per NTL 2006 G14, the WCD planning volume from an MMS area of interest perspective is [redacted] barrels per day with an API gravity of 23° based on the blowout scenario (which is a larger planning volume than the largest topside tank or production vessel).

Land Segment and Resource Identification

Trajectories of a spill and the probability of it impacting a land segment have been projected utilizing information in MMS Oil Spill Risk Analysis Model (OSRAM) for the Central and Western Gulf of Mexico available on MMS website using (30) day impact. The results are shown in Table 9-6. These trajectories are consistent with the site specific Oil Spill Risk Analysis (OSRA) performed by MMS in February 2007 as described in 9(d).

Table 9-6 – Trajectory by Land Segment

Area / Block	OCS-G	Launch Area	Land Segment and / or Resource	Conditional Probability (%) within 30 days
WR 205	16964	Central 48	Matagorda County, Texas	1
WR 206	16965		Brazoria County, Texas	1
WR 249	16969		Galveston County, Texas	2
WR 250	16970		Jefferson County, Texas	1
WR 425	16987		Cameron Parish, Louisiana	2
WR 426	16988		Vermilion Parish, Louisiana	1
WR 469	16997		Terrebonne Parish, Louisiana	1
WR 470	16998		LaFourche Parish, LA	1
			Plaquemines Parish, Louisiana	1

The MMS OSRAM identifies a 2% probability of impact to the shorelines of Galveston County, Texas; and/or Cameron Parish, Louisiana within 30 days.

Galveston County includes the Gulf Beach from the west end of Galveston Island at Texas Highway 3005 to the east coast of High Island at the Jefferson County line. Habitats include marshes at the west end of Seawall Boulevard and on the east end of the island and open beaches and avian feeding areas all along the coastline, including a National Audubon Society Sanctuary. The waters of Galveston Bay are classified as an EPA National Estuary.

Cameron Parish includes the east side of Sabine Lake, Sabine National Wildlife Refuge, Calcasieu Lake, Lacassine National Wildlife Refuge (inland) and Grand Lake; along the Gulf beach from Sabine Pass to Big Constance Lake in Rockefeller Wildlife Refuge. This region is composed of open public beaches, marshlands and swamps. It serves as a habitat for numerous birds, finfish and other animals, including several rare, threatened and endangered species.

Additional discussion of protection strategies for potentially affected resources is included in PAI R-OSRP.

Spill Response

PAI will make every effort to respond to the Worst Case Discharge as effectively as possible. A description of the response equipment available to contain and recover the Worst Case Discharge is shown in Appendix 5.

Using the estimated chemical and physical characteristics of crude, an ADIOS weathering model was run on a similar product from the ADIOS oil database. The results indicate 91% of the product would remain after 12 hours, leaving approximately [redacted] barrels on the water.

Appendix 5 outlines equipment, personnel, materials and support vessels, and temporary storage equipment to be considered in order to cope with an initial spill of [redacted] barrels. The list estimates individual times needed for procurement, load out, travel time to the site and deployment. If appropriate, 5 sorties (10,000 gallons) from the DC-4 and 5 sorties (5,000 gallons) from the DC-3 should disperse approximately [redacted] barrels of oil.

Offshore response strategies may also include attempting to skim utilizing the HOSS Barge, and five Fast Response Units (FRU), with a total derated skimming capacity of 60,740 barrels. Temporary storage associated with the identified skimming equipment equals 5,130 barrels. An additional open ocean storage barge with a capacity of 23,000 barrels would be mobilized as necessary. Safety is first priority; air monitoring will be performed and operations deemed safe prior to any containment / skimming attempts.

If the spill would go unabated, shoreline impact in coastal environments would depend upon existing environmental conditions. Onshore response may include the deployment of shoreline boom on beach areas, or protection and sorbent boom in vegetated areas. Strategies would be based upon surveillance and real time trajectories that depict areas of potential impact given actual sea and weather conditions. Strategies from the One Plan Gulf of Mexico Area Contingency Plan (ACP) and Unified Command would be consulted to ensure that environmental and special economic resources would be correctly identified and prioritized to ensure optimal protection. ACPs depict the protection response modes applicable for oil spill clean-up operations. Each response mode is schematically represented to show optimum deployment and operation of the equipment in areas of environmental concern. Supervisory personnel have the option to modify the deployment and operation of equipment allowing a more effective response to site-specific circumstances.

9(c) Oil Spill Response Discussion - USCG Areas of Interest

This section is provided to assure a comprehensive NEPA review.

PAI is also capable of responding to the Worst Case Discharge, the Maximum Most Probable Discharge, and Average Most Probable Discharge scenarios which are focused on USCG areas of interest related to marine vessels as described in the most recent Memorandum of Agreement between the MMS and the USCG (OCS-03) and 33 CFR Part 155 Subpart D. PAI will utilize existing memberships in Clean Gulf Associates (CGA) and Clean Caribbean & Americas (CCA) to demonstrate oil spill response capability.

Although PAI is capable of responding to the various USCG defined discharge scenarios, it should be noted that the owners of the FPSO and the Shuttle Vessels will also be responsible for demonstrating that they have the capability to respond to the USCG defined discharge scenarios prior to USCG approval of their vessel specific oil spill response plans. Although each of the organizations (PAI and vessels owners) will be capable of responding to the USCG defined discharge scenarios, it is anticipated that the vessel owners' will have the primary responsibility as vessel operators while PAI will have secondary responsibility due to ownership of the produced oil. The details regarding primary and secondary responsibility will be finalized with the USCG after PAI awards contracts for the provision of the FPSO and Shuttle Vessels (approximately 3Q07).

Table 9-7 describes the amounts associated with each USCG discharge scenario for the FPSO.

Table 9-7 – FPSO Discharge Scenarios (USCG Areas of Interest)

USCG Discharge Scenario for FPSO	Estimated Amount (barrels)	Comments
Worst Case Discharge	550,000 - 850,000	Equal to discharge of a marine vessel's entire cargo tanks in adverse weather conditions. See notes (1) and (2) for additional details.
Maximum Most Probable Discharge	2,500	Equal to 2,500 barrels of oil for vessels with a cargo capacity equal to or greater than 25,000 barrels OR 10% of the vessels oil cargo capacity with a capacity of less than 25,000 barrels. See note (3) for additional details.
Average Most Probable Discharge	50	Equal to the lessor of 50 barrels of oil or 1% of the cargo from the vessel during cargo oil transfer operations to or from the vessel

Notes :

(1) The USCG Worst Case Discharge would involve a total loss of the FPSO which is an extreme low probability event given the industry proven controls that PAI will put in place.

(2) The USCG has implemented a geographic (i.e. inland, nearshore, offshore, open ocean) based cap system to identify the amount of planning volumes that must be covered by contract. For offshore work scopes, the planning volume caps are 12,500 barrels per day for Tier 1, 25,000 barrels per day for Tier 2, and 50,000 barrels per day for Tier 3. When the required planning volume exceeds the cap amounts, the vessel owner is only required to have OSRO contracts in place up to the amount of the caps, but the vessel owner is required to identify sources of additional OSRO resources to respond to the required planning volumes over and above the cap. Regarding the USCG Worst Case Discharge planning volumes for the FPSO, PAI currently has the capability to respond to the cap amounts of the required planning volumes for Tiers 1-3 through CGA and CCA. PAI may be required to identify but not contract additional OSRO coverage (e.g. MSRC, NRC) due to the required planning volumes associated with onshore recovery of oil spilled offshore which could reach the shore, depending on the OSRO coverage that the FPSO owner has in place.

(3) The USCG Maximum Most Probable Discharge is significantly greater than an oil spill associated with FPSO offloading, which may be the highest exposure regarding oil spills associated with FPSOs. As described in section 1(f), PAI will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during FPSO offloading. If multiple controls described in section 1(f) failed, the amount of oil spilled during FPSO offloading would likely be an order of magnitude lower (i.e. the amount of oil in the offloading hose) than the amount of the USCG Maximum Most Probable Discharge.

Table 9-8 describes the amounts associated with each USCG discharge scenario for the Shuttle Vessels.

Table 9-8 – Shuttle Vessel Discharge Scenarios (USCG Areas of Interest)

USCG Discharge Scenario for Shuttle Vessels	Estimated Amount (barrels)	Comments
Worst Case Discharge	185,000 - 500,000	Equal to discharge of a marine vessel's entire cargo tanks in adverse weather conditions. See notes (1) and (2) for additional details.
Maximum Most Probable Discharge	2,500	Equal to 2,500 barrels of oil for vessels with a cargo capacity equal to or greater than 25,000 barrels OR 10% of the vessels oil cargo capacity with a capacity of less than 25,000 barrels. See note (3) for additional details.
Average Most Probable Discharge	50	Equal to the lessor of 50 barrels of oil or 1% of the cargo from the vessel during cargo oil transfer operations to or from the vessel

Notes :

(1) The USCG Worst Case Discharge would involve a total loss of the Shuttle Vessel which is an extreme low probability event given the industry proven controls that PAI will put in place.

(2) The USCG has implemented a geographic (i.e. inland, nearshore, offshore, open ocean) based cap system to identify the amount of planning volumes that must be covered by contract. For offshore work scopes, the planning volume caps are 12,500 barrels per day for Tier 1, 25,000 barrels per day for Tier 2, and 50,000 barrels per day for Tier 3. When the required planning volume exceeds the cap amounts, the vessel owner is only required to have OSRO contracts in place up to the amount of the caps, but the vessel owner is required to identify sources of additional OSRO resources to respond to the required planning volumes over and above the cap. PAI may be required to identify but not contract additional OSRO coverage (e.g. MSRC, NRC) due to the required planning volumes associated with onshore recovery of oil spilled offshore or nearshore which could reach the shore, depending on the OSRO coverage that the Shuttle Vessel owner has in place.

(3) The USCG Maximum Most Probable Discharge is significantly greater than an oil spill associated with Shuttle Vessel loading at the FPSO or Shuttle Vessel offloading at terminals, which may be the highest exposures regarding oil spills associated with Shuttle Vessels. As described in section 1(f), PAI will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during Shuttle Vessel loading at the FPSO while terminal operators will utilize a number of industry proven safety and pollution prevention measures to mitigate against oil spills during Shuttle Vessel offloading at terminals. If multiple controls described in section 1(f) failed, the amount of oil spilled would likely be an order of magnitude lower (i.e. the amount of oil in the offloading hose) than the amount of the USCG Maximum Most Probable Discharge.

PAI and the USCG will require the FPSO provider to implement a vessel specific oil spill response plan (i.e. SOPEP) which is approved by the USCG and which will be bridged into the PAI R-OSRP. PAI and the USCG will also require the Shuttle Vessel provider to implement a vessel specific oil spill response plan which is approved by the USCG and which will be bridged into the PAI R-OSRP. Comprehensive drills will be performed to verify readiness from all involved parties (PAI, FPSO provider, and Shuttle Vessel provider).

PAI will utilize a dedicated field support tug during FPSO operations. In addition to offloading support, the tug will be outfitted with equipment (e.g. spill booms) to support spill response.

9(d) Modeling Report

At PAI's request, MMS conducted a site specific Oil Spill Risk Analysis (OSRA) in February 2007 to estimate the risk of impacts to coastal resources resulting from oil spills in the Walker Ridge area. A summary of the results follow. See Appendix 6 to review the details of the report.

This model calculates the trajectories of oil spills from hypothetical spill locations to various environmental resources using realistic data fields of winds and ocean currents in the GoM. The ocean currents used are computed from an ocean circulation model of the GoM driven by "analyzed meteorological forces," such as near-surface winds and total heat fluxes, and observed river inflow. The models used are versions of the Princeton Ocean Model (POM), which allows a realistic coastline and bottom topography to be represented in the model. In addition, the OSRA model incorporates the Mellor-Yamada turbulence closure model to represent the vertical mixing process in the water column.

In the trajectory simulation portion of the OSRA model, hypothetical oil spills are initiated at regular intervals in space and time within the study area. The other portion of the model records the number of times the simulated oil spills come into contact with the shoreline and other environmental resources. The OSRA model periodically divides the total number of contacts to shoreline segments by the total number of simulated oil spills in the study area to arrive at estimated probabilities of oil-spill contact (Ji *et al.*, 2007).

For this analysis at Walker Ridge, MMS analyzed the trajectories of a typical offshore oil spill of 1,000 bbls or greater occurring under the activities described in this DOCD. The simulations did not include factors such as possible cleanup operations, chemical composition, or biological weathering of oil spills, or the spreading and splitting of oil spills, which could affect the transport of spilled oil as well as the dimensions, volume, and nature of the oil spills. The model takes a more environmentally conservative approach by presuming persistence of spilled oil over the selected duration of time of the trajectories. However, an implicit analysis of the likely weathering and cleanup of a typical offshore oil spill of 1,000 bbl or greater occurring under the proposed action scenarios shows that the slick would not persist on the water surface beyond 10 days (MMS 2002).

The trajectories run for Walker Ridge were followed for at least 30 days in the model. This allowed more hypothetical spills to reach the environmental resources and the shoreline from more distant spill locations. With increased travel time, the complex patterns of wind and ocean currents produce eddy-like motions of the oil spills and results in multiple opportunities for a spill to make contact with any given environmental resource or shoreline segment (Ji *et al.*, 2007).

The OSRA results were that, due to the study area's distance of 140 to 160 nautical miles from the shoreline, there were no probabilities of contact greater than 0.5% for oil spills persisting from 3 to 10 days and an annual average maximum probability of contact of 2%. Oil spills in transit for 30 days were more likely to come into contact with environmental resources and the shoreline. However, it is contemplated that active response activities and weathering factors would likely mean that oil would not persist long enough to reach the U.S. shoreline. The study area is approximately 40 to 55 nautical miles from the limits of the Exclusive Economic Zone; therefore, the international boundary segments included in the model have annual average contact probabilities of up to 16% within 10 days (Ji *et al.*, 2007).

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10 Environmental Monitoring Information

10(a) Monitoring Systems

PAI will utilize numerous monitoring systems to measure environmental conditions and to identify conditions which may impact the environment or asset integrity of the facilities. A list of the most important monitoring systems is included below.

- Fully outfitted Central Control Room on the FPSO providing the capability of monitoring topsides / subsea production systems and FPSO marine systems
- Monitoring and testing per Region 6 NPDES General Permit requirements
- Monitoring and testing of surface and subsurface safety systems per 30 CFR 250 Subpart H
- Inert Gas Monitoring System to be used on FPSO and Shuttle Vessels
- Ballast Monitoring System to be used on FPSO and Shuttle Vessels
- In-Service Inspection Plan (utilizing CCTV and ROV inspections) to be used on the FPSO in lieu of dry-docking
- Leak detection and recovery system for the swivel located in the FPSO turret
- Leak testing of critical connections performed after FPSO re-connection prior to introduction of pressurized fluids
- CCTV to be utilized in the FPSO turret for critical connection systems
- Life cycle management of polyester components of mooring system managed through IMRR Plan (if polyester mooring is used)
- ROV surveys performed after installation of polyester mooring system; performed annually thereafter (if polyester mooring is used)
- Watchkeeping performed by FPSO and Shuttle Vessel crews during offloading operations
- Offloading Telemetry System with OESD1 and OESD2 capabilities

- Hawser (i.e. mooring line between FPSO and Shuttle Vessel) tension monitoring system
- CCTV for spill detection during offloading operations
- Infrared leak detection system during offloading operations
- Flexible jumpers outfitted with a leak detection system
- FSHRs outfitted with a tension monitoring system
- FSHRs outfitted with VIV monitoring system (if needed)
- Monitoring of turret motions in FPSO-connected and FPSO-disconnected conditions
- Downhole monitoring system for wells
- Ocean current monitoring performed using ADCP arrays (during drilling and production operations) as required by NTL 2007-G17.

10(b) Flower Garden Banks National Marine Sanctuary

Phase 1 of the development plan will not include activities within either the protective zones of the Flower Garden Banks or the Stetson Banks.

11 Lease Stipulations Information

11(a) Topographic Features Stipulation

The facilities associated with Phase 1 of the development plan are located in a water depth of over 8000 feet and are not located near a "No Activity Zone". Shuttle Vessels and marine support vessels could cross over "No Activity Zones" but disturbances to these features are not anticipated.

11(b) Live Bottoms (Pinnacle Trend) Stipulation

The facilities associated with Phase 1 of the development plan are not located near a Live Bottom (Pinnacle Trend).

11(c) Military Warning Area Stipulation

The FPSO will be located in WR Block 249 which is approximately 15 miles south of Military Warning Area W92. PAI will notify the designated military contact prior to engaging in operations which may cross the W92 Military Warning Area (Shuttle Vessels, marine support vessels, and helicopters).

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12 Environmental Mitigation Measures Information

Florida is not an Affected State. Per NTL 2006 G14, it is not required to include information regarding the measures PAI will take to avoid, minimize, and mitigate impacts to marine and coastal resources in the state of Florida.

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13 Decomissioning Information

Per NTL 2006 G14, decommissioning information is not required for DOCDs in the MMS GoM region.

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14 Related Facilities and Operations Information

14(a) Related OCS Facilities and Operations

This section provides an overview of the various drilling units, topside and subsea facilities, and pipelines. Section 2(e) describes technologies which are considered new to the GoM in more detail. Section 1(f) describes the most important safety and pollution prevention features of the facilities covered by this DOCD.

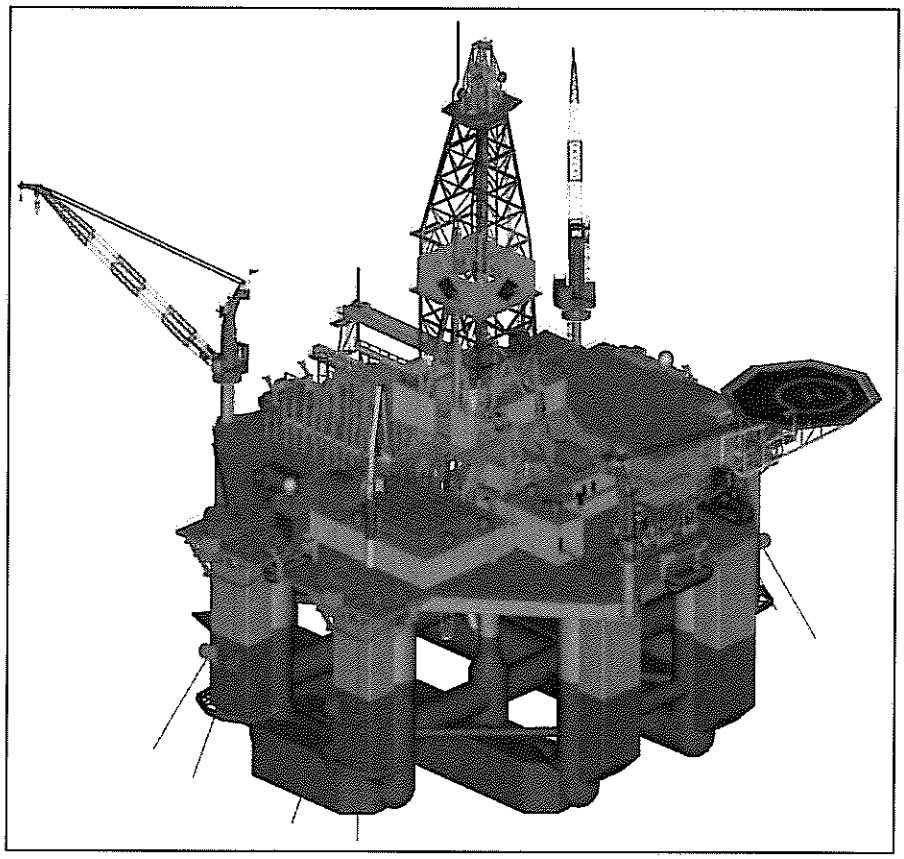
Drilling Rigs

Phase 1 includes the drilling and completion of three new wells. It is anticipated that PAI will temporarily transfer operatorship of the two Cascade wells to Devon Energy Inc (i.e. Devon) so that they may be drilled and completed using the Diamond "Ocean Endeavor". Upon completion of the second Cascade well, Devon would transfer operatorship of the two Cascade wells back to PAI. PAI will be the operator of the Chinook well. PAI will drill and complete the well using the Seadrill "Petrorig 1". It should be noted that the Seadrill "West Sirius" (sister ship to "Petrorig 1") is the first alternate rig for the Diamond "Ocean Endeavor", while the Seadrill "Petrorig 1" is the second alternate. Although the two Cascade wells will be operated by Devon, all three wells will be covered by this DOCD since all three wells will be operated by PAI during Phase 1 production operations. If any additional wells are added to future development plans, PAI will supplement the DOCD as appropriate.

Wells will be directionally drilled, cased, and perforated with multi-zone frac-pacs. Although there are some well engineering challenges due to reservoir characteristics, well engineering will utilize proven GoM practices and there are no extraordinary safety or environmental considerations to be addressed.

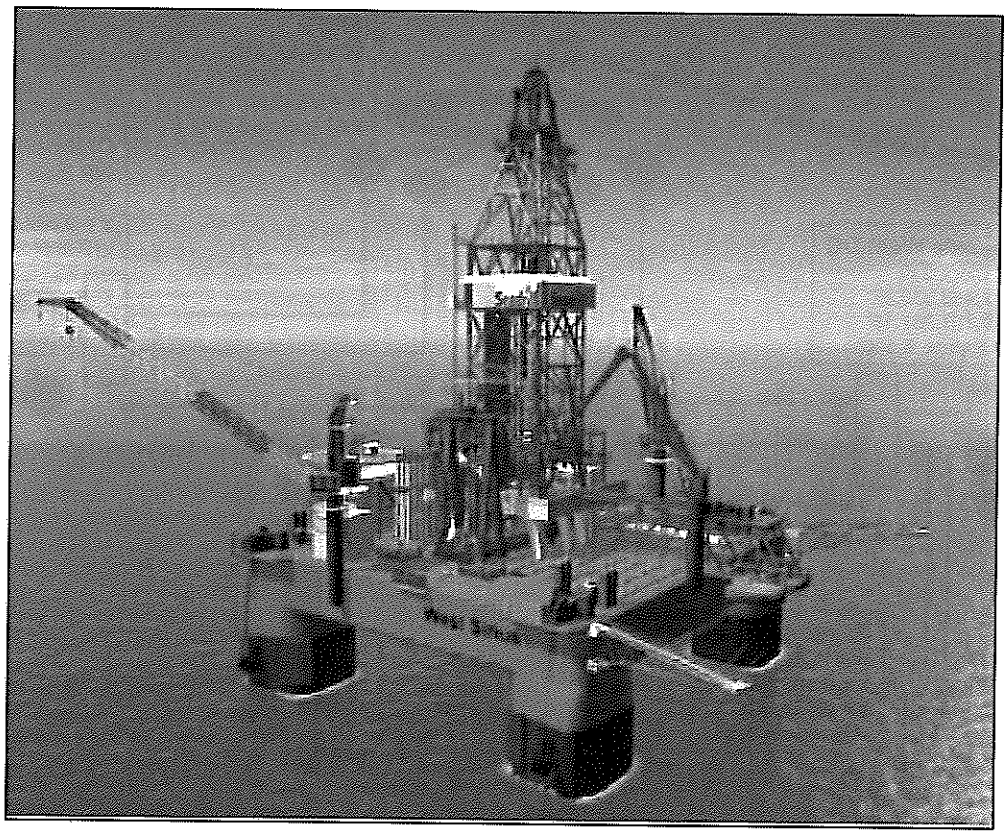
The Diamond "Ocean Endeavor" is a mobile offshore drilling unit (MODU) which will be moored with a combination anchor / chain / wire system in up to 10,000 foot water depth and for drilling up to 35,000 feet below mud level. The "Ocean Endeavor" is equipped with lifesaving equipment to accommodate up to 140 personnel and has gas, fire, and smoke detection systems, which would be monitored from a 24-hour manned station. The rig would include fixed fire fighting equipment including carbon dioxide foam flooding. The rig has a sump system to catch all deck drainage. Rig personnel will follow PAI and Diamond offshore HSE policies. Safety features include well control, pollution prevention, welding procedures, and blowout prevention equipment as described in 30 CFR 250, Subparts C, D, E, G, and O. The drilling rig will comply with MMS, USCG, and EPA requirements for operating in the GoM. See Figure 14-1 to review a conceptual representation of the "Ocean Endeavor".

Figure 14-1 – Diamond "Ocean Endeavor"



The "Petrorig 1" is a sister ship to the "West Sirius" and "West Taurus" DP semi-submersible rigs built in the Jurong shipyard in Singapore for Seadrill. "Petrorig 1" will have state-of-the-art drilling equipment, station keeping, and robust capacities required for drilling in up to 10,000 foot water depth and drilling to 35,000 feet below mud level. The "Petrorig 1" is equipped with lifesaving equipment to accommodate up to 180 personnel and has gas, fire, and smoke detection systems which would be monitored from a 24-hour manned station. The rig will also include fixed fire fighting equipment including carbon dioxide foam flooding. The rig has a sump system to catch all deck drainage. Rig personnel will follow PAI and Seadrill HSE policies. Safety features include well control, pollution prevention, welding procedure, and blowout prevention equipment as described in 30 CFR 250, Subparts C, D, E, G, and O. The rig would also comply with MMS, USCG, and EPA requirements for operating in the GoM. See Figure 14-2 to review a conceptual representation of the "Petrorig 1".

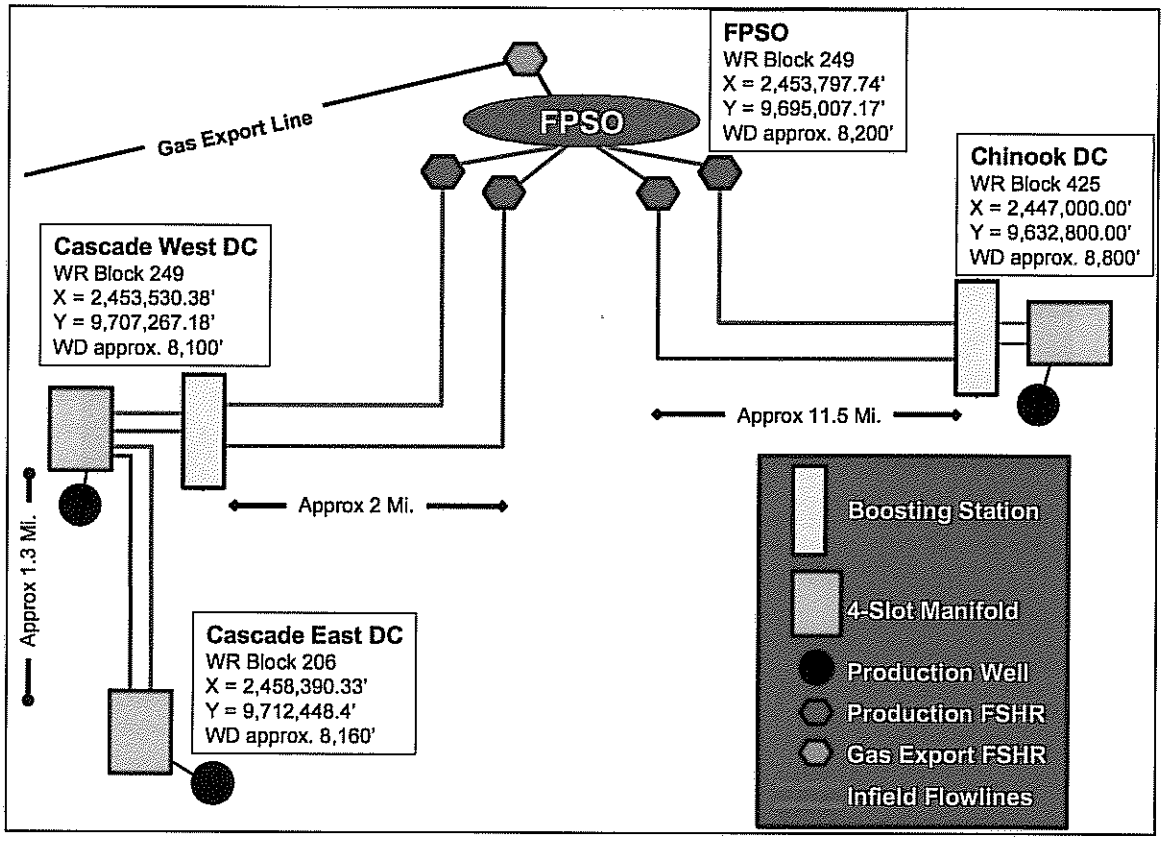
Figure 14-2 – Seadrill "Petrorig 1"



Subsea Facilities and Pipelines / Risers

Phase 1 of the development plan will include drill centers at Cascade East, Cascade West, and Chinook. With the exception of the FSHRs and subsea booster pumps, the Cascade and Chinook subsea facilities will use field proven designs that have been extensively used in deepwater projects in the GoM. The FSHRs and subsea booster pumps are discussed in greater detail in Section 2(e) as they are considered technology new to the GoM by MMS. See Figure 1-2 to review a conceptual representation of the subsea facilities and associated pipelines and risers. Figure 14-3 provides an illustration which summarizes the subsea facilities and associated pipelines and risers. See Figure 1-3 to review the Field Layout.

Figure 14-3 – Illustration of Subsea Facilities Layout



Cascade consists of two drill centers, Cascade East located in WR Block 249 and Cascade West located in WR Block 206. The Cascade East and Cascade West drill centers are in approximately 8200 feet of water. The Chinook drill center is in approximately 8800 feet of water.

Production from the well in Cascade East is gathered into a 4 slot manifold and transported approximately 1.5 miles to Cascade West via two 9 5/8" flowlines. Production from the well in Cascade West is gathered into a 4 slot manifold and is commingled with production from Cascade East before being transported approximately 2.5 miles to the FPSO via two 9 5/8" flowlines and two production FSHRs. Production from Cascade East and Cascade West is enhanced by skid mounted booster pumps ([redacted] bpd) which are located immediately downstream of the Cascade West gathering manifold. Dual flowlines will allow for round trip pigging. The Cascade East and Cascade West production flowlines will be wet insulated for flow assurance considerations. Cascade East and Cascade West will utilize PLETs and jumpers for subsea connectivity. Cascade East and Cascade West are powered and controlled by one power umbilical and one control umbilical (with flying leads) originating from the FPSO. See Figures 14-4 and 14-5 to review the Cascade East and Cascade West drill centers, respectively.

Figure 14-4 – Cascade East Drill Center

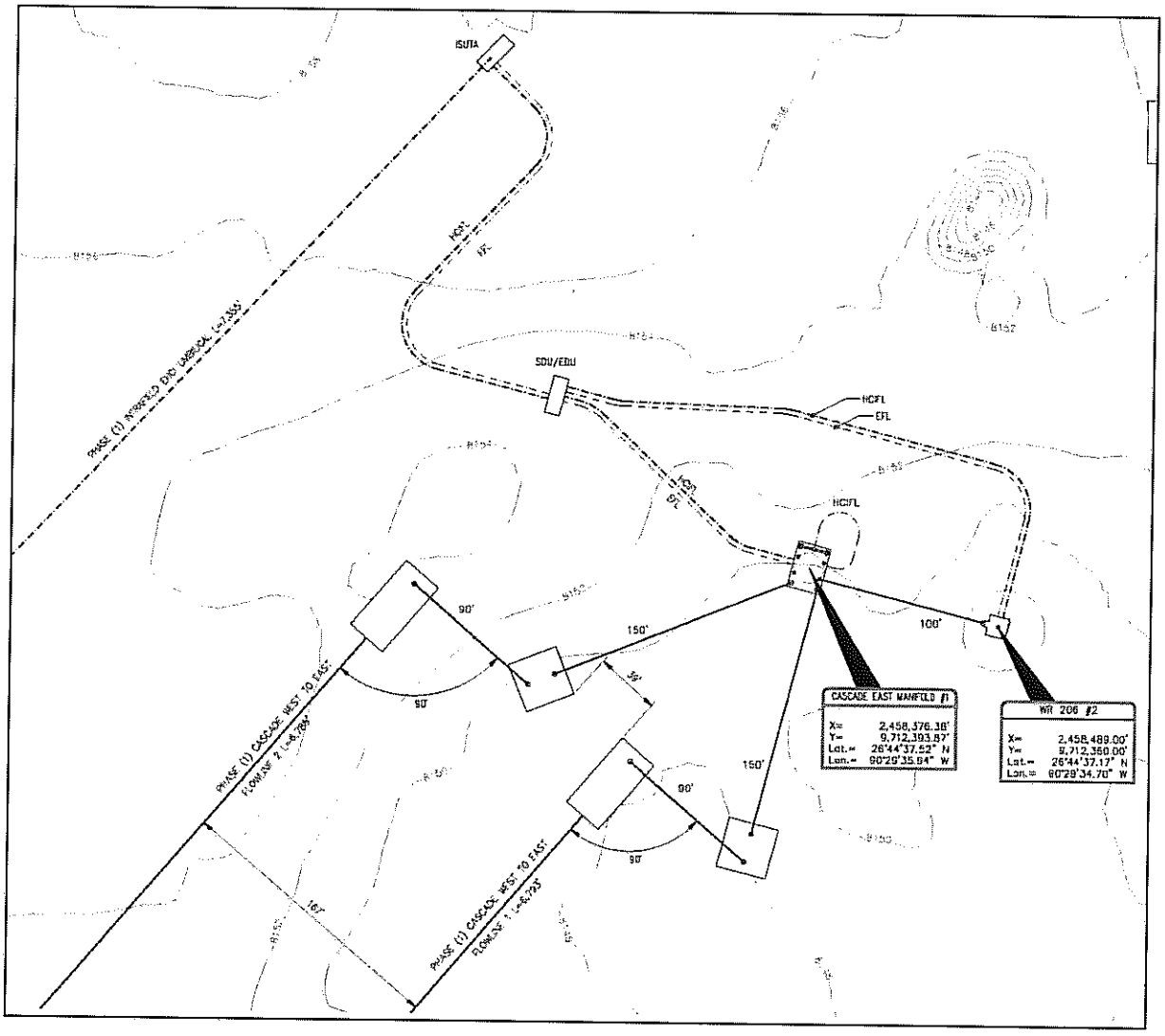
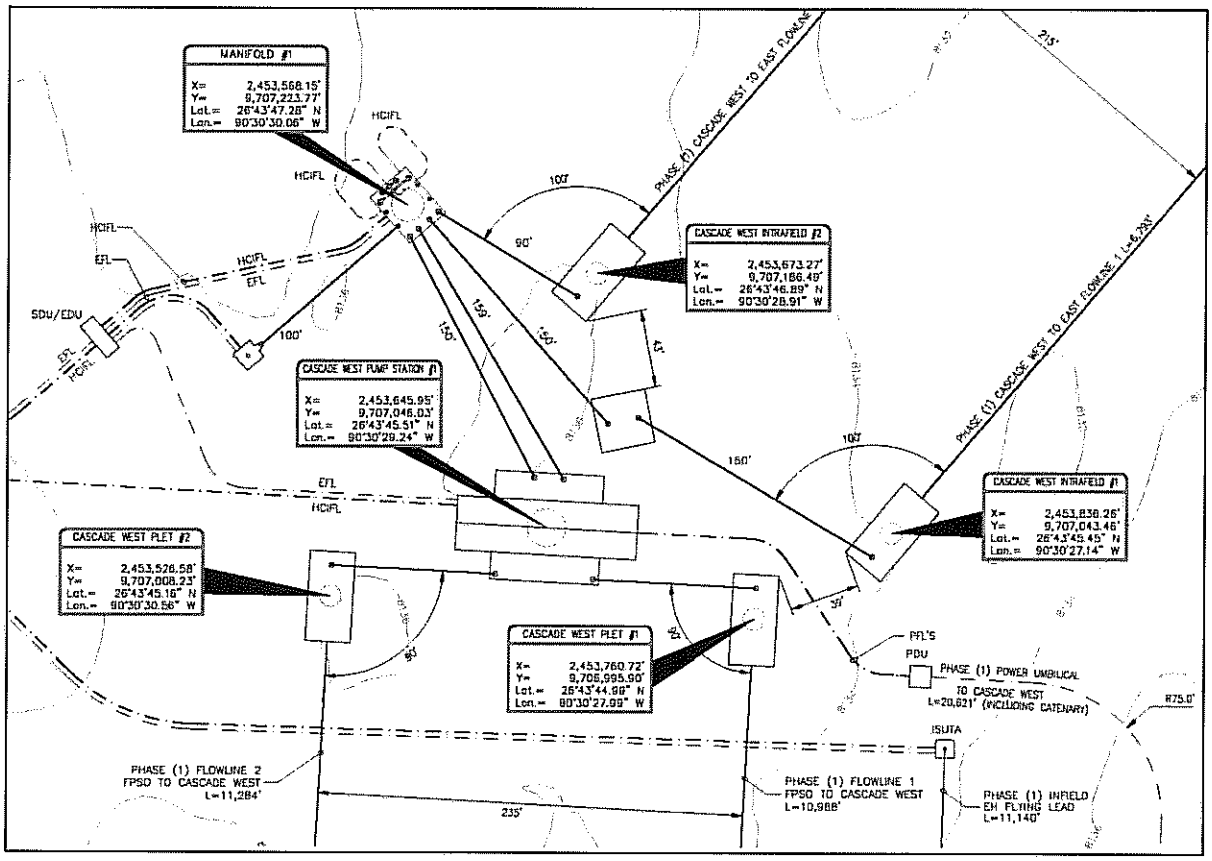
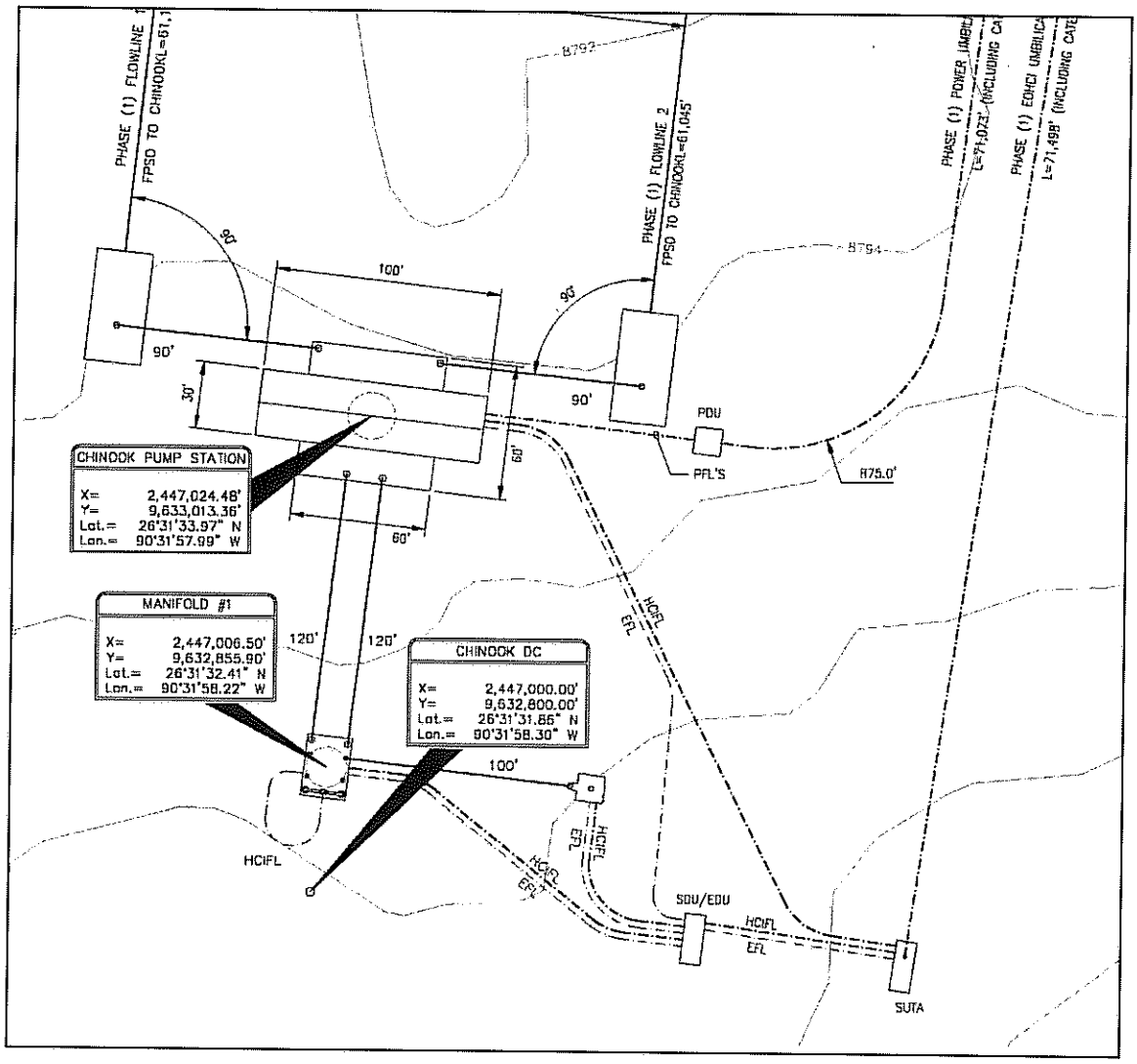


Figure 14-5 - Cascade West Drill Center



Production from the well in Chinook is gathered into a 4 slot manifold and transported approximately 12 miles to the FPSO via two flowlines and two production FSHRs. Production from Chinook is enhanced by a skid mounted booster pump ([redacted] bpd) which is located immediately downstream of the gathering manifold. Dual flowlines will allow for round trip pigging. The Chinook production flowlines will be a Pipe-in-Pipe (9 5/8" inner pipe OD) configuration for flow assurance considerations. Chinook will utilize PLETs and jumpers for subsea connectivity. Chinook is powered and controlled by one power umbilical and one control umbilical (with flying leads) originating from the FPSO. See Figure 14-6 to review the Chinook drill center.

Figure 14-6 – Chinook Drill Center



See Section 14(b) for a description of the gas export pipeline.

The development plan for Phase 1 includes five FSHRs; two production FSHRs connected to Cascade West, two production FSHRs connected to Chinook, and one gas export FSHR. The free standing vertical riser design consists of a section of vertical line pipe (anchored to the seabed by a deep foundation) which is tensioned at the top by a buoyancy can. The free standing vertical riser is connected to the FPSO turret buoy by a flexible jumper. See Figure 2-6 for FSHR details. Each FSHR shall be located approximately 1200 feet from the FPSO.

FPSO

The development plan for Phase 1 includes the use of an FPSO as the host production facility. Produced oil from Cascade and Chinook will be separated, treated, measured, and temporarily stored on the FPSO prior to transportation to market.

The FPSO will be an existing converted tanker modified for use in GoM. The FPSO will be a foreign flagged vessel which will be given a Certificate of Compliance by the USCG prior to first oil production.

The FPSO will be double hulled with segregated cargo and ballast tanks. The FPSO will have a cargo tank capacity of 550,000 – 850,000 barrels.

The FPSO will have a single point mooring (SPM) system which will allow for full passive weathervaning. The SPM will have a disconnectable feature which will allow her to disconnect and motor away from named storms and hurricanes under her own power, returning for re-connection when it is safe to do so.

The FPSO will be designed to remain on station for 1.) a 100 year return winter storm with a 1 year return loop current or 2.) a 100 year return loop current with a 1 year return winter storm. The FPSO will disconnect for named storms and hurricanes, with no hydrocarbon release to the environment. After disconnection, the turret buoy (which is attached to the mooring lines and FSHRs) will be left behind in a submerged condition out of harms way of the environment conditions at the surface. See Figure 2-2 to review a conceptual representation of the FPSO in her connected and disconnected conditions.

Table 14-1 describes the design capacities of that the FPSO will be able to accommodate :

Table 14-1 – FPSO Topsides Design Parameters

Capacity	Minimum	Maximum
Oil	[redacted] bpd	80,000 bpd
Produced Water	[redacted] bpd	16,000 bpd
Total Fluids	[redacted] bpd	80,000 bpd
Gas	[redacted] MMscfd	16 MMscfd

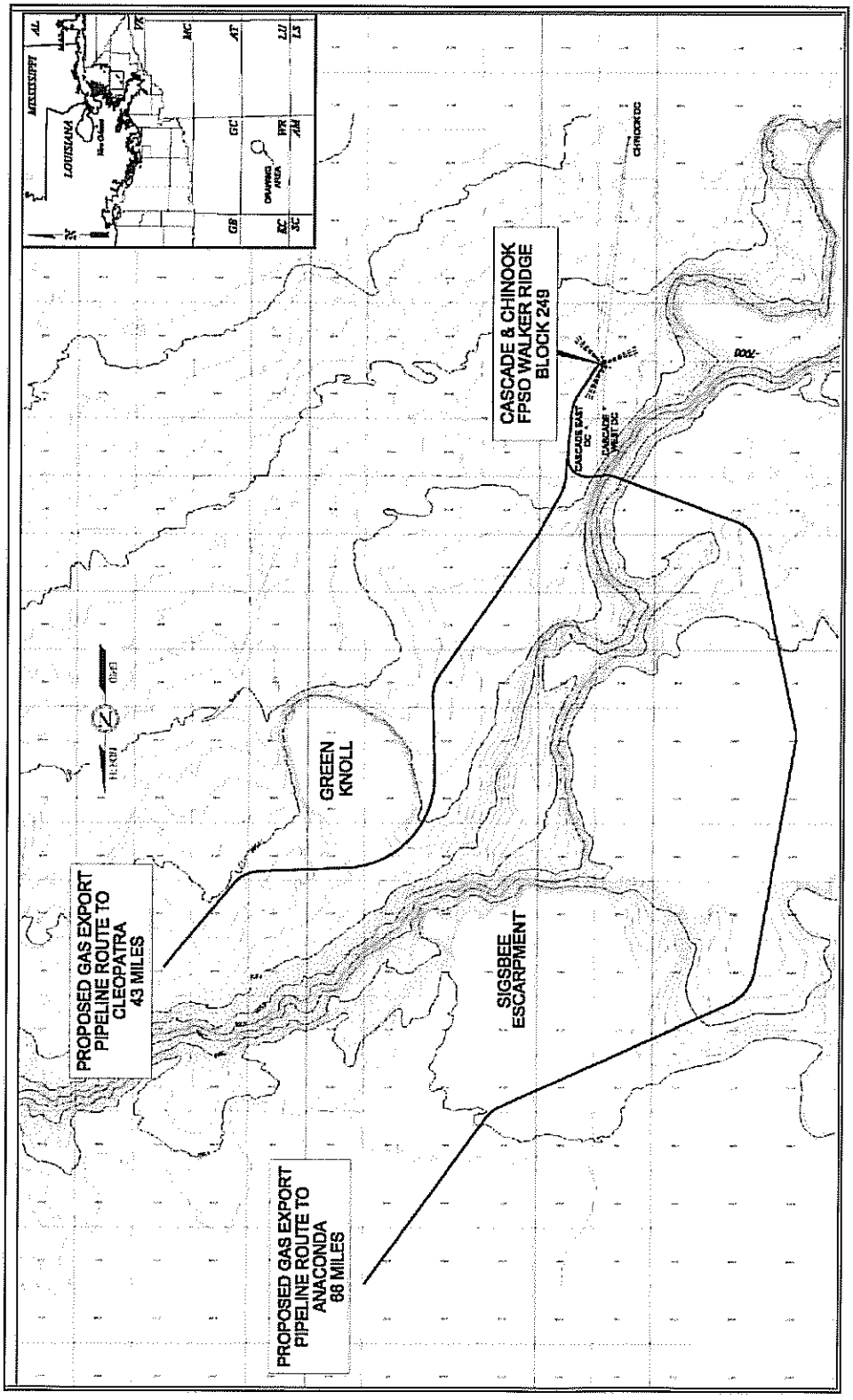
The FPSO would comply with all requirements for continuous operation during Phase 1 without the need to be dry-docked in a shipyard.

The FPSO is discussed in greater detail in Section 2(e) as it is considered technology new to the GoM by MMS.

14(b) Transportation System

Phase 1 of the development plan will utilize a 6" gas export pipeline to transport gas (maximum of 16 MMscfd) which is not consumed on the FPSO to market. As there is no existing pipeline infrastructure in Walker Ridge, PAI will install a gas export pipeline which will tie into an existing facility (operated by others) in Green Canyon. At this time, PAI has two tie-in options. The "Cleopatra" option (operated by BP) is located at GC Block 829 and is approximately 43 miles from the FPSO. The "Anaconda" option (operated by Enterprise) is located at GC Block 606 and is approximately 66 miles from the FPSO. See Figure 14-7 to review the pipeline routing for each option. Although PAI has not finalized which gas export option will be chosen, PAI has evaluated both options via a shallow hazards assessment to assure that the upcoming NEPA review is comprehensive in nature. See GEMS the Summary of Environmental Conditions for Cascade / Chinook in Appendix 2 for additional details regarding shallow hazards assessment of the two proposed gas export line routes.

Figure 14-7 – Gas Export Pipeline Routing



14(c) Produced Liquid Hydrocarbon Transportation Vessels

The development plan for Phase 1 will utilize dedicated Shuttle Vessels to transport produced oil to market. Shuttle Vessels will be either shuttle tankers or articulated tug barges (ATBs) and will be Jones Act and OPA90 compliant. The size of the Shuttle Vessels will be 185,000 – 500,000 bbls.

PAI will likely utilize one Shuttle Vessel to perform one offloading every two weeks in the first year of production operations (i.e. during production ramp-up). PAI will likely utilize two Shuttle Vessels (on a staggered schedule) to perform one offloading every week in subsequent years of production operations for Phase 1. The frequency of offloading will evolve over time as the frequency is driven by the size / speed / number of the Shuttle Vessels relative to the production profile of the reservoirs. Offloading from the FPSO to the Shuttle Vessel will take approximately 24 hours. See Table 14-2.

Table 14-2 – Shuttle Vessel Transportation Information

Transport Method	Shuttle Vessel Capacity (barrels)	Average Volume to be Loaded (barrels per offloading)	Anticipated FPSO Offloadings per Year
One Shuttle Vessel (Year 1)	185,000 - 500,000	185,000 - 500,000	26
Two Shuttle Vessels (Years 2 through end of Phase 1)	185,000 - 500,000	185,000 - 500,000	52

During offloading, Shuttle Vessels will be connected to the FPSO via a hawser system (i.e. mooring line) and offloading hose between the bow of the Shuttle Vessel and the stern of the FPSO in a tandem offloading configuration. The Shuttle Tanker will weathervane in a similar manner as the FPSO (i.e. both vessels will react to the environmental conditions as one "system"). A dedicated field support tug will be utilized to support offloading. See Figure 2-5 to review an example of the tandem offloading configuration that will be utilized.

Additional information on the Shuttle Vessels is included in Section 2(e) as they are considered technology new to the GoM (relative to FPSO offloading).

Shuttle Vessels will transport produced oil to the terminals of choice along the GoM coast, potentially including terminals in Texas, Louisiana, Mississippi, and Alabama. PAI has not yet determined which specific terminals will be used.

PAI is currently evaluating which terminals may be used based on the following considerations :

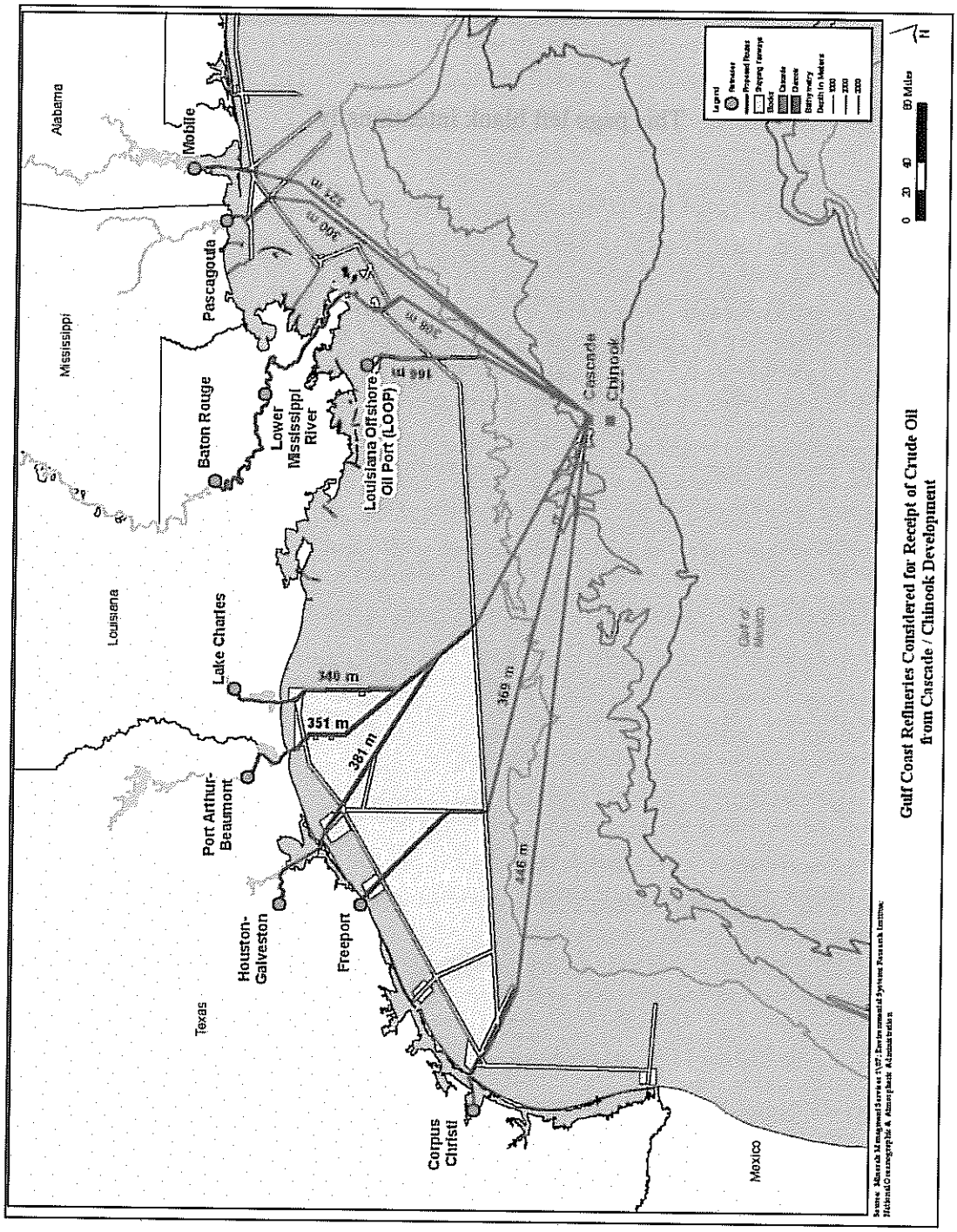
- quality of produced oil relative to the processing capability of terminals (1)
- vessel size limitations (1)
- terminal capacities (2)
- commercial (2)

Notes :

(1) assessment made by PAI during the planning phase
(2) assessment made by PAI just prior to each offloading

Figure 14-8 provides the locations of the terminals that PAI is considering.

Figure 14-8 – Potential Terminals Under Consideration



There will not be a need to expand or modify any terminals to accommodate transportation of oil to market via Shuttle Vessels.

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15 Support Vessels and Aircraft Information

15(a) General

Table 15-1 provides an overview of the equipment that PAI anticipates using for drilling and completion operations during Phase 1 of the development plan. PAI anticipates approximately 18 months of drilling and completion operations during Phase 1.

Table 15-1 – Support Equipment (Drilling and Completions Operations)

Type	Maximum Fuel Tank Storage Capacity (barrels)	Maximum Number in Area at Any Time	Trip Frequency or Duration
Drilling Rig (DP)	21,250	1	6 months
Drilling Rig (Moored)	6,900	1	12 months
Crew Boat / Fast Supplier	550	1	3 round trips per week
Offshore Service Vessel	7,000	2	2 round trips per week
Anchor Handling Tug	9,500	2	Rig moves (1)
Helicopter	22	1	2 round trips per day

(1) Moored drilling rigs only

Table 15-2 provides an overview of the equipment that PAI anticipates using for FPSO production operations during Phase 1 of the development plan. PAI anticipates 6-8 years of production operations during Phase 1.

Table 15-2 - Support Equipment (FPSO Production Operations)

Type	Maximum Fuel Tank Storage Capacity (barrels)	Maximum Number in Area at Any Time	Trip Frequency or Duration
Crew Boat / Fast Supplier	550	1	3 round trips per week
Offshore Service Vessel	7,000	1	2 round trips per week
Field Service Tug	7,000	1	100% in field (1)
Helicopter	22	1	2 round trips per day

(1) Offloading and general marine support

Table 15-3 provides an overview of the equipment that PAI anticipates using for installation activities during Phase 1 of the development plan. PAI anticipates that all Phase 1 installation activities will be performed in 2009.

Table 15-3 - Support Equipment (Shuttle Vessel Operations)

Type	Maximum Fuel Tank Storage Capacity (barrels)	Maximum Number in Area at Any Time	Trip Frequency or Duration
DP Pipelay Barge (1)	57,500	1	30 days
DP Pipelay Barge (2)	18,900	1	60 days
DP Construction Vessel (3)	26,250	1	40 days
DP Construction Vessel (4)	26,250	1	30 days
DP Construction Vessel (5)	26,250	1	30 days
Offshore Service Vessel (6)	7,000	1	180 days
Anchor Handling Tug (7)	9,500	2	45 days
Tug with Barge (8)	550	1	9 days
Helicopter (9)	22	1	180 days

(1) Chinook Flowlines
(2) Cascade Flowlines and Gas Export
(3) FSHRs
(4) Flexible Jumpers and Flying Leads
(5) Subsea Heavy Lifts
(6) Multiple vessels supporting multiple work scopes over approximately 6 months
(7) FPSO Mooring System and Various Piles
(8) Support for Chinook Flowlines
(9) Supports all installation work scopes

15(b) Diesel Oil Supply Vessels

Table 15-4 provides an overview of the diesel oil supply vessels PAI anticipates using for drilling / completion operations and FPSO production operations.

Table 15-4 – Diesel Oil Supply Vessels

Size of Fuel Supply Vessel	Capacity of Fuel Supply Vessel (barrels)	Frequency of Fuel Transfers	Route Fuel Supply Vessel Would Take
280' Class Offshore Service Vessel (1)	7,000	2 round trips per week	Port Fourchon to Cascade / Chinook Units and return
280' Class Offshore Service Vessel (2)	7,000	2 round trips per week	Port Fourchon to Cascade / Chinook Units and return

(1) Supports Drilling and Completion operations for approximately 18 months
(2) Supports FPSO Production Operations for 6-8 years

15(c) Drilling Fluids Transportation

Florida is not an Affected State for Phase 1 of the development plan. Per NTL 2006 G14, information regarding drilling fluids transportation is not required in this DOCD.

15(d) Solid and Liquid Wastes Transportation

Table 15-5 provides an overview of the methods PAI anticipates will be used to transport the anticipated amounts of solid and liquid wastes associated with drilling and completions operations to onshore facilities for disposal. PAI anticipates approximately 18 months of drilling and completion operations during Phase 1.

Table 15-5 – Solid and Liquid Waste Transportation (Drilling and Completions Operations)

Type of Waste	Total Amount	Facility Name (Location)	Rate	Transport Method
Synthetic Based Drilling Fluids	2,250 barrels	US Liquids (Fourchon), Newpark Services (Fourchon), or CCT (Fourchon)	750 barrels per well	Tanks or drums on supply or crew boats
Solid Wastes	4 standard containers per month	Solid Waste Disposal (Fourchon) or Galiano Waste (Fourchon)	1 standard container per week	Containers on supply or crew boats
Waste Oil	1-3 barrels per month	L & L (Fourchon)	0-1 barrels per week	Drums on supply or crew boats

Table 15-6 provides an overview of the methods PAI anticipates will be used to transport the anticipated amounts of solid and liquid wastes associated with FPSO production operations to onshore facilities for disposal. PAI anticipates approximately 6-8 years of FPSO production operations during Phase 1.

Table 15-6 - Solid and Liquid Waste Transportation (FPSO Production Operations)

Type of Waste	Total Amount	Facility Name / Location	Rate	Transport Method
Solid Wastes	4 standard containers per month	Solid Waste Disposal (Fourchon) or Galiano Waste (Fourchon)	1 standard container per week	Containers on supply or crew boats
Waste Oil	10 barrels per month	L & L (Fourchon)	2-3 barrels per week	Drums on supply or crew boats

Table 15-7 provides an overview of the methods PAI anticipates will be used to transport the anticipated amounts of solid and liquid wastes associated with Shuttle Vessel operations to onshore facilities for disposal. PAI anticipates approximately 6-8 years of FPSO production operations during Phase 1.

Table 15-7 - Solid and Liquid Waste Transportation (Shuttle Vessel Operations)

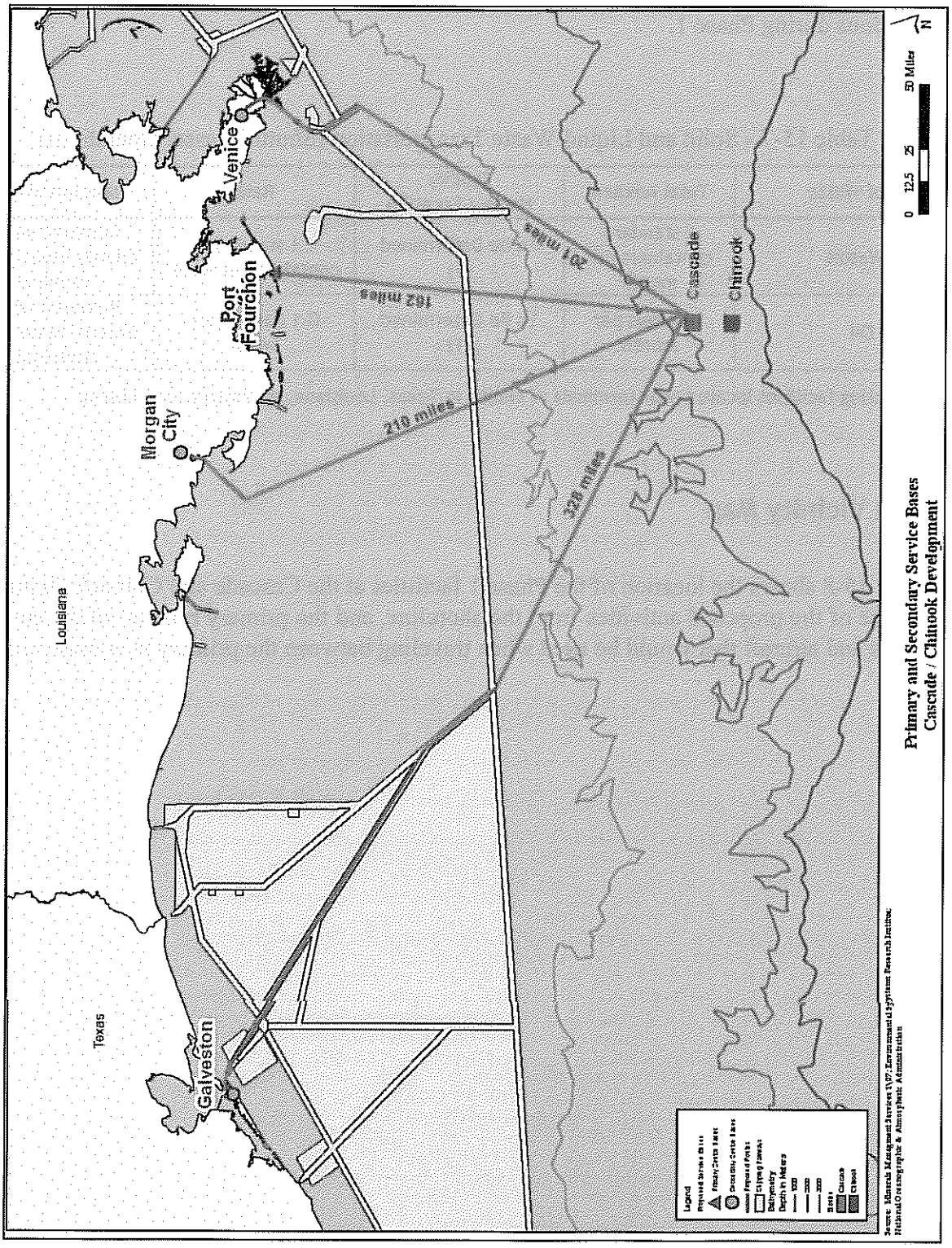
Type of Waste	Total Amount	Facility Name / Location	Rate	Transport Method
Solid Wastes	4 standard containers per month	To Be Determined (1)	1 standard container per week	Removed while Shuttle Vessel is at terminal
Waste Oil	1 barrels per month	To Be Determined (1)	0-1 barrels per week	Removed while Shuttle Vessel is at terminal

(1) Existing facilities located near terminals of choice in Texas, Louisiana, Mississippi, or Alabama

15(e) Vicinity Map

Figure 15-8 shows the location of the Phase 1 facilities at the Cascade and Chinook Units, the distance of the proposed activities from the shoreline, and the primary route(s) of the support vessels and aircraft that would be used when traveling between the primary shorebase and the FPSO.

Figure 15-8 – Vicinity Map



16 Onshore Support Facilities Information

16(a) General

PAI proposes to use onshore support facilities located in Port Fourchon, Louisiana to support Phase 1 of the development plan. See Table 16-1.

Table 16-1 – Onshore Support Facilities

Name	Location	Existing, New, or Modified
Marine Shorebase (1)	Fourchon, LA	Existing
Aviation Facilities (1)	Fourchon, LA	Existing

(1) PAI anticipates identification of the specific companies and locations of onshore support facilities to be used in Port Fourchon to occur in the 3Q07.

The marine shorebase would be equipped with facilities related to warehouse and outside storage spaces, material handling equipment, marine vessel dock space, fuel storage and bunkering, water storage and bunkering, drilling fluids storage and bunkering, communications, security, offices, and vehicle parking lot.

The aviation facilities will be equipped with a helipad, office space, waiting room, and vehicle parking lot.

PAI anticipates that secondary onshore support facilities in Texas and Louisiana may be used on occasion due to specific conditions such as weather, market availability of marine vessels or helicopters, security, and / or safety.

16(b) Support Base Construction or Expansion

PAI will utilize an existing onshore support bases with adequate facilities to support operational needs for Phase 1 of the development plan. No expansions will be required.

16(c) Support Base Construction or Expansion Timetable

Per 16(b), no expansion activities will be performed for Phase 1 of the development plan.

16(d) Waste Disposal

Table 16-2 describes the onshore facilities that PAI anticipates utilizing to dispose of solid and liquid wastes associated with drilling and completion operations during Phase 1 of the development plan.

Table 16-2 – Disposal of Solid and Liquid Wastes (Drilling and Completion Operations)

Name/Location of Facility	Type of Waste	Amount	Rate	Disposal Method
US Liquids, Newpark Services, or CCT	Synthetic drilling based fluids	2,250 barrels	750 barrels per well	Recycled
Solid Waste Disposal or Gagliano Waste	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
L & L	Waste oil	1-3 barrels per month	0-1 barrels per week	Recycled

Table 16-3 describes the onshore facilities that PAI anticipates utilizing to dispose of solid and liquid wastes associated with FPSO production operations during Phase 1 of the development plan.

Table 16-3 - Disposal of Solid and Liquid Wastes (FPSO Production Operations)

Name/Location of Facility	Type of Waste	Amount	Rate	Disposal Method
Solid Waste Disposal or Gagliano Waste	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
L & L	Waste oil	10 barrels per month	2-3 barrels per week	Recycled

Table 16-4 describes the onshore facilities that PAI anticipates utilizing to dispose of solid and liquid wastes associated with Shuttle Vessel operations during Phase 1 of the development plan.

Table 16-4 - Disposal of Solid and Liquid Wastes (Shuttle Vessel Operations)

Name/Location of Facility	Type of Waste	Amount	Rate	Disposal Method
To Be Determined (1)	Non-hazardous garbage, trash, and debris which can't be recycled	4 standard containers per month	1 standard container per week	Land farmed
To Be Determined (1)	Waste oil	1 barrels per month	0-1 barrels per week	Recycled

(1) Existing facilities located near terminals of choice in Texas, Louisiana, Mississippi, or Alabama

16(e) Air Emissions

Per NTL 2006 G14, information regarding air emissions generated by onshore support facilities is not required for DOCDs submitted in the MMS GoM region.

16(f) Unusual Solid and Liquid Wastes

Per NTL 2006 G14, information regarding unusual solid and liquid wastes generated by onshore support facilities is not required for DOCDs submitted in the MMS GoM region.

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17 Sulfur Operations Information

No sulfur operations are proposed as part of the Phase 1 (or future phases) of the development plan.

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18 Coastal Zone Management Act (CZMA) Information

LOUISIANA

COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

DEVELOPMENT

TYPE OF PLAN

WALKER RIDGE BLOCKS 205, 206, 249, 250, 425, 426, 469, and 470

AREA AND BLOCKS

The proposed activities described in detail in this Development Operations Coordination Document (DOCD) for Walker Ridge Blocks 205 (Lease OCS-G 16964), 206 (Lease OCS-G 16965), 249 (Lease OCS-G 16969), 250 (Lease OCS-G 16970), 425 (Lease OCS-G 16987), 426 (Lease OCS-G 16988), 469 (Lease OSC-G 16997) and 470 (Lease OCS-G 16998) comply with the State of Louisiana's approved Coastal Management Program and the enforceable policies of the state. The proposed activities will be conducted in a manner consistent with this program and its enforceable policies.

PETROBRAS AMERICA INC.

LESSEE OR OPERATOR

CHERYL A. SAHA
CERTIFYING OFFICIAL

June 8th, 2007

Louisiana Coastal Resources Program

In 1978, the Coastal Management Division (CMD) of the Louisiana Department of Natural Resources implemented the Louisiana Coastal Resources Program (LCRP) under authority of the State and Local Coastal Resources Management Act, as amended (Act 361, Louisiana Revised Statute Title 49 Section 214). The law provides for the review of federally permitted actions that could potentially impact Louisiana's coastal resources. The intent of the LCRP is to protect, develop, and where feasible, restore or enhance the resources of the state's coastal zone. The LCRP encourages multiple uses of resources and adequate economic growth in order to reduce adverse effects of one resource upon another. Program regulations can be found in Louisiana Administrative Code, Title 43 Part I Chapter 7.

As described more fully in this DOCD, Petrobras America Inc. (PAI) proposes to develop the Cascade / Chinook deep water fields with a Floating Production, Storage and Offloading (FPSO) facility. Specific details related to the proposed offshore development activities can be found in Section 1.

The project will be located in the Central Planning Area of the Gulf of Mexico in Walker Ridge blocks 205, 206, 249, 250, 425, 426, 469, and 470 approximately 165 miles from the coast of Louisiana as shown in Figure 1-1. Because of its location in the Central Planning Area, Louisiana is considered to be an "affected state" and the state's review and concurrence is required to ensure that the proposed activities are consistent with the enforceable policies of the LCRP.

The Cascade / Chinook Development will include the use of existing onshore support facilities at Port Fourchon for marine vessel support and disposal of wastes (see Figure 15-8). Port Fourchon will serve as the port of debarkation for equipment, supplies, and crews for drilling / completion operations, development activities, and production operations. No new construction or expansion of Port Fourchon's facilities will be necessary. No new dredging or changes to Louisiana's coastal areas or shipping channels would be needed. Refer to Section 16 for additional details. The following is a list of shore-based facilities in Louisiana that would be used for the projected wastes associated with the Cascade / Chinook development :

- US Liquids of Louisiana, Newpark Services, and / or CCT located in Fourchon. These contractors will accept environmental wastes such as cutting boxes, solid wastes from the marine portable tanks, and tank clearing fluids.

- Solid Waste Disposal or Galiano Waste located in Fourchon. These contractors will accept the disposal of domestic wastes.

- L&L located in Fourchon. This contractor will accept waste oils.

As described in Section 14(c), PAI will charter Shuttle Vessels to deliver the produced oil to market to terminals along the coast of the GoM. After the initial production ramp-up in the first year of operations, PAI anticipates an offloading frequency of once per week during 6-8 years of production operations for Phase 1 of the development plan. PAI has not yet determined which specific terminals will be used. However, PAI anticipates using several refineries located in Louisiana (see Figure 14-8). The specific refineries to be utilized will depend on several factors including market conditions and available terminal capacities. The Louisiana refineries that could potentially be used are shown below. This list includes the ranking of each refinery in Louisiana compared to all US refineries relative to their daily crude operating capacity as of January 1, 2006 (Energy Information Administration 2006).

Lake Charles

- Citgo Petroleum, Lake Charles (#4)
- ConocoPhillips, Westlake (#22)
- Calcasieu Refining, Lake Charles (#110)

Baton Rouge

- ExxonMobil, Baton Rouge (#2)
- Motiva Enterprises, Convent (#25)
- Placid Refining, Port Allen (#94)

Lower Mississippi River

- ConocoPhillips, Belle Chasse (#18)
- Marathon Petroleum, Garyville (#20)
- Motiva Enterprises, Norco (#27)
- Chalmette Refining, Chalmette (#34)
- Valero Refining, Norco (#35)
- Murphy Oil, Meraux (#56)
- Shell, Saint Rose (#96)

Louisiana Offshore Oil Port (LOOP)

- The LOOP eventually connects to pipelines that can transport crude oil to 35% of the total US refining capacity.

No new construction or expansion of these terminals will be necessary. No new dredging or changes to Louisiana's shipping channels will be needed.

PAI has evaluated the proposed actions related to the Cascade / Chinook Development to determine if there would be any reasonably foreseeable coastal effects on the land, water uses, or natural resources of the coastal zone of Louisiana, pursuant to the enforceable policies of the state's LCRP. Specific policies that address the potential environmental impacts to coastal uses, such as waste disposal, accidental spills, and nearshore water quality, are briefly described in Table 18-1 with relevant cross references to this DOCD where further details are provided. The analysis upon which this effects determination has been made is provided in Section 19.

Table 18-1 – Consistency Review Summary

Policy	Effects Analysis	Cross References
Guidelines Applicable to All Uses		
Policy 1.2 - Conformance with applicable air and water quality laws	• The project site will be located at least 165 miles from the Louisiana coast. • The air emissions analysis shows that the project will not exceed emission thresholds established by the MMS. The project will not affect air resources in Louisiana. • No air or water quality impacts will occur because of the use of existing support base and refineries that are located at established ports. Wastes will be properly contained, transported, and disposed in designated waste facilities. • The project will comply with all requirements including the US Environmental Protection Agency (EPA) National Pollutant Discharge Elimination System (NPDES) general permit for offshore discharges and US Coast Guard (USCG) regulations for vessels operating in state waters. The project would not affect water quality in Louisiana. • The use of a gas export pipeline at the beginning of production would provide a positive environmental effect because no flaring would occur during normal production operations. Short term flaring (several days per well) would likely occur during the well testing phase but this would not affect near shore resources.	Section 7(a), Projected Generated Wastes Section 8, Air Emissions Sections 19(b), Existing Resource Conditions and 19(c), Project Impacts Appendix 4, Air Emission Worksheets

Policy	Effects Analysis	Cross References
Policy 1.6 - General factors that will be utilized by the permitting authority	• No state permits are required for the project. • The FPSO will be able to disconnect from its mooring and motor away from a hurricane or named storm, which will prevent storm related damages or accidents and reduce the potential for impacts to coastal resources. • The direct and indirect expenditures of the project will have a minor and temporary positive impact on the economic activities around the support facilities at Port Fourchon, which would provide direct private benefits. • The project area is not located in or near nor would have any impacts on historical or recreational sites, or protected / sensitive areas. • No impacts to state fisheries are likely due to the distance from shore and the use of existing transportation and shore based infrastructure.	Sections 1(a), Introduction; 1(c), Safety and Pollution Prevention Features; and 1(f), Additional Safety and Pollution Prevention Features Section 2(e), New or Unusual Technology Sections 19(b), Existing Resource Conditions and 19(c), Project Impacts
Policy 1.7 - Adverse effects from land and water uses in the coastal areas	• All of the wastes generated from the proposed development will be either (1) discharged overboard in compliance with NPDES requirements or (2) transported to shore for disposal in permitted or licensed commercial facilities or for recycling. All wastes brought to shore will be properly disposed so there would be no effects to the coastal area. • Minor, localized impacts to federal OCS waters near the project site will occur during the life of the project as a result of the proposed discharges from drilling and production activities but the effects are expected to be minimal because the project will comply with NPDES requirements. There will be no effects to the coastal area. • Insignificant impacts related to the burial of soft-bottom benthic communities are expected from the discharge of drill cuttings. There will be no effects to the nearshore coastal areas. • Short term turbidity will result from bottom disturbances caused by emplacement of anchor pilings and mooring lines, the infield and export pipelines, subsea production centers, and umbilicals. There will be no effects to land and water uses in the coastal area. • No impacts on chemosynthetic fauna are expected because chemosynthetic communities or hard-ground substrates are not present. • No federal or state listed species are known to occur in proximity to the proposed development site. • This project would have no effects on minority or low income populations in Louisiana.	Section 6(a), Chemosynthetic Communities Section 7, Projected Wastes Section 9(a), Oil Spill Response Planning Section 16(a) Onshore Support Facilities Section 19(c), Project Impacts

Policy	Effects Analysis	Cross References
Policy 1.9 - Permitting multiple uses to avoid conflicts	There will be no conflicts with other users because existing shore based and transportation infrastructure will be used.	Section 15, Support Vessels and Aircraft Information Section 16(a), Onshore Support Facilities
Guidelines for Linear Facilities (Policies 3.1 through 3.16) - The project does not involve the construction of linear facilities in or near the coastal zone. The gas export pipeline will tie into an existing facility located on either Green Canyon block 829 (Option 1) or Green Canyon block 606 (Option 2; See Section 6(a), Chemosynthetic Communities Report).		
Guidelines for Dredged Spoil Deposition (Policies 4.1 through 4.7) - This project does not involve any expansion of facilities or new dredging (See Section 16, Onshore Support Facilities Information).		
Guidelines for Surface Alterations (Policy 6.1) - The project will use only existing shore based support and waste disposal facilities and will not involve any surface alterations (See Section 15(d), Solid and Liquid Wastes Transportation and Section 16, Onshore Support Facilities Information).		
Guidelines for Hydrologic and Sediment Transport Modifications (Policies 7.1, sediment diversions; 7.3, deposition of sediments; and 7.9, water withdrawal) - The project will use desalination units to generate the needed freshwater at the project site (See Section 7, Waste and Discharge Information).		
Guidelines for Disposal of Waste		
Policy	Effects Analysis	Cross References
Policy 8.1 - Location and operation of waste storage, treatment, and disposal facilities	• Solid waste trash generated by the development activities will be bagged and kept onboard the FPSO and drilling rig, then transported via supply boat to a designated contractor in Louisiana for proper disposal in Port Fourchon. • Sanitary wastes on each of the vessels will be treated by a Marine Sanitation Device and discharged overboard in accordance with USCG regulations. • Other waste streams from the FPSO and drilling rig will be discharged overboard in accordance with the NPDES general permit. • Trash and debris and other waste products will be brought to a designated contractor in Louisiana for proper disposal. • Other wastes consisting of waste oil will be stored in barrels, transported to shore, and then disposed of by a designated contractor in Louisiana.	Section 7(a), Projected Wastes Section 15(d), Solid and Liquid Wastes Transportation Section 16, Onshore Support Facilities Information
Policy 8.1 - Generation, transportation, treatment, storage, and disposal of hazardous waste	Only oil field wastes would be generated as a result of this project and these would be disposed in an authorized waste facility.	Section 7, Waste and Discharge Information Section 15, Support Vessels and Aircraft Information Section 16(d), Waste Disposal Facilities

Policy	Effects Analysis	Cross References
Policy 8.8 - Approved disposal sites	No unusual solid or liquid wastes will be generated or disposed. Only existing and approved onshore waste disposal facilities would be used. No air or water quality impacts would occur as a result.	Section 7(a), Projected Generated Wastes Section 15, Support Vessels and Aircraft Information Section 16, Onshore Support Facilities Information
Policy 8.9 - Radioactive Wastes	Only oil field wastes will be generated as a result of this project and these will be disposed in an authorized waste facility.	Section 7, Waste and Discharge Information Section 16(d), Waste Disposal Facilities
Guidelines for Uses that Result in the Alteration of Waters Draining into Coastal Waters (Policy 9.2) - The project will not result in any increase in developed area runoff (See Section 16, Onshore Support Facilities Information).		
Guidelines for Oil, Gas and other Mineral Activities		
Policy	Effects Analysis	Cross References
Policy 10.3 - Siting of exploration, production and refining activities	Production or refining activities will not be located in areas containing critical wildlife or vegetation.	Sections 19(b).4, Coastal Environments
Policy 10.5 - Access to sites	• Access routes to production and refining sites will not affect critical wildlife and vegetation areas. • Based on surveys conducted, there was no detection of chemosynthetic features or hard substrate along the pipeline routes for the flowlines and umbilicals or along the export gas pipeline route.	Section 14, Related Facilities and Operations Information, and Figure 14-8, Gulf Coast Refineries Considered for Receipt of Crude Oil Appendix 2, GEMS Shallow Hazards Report for Facilities
Policy 10.6 - Best practical techniques for drilling and production sites	The estimated volume of drilling muds and cuttings generated will be discharged according to NPDES permit limitations and will therefore not release pollutants or toxic substances into the environment.	Section 2(b), Drilling Fluids

Guidelines Applicable to All Uses	Effects Analysis	Cross References
Policy 10.10 - Guidelines for drilling and production equipment for preventing adverse environmental effects	• Emplacement of subsea equipment, the mooring lines, export pipeline, and other emplacements on the seafloor will cause minor, short term turbidity but this will have no effect to coastal resources. • There is no additional oil spill risk resulting from bringing the crude product to shore. The various terminals will likely operate at capacity whether or not this proposed project is approved. If the shuttle vessels proposed for this development are not used, it is anticipated that some other tanker, likely carrying foreign supplied oil, will be used in its place. • PAI would use a dedicated field tug, which will enhance safety and pollution response during offloading and other operational activities.	Sections 1(a), Safety and Pollution Prevention Measures and 1(f), Additional Safety and Pollution Prevention Measures Section 2(e), New or Unusual Technology Section 9(a), Oil Spill Response Planning Section 19(c), Project Impacts
Policy 10.11 - Effective environmental protection and emergency or contingency plans	• A dedicated field tug will help prevent collisions or accidents during offloading operations and other operational activities and will be outfitted with a spill boom to be able to respond immediately if a spill were to occur. • A hurricane avoidance plan will be developed for the FPSO. • A vessel Shipboard Oil Pollution Emergency Plan will be developed for the FPSO and Shuttle Vessels. • Existing procedures such as the use of radar, watch standing, and other communication efforts will minimize the chance of collisions with other vessels. • The FPSO would have an emergency shutdown system that will handle any extreme process conditions or hazardous situations such as fire and gas cloud formation. • PAI is a member of Clean Gulf Associates (CGA) and Clean Caribbean and Americas (CCA). PAI's primary spill response equipment is provided by CGA. PAI also has access to secondary spill response equipment from CCA.	Sections 1(a), Safety and Pollution Prevention Measures and 1(f), Additional Safety and Pollution Prevention Measures Section 2(e), New or Unusual Technology Sections 9(a), Oil Spill Response Planning and 9(b), Oil Spill Response Discussion Section 10, Environmental Monitoring

The proposed activities of the Cascade / Chinook Development Project are supported by sufficient data and information concerning the potential impacts associated with the proposed actions. The proposed activities would be conducted in accordance with all federal and state regulations, applicable notices to lessees (NTLs), conditions in the approved permits, and lease stipulations. PAI has therefore determined that the proposed activities associated with this project are consistent with the Louisiana LCRP.

TEXAS

COASTAL ZONE MANAGEMENT CONSISTENCY CERTIFICATION

DEVELOPMENT

TYPE OF PLAN

WALKER RIDGE BLOCKS 205, 206, 249, 250, 425, 426, 469, and 470

AREA AND BLOCKS

The proposed activities described in detail in this Development Operations Coordination Document for Walker Ridge Blocks 205 (Lease OCS-G 16964), 206 (Lease OCS-G 16965), 249 (Lease OCS-G 16969), 250 (Lease OCS-G 16970), 425 (Lease OCS-G 16987), 426 (Lease OCS-G 16988), 469 (Lease OSC-G 16997) and 470 (Lease OCS-G 16998) comply with the State of Texas's approved Coastal Management Program and the enforceable policies of the state. The proposed activities will be conducted in a manner consistent with this program and its enforceable policies.

PETROBRAS AMERICA INC.

LESSEE OR OPERATOR

Cheryl A Saha

CHERYL A. SAHA
CERTIFYING OFFICIAL

June 8th, 2007

Texas Coastal Management Program

The Texas Coastal Management Program (TCMP) is a comprehensive management program for coastal land and water activities that sets policies, standards, and regulations affecting private and public property. These policies are administered under Texas laws. The program protects coastal resources by preventing resource destruction, promoting the benefits of resources, and managing activities that impact resources. The TCMP is based primarily on the Coastal Coordination Act of 1991, as amended by House Bill 3226 in 1995. Program policies are set forth in Texas Administrative Code Title 31 Part 16 Chapters 501 – 506.

As described more fully in this DOCD, Petrobras America, Inc (PAI) proposes to develop the Cascade / Chinook deep water fields with a Floating Production, Storage and Offloading (FPSO) facility. Specific details related to the proposed offshore development activities can be found in Section 1.

The project would be located in the Central Planning Area of the Gulf of Mexico on Walker Ridge blocks 205, 206, 249, 250, 425, 426, 469, and 470 more than 285 miles from the coast of Texas as shown in Figure 1-1.

Texas is considered to be an "affected state" because some aspects of the project may use resources in the state. This would require the state's review and concurrence with the project to ensure that the proposed activities are consistent with the enforceable policies of the TCMP.

PAI may occasionally use existing facilities at the Port of Galveston as a secondary onshore support base for equipment and supplies due to specific conditions such as weather, market availability of marine vessels or helicopters, security, or safety (see Figure 15-8). No new construction or expansion of facilities at the port will be required. No new dredging or changes to coastal areas will occur.

The following is a list of shore-based waste disposal facilities in Texas that could be used for the projected wastes associated with the Cascade / Chinook development:

- US Liquids of Louisiana located in Galveston and Newpark Services located in Winnie. These contractors will accept environmental wastes such as cutting boxes, solid wastes from the marine portable tanks, and tank clearing fluids.

- L&L located in Houston. This contractor will accept the disposal of used oil and filters, and oil rags.

As described in Section 14(c), PAI will charter Shuttle Vessels to deliver the produced oil to market to terminals along the coast of the GoM. After the initial production ramp-up in the first year of operations, PAI anticipates an offloading frequency of once per week during 6-8 years of production operations for Phase 1 of the development plan. PAI has not yet determined which specific terminals will be used. However, PAI anticipates using several refineries located in Texas (see Figure 14-8). The specific refineries to be utilized will depend on several factors including market conditions and available terminal capacities. The Texas refineries that could potentially be used are shown below. This list includes the ranking of each refinery in Texas compared to all US refineries relative to their daily crude operating capacity as of January 1, 2006 (Energy Information Administration 2006).

Corpus Christi

- Flint Hills Resources, Corpus Christi (#11)
- Citgo Refining, Corpus Christi (#45)
- Valero Refining, Corpus Christi (#53)

Freeport

- ConocoPhillips, Sweeny (#19)

Galveston / Houston

- ExxonMobil Refining, Baytown (#1)
- BP Products, Texas City (#3)
- Deer Park Refining, Deer Park (#8)
- Lyondell Citgo Refining, Houston (#14)
- Valero Refining, Texas City (#30)
- Pasadena Refining, Pasadena, TX
- Valero Refining, Houston (#69)
- Marathon Petroleum, Texas City (#78)

Port Arthur / Beaumont

- ExxonMobil Refining, Beaumont (#6)
- Motiva Enterprises, Port Arthur (#12)
- Premcor Refining, Port Arthur (#17)
- Total Petrochemicals, Port Arthur (#26)

PAI has evaluated the proposed actions related to the Cascade / Chinook Development to determine if there would be any reasonably foreseeable coastal effects on the land, water uses, or natural resources of the coastal zone of Texas, pursuant to the enforceable policies of the state's CMP. Specific policies that address the potential environmental impacts to coastal uses from oil and gas exploration and production activities, are briefly described in Table 18-2 with relevant cross references to this DOCD where further details are provided. The analysis upon which this effects determination has been made is provided in Section 19.

Table 18-2 – Consistency Review Summary

Policies	Information Required	Cross References
Category 2 - Construction, Operation and Maintenance of Oil and Gas Exploration and Production Facilities	• The project site will be located at least 285 miles offshore the Texas coast and will use existing shore based facilities. • The use of a gas export pipeline at the beginning of production will provide a positive environmental effect because no flaring would occur during normal production operations. Short term flaring (several days per well) will likely occur during the well testing phase but this would not affect near shore resources.	Section 8, Air Emissions Appendix 4, Air Emission Worksheets
Category 3 - Discharges of Wastewater and Disposal of Waste from Oil and Gas Exploration and Production Activities	• No water quality impacts will occur because of the use of existing support base and terminals that are located at established ports. Wastes will be properly contained, transported, and disposed in designated waste facilities. • The project will comply with all requirements including the EPA NPDES general permit for offshore discharges and USCG regulations for vessels operating in state waters. The project will not affect water quality in Texas. • Solid waste trash and other waste products generated by the FPSO and the drilling rigs will be bagged and kept onboard until transported via supply boat to a designated contractor (potentially as secondary onshore support facilities in Texas could be used occasionally) for proper disposal. • Sanitary wastes on each of the vessels will be treated by a Marine Sanitation Device and discharged overboard in accordance with USCG regulations. • Other waste streams from the FPSO and construction vessels will be discharged overboard in accordance with the NPDES general permit.	Section 7, Waste Discharge Information Section 14, Related Facilities and Operations Information, and Figure 14-8, Gulf Coast Refineries Considered for Receipt of Crude Oil Section 16, Waste Disposal Facilities Sections 19 (c), Project Impacts

Policies	Information Required	Cross References
Category 4 - Construction and Operation of Solid Waste Treatment, Storage, and Disposal Facilities	The project will have no effect on the construction and operation of solid waste treatment facilities because only existing and approved onshore waste disposal facilities will be used. Furthermore, no unusual solid or liquid wastes would be generated or disposed.	Section 16, Onshore Support Facilities Information
Category 5 - Prevention, Response and Remediation of Oil Spills	• There is no additional oil spill risk resulting from bringing the crude product to shore. The various refineries will likely operate at capacity whether or not this proposed project is approved. If the shuttle vessels proposed for this development are not used, it is anticipated that some other tanker, likely carrying foreign supplied oil, would be used in its place. • PAI will use a dedicated field tug, which would enhance safety and pollution response during offloading and other operational activities. The tug will be outfitted with a spill boom to be able to respond immediately if a spill were to occur. • A hurricane avoidance plan will be developed for the FPSO. • A vessel Shipboard Oil Pollution Emergency Plan will be developed for the FPSO and Shuttle Vessels. • Existing procedures such as the use of radar, watch standing, and other communication efforts will minimize the chance of collisions with other vessels. • The FPSO will have an emergency shutdown system that would handle any extreme process conditions or hazardous situations such as fire and gas cloud formation. • PAI is a member of Clean Gulf Associates (CGA) and Clean Caribbean and Americas (CCA). PAI's primary spill response equipment is provided by CGA. PAI also has access to secondary spill response equipment from CCA.	Sections 1(c), Safety and Pollution Prevention Features, and 1(f), Additional Safety and Pollution Prevention Features Section 9, Oil Spill Information
Category 6 - Discharge of Municipal and Industrial Waste Water to Coastal Waters	No municipal or industrial waste discharges would occur in coastal waters. Only existing designated wastes facilities in Texas may be used.	Section 7(a), Projected Generated Wastes Section 15, Support Vessels and Aircraft Information Section 16, Onshore Support Facilities Information

Policies	Information Required	Cross References
Category 7 - Non Point Source Pollution	The project will comply with NPDES permit limitations and will therefore not release pollutants or toxic substances into the environment. There will be no impact to water quality in Texas coastal waters.	Section 2(b), Drilling Fluids
Category 8 - Development in Critical Areas	No development or dredging and filling will occur in or near state waters; therefore, there will be no impact to critical areas.	Section 1, Introduction and Plan Contents
Category 9 - Construction of Waterfront Facilities and Other Structures on Submerged Lands	Only existing terminal facilities in Texas will be used and no industrial expansion is proposed to occur.	Section 1, Introduction and Plan Contents Section 14, Related Facilities and Operations Information
Category 10 - Dredging and Dredged Material Disposal and Placement	The project does not involve any new development or dredging and filling in or near state waters; therefore, there will be no effects to coastal waters, submerged lands, critical areas, coastal shore areas, and Gulf beaches.	Section 1, Introduction and Plan Contents
Category 11 - Construction in the Beach / Dune System	The project does not involve any construction in critical dune areas or on Texas beaches.	Section 1, Introduction and Plan Contents
Category 12 - Development in Coastal Hazard Areas	The project does not involve any new development in Coastal Hazard Areas.	Section 1, Introduction and Plan Contents
Category 13 - Development Within Coastal Barrier Resource	The project does not involve the development of new infrastructure or major repair of existing infrastructure within or supporting development within or near a Coastal Barrier Resource System Unit or any other protected area.	Section 1, Introduction and Plan Contents
Category 14 - Development in State Parks, Wildlife Management Areas or Preserves	The project does not in involve the use of or the taking of any public land in Texas.	Section 1, Introduction and Plan Contents
Category 15- Alteration of Coastal Historic Areas	To ensure any shallow hazards and historic sites are identified and avoided, a shallow hazards assessment of the seafloor at the project site was conducted. No coastal areas would be affected by the proposed action.	Section 19(b).14 Section 6(i), Archeological Report and Appendix 2, Shallow Hazards Report for Facilities
Category 16 - Transportation Projects	The project involves the use of existing shore based facilities and will not require new transportation construction within the coastal zone.	Section 1, Introduction and Plan Contents

Policies	Information Required	Cross References
Category 17- Emission of Air Pollutants	• The air emissions analysis shows that the project will not exceed emission thresholds established by MMS. The project would not affect air resources in Texas. • No increase in air quality effects are expected because there would be no change in refinery capacity or increase in the number of shuttle vessels bringing crude oil to port.	Section 8, Air Emissions Information Section 19(b).1 and 19(c).1, Air Quality Appendix 4, Air Emission Worksheets
Category 18 - Appropriations of Water	The project does not involve the use of impoundments or the diversion of state water.	Section 1, Introduction and Plan Contents
Category 19 - Levee and Control Projects	The project does not involve drainage, reclamation, channelization, levee construction or modification, or flood or floodwater-control.	Section 1, Introduction and Plan Contents
Category 20 - Marine Fishery Management	The project will not affect any commercial or recreational fishing activities or management efforts.	Section 19(b).8, Commercial and Recreational Fisheries
Category 21 - Policies for Major Actions	A major action under this policy is considered to be an activity for which an environmental impact statement is required. PAI conducted a gap analysis and determined that the proposed project generally falls within the design and operational parameters that were assessed in the programmatic FPSO EIS document. Although there are some differences (primarily due to project specific considerations), PAI believes that the differences are inherently positive (i.e. provide less risk to personnel, the environment, and assets).	Section 1, Introduction and Plan Contents and Table 1-1, Summary of Gap Analysis

The proposed activities of the Cascade/Chinook Development Project are supported by sufficient data and information concerning the potential impacts associated with the proposed actions. The proposed activities will be conducted in accordance with all federal and state regulations, applicable NTLs, conditions in the approved permits, and lease stipulations. PAI has therefore determined that the proposed activities associated with this project are consistent with the Texas TCMP.

MISSISSIPPI

COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

DEVELOPMENT

TYPE OF PLAN

WALKER RIDGE BLOCKS 205, 206, 249, 250, 425, 426, 469, and 470

AREA AND BLOCKS

The proposed activities described in detail in this Development Operations Coordination Document for Walker Ridge Blocks 205 (Lease OCS-G 16964), 206 (Lease OCS-G 16965), 249 (Lease OCS-G 16969), 250 (Lease OCS-G 16970), 425 (Lease OCS-G 16987), 426 (Lease OCS-G 16988), 469 (Lease OSC-G 16997) and 470 (Lease OCS-G 16998) comply with the State of Mississippi's approved Coastal Management Program and the enforceable policies of the state. The proposed activities will be conducted in a manner consistent with this program and its enforceable policies.

PETROBRAS AMERICA INC.

LESSEE OR OPERATOR

CHERYL A. SAHA
CERTIFYING OFFICIAL

June 8th, 2007

Mississippi Coastal Zone Management Program

The Mississippi Coastal Program has been in effect since 1972. The regulations, guidelines, and procedures (Section 57-15-6 of the Mississippi Code of 1972) carry out state policy in the Mississippi coastal area in order to protect coastal resources by preventing resource destruction, promoting the benefits of resources, and managing activities that impact resources.

The proposed Cascade/Chinook project, located in the Central GoM, does not involve any construction of facilities within the coastal zone of Mississippi. The only action that could potentially affect the State of Mississippi is the transportation of produced oil to market. As described in Section 14(c), PAI will charter Shuttle Vessels to deliver the produced oil to market to terminals along the coast of the GoM. After the initial production ramp-up in the first year of operations, PAI anticipates an offloading frequency of once per week during 6-8 years of production operations for Phase 1 of the development plan. PAI has not yet determined which specific terminals will be used. The specific refineries to be utilized will depend on several factors including market conditions and available terminal capacities. PAI could potentially utilize the Chevron USA terminal located in Pascagoula (see Figure 14-8). This terminal ranks number 9 among all US refineries relative to daily crude operating capacity as of January 1, 2006 (Energy Information Administration 2006).

PAI has evaluated the proposed actions related to the Cascade / Chinook Development to determine if there would be any reasonably foreseeable coastal effects on the land, water uses, or natural resources of the coastal zone of Mississippi pursuant to the enforceable policies of the state's Coastal Zone Management Program. Specific policies that address the potential environmental impacts to coastal uses related to oil and gas exploration and production, are briefly described in Table 18-3 with relevant cross references to this DOCD where further details are provided. The analysis upon which this effects determination has been made is provided in Section 19.

Table 18-3 – Consistency Review Summary

Policies	Information Required	Cross Reference
Goal 1 - To provide for reasonable industrial expansion in the coastal area and to insure the efficient utilization of waterfront industrial sites	• Only existing terminal facilities in Pascagoula may be potentially used and no industrial expansion is proposed. • There is no additional oil spill risk resulting from bringing the crude product to shore. The various refineries will likely operate at capacity whether or not this proposed project is approved. If the shuttle vessels proposed for this development are not used, it is anticipated that some other tanker, likely carrying foreign supplied oil, would be used in its place.	Section 14, Related Facilities and Operations Information
Goal 2 - To favor the preservation of coastal wetlands and ecosystems	The project site is located 270 miles from Mississippi and would not directly impact coastal wetlands or ecosystems in Mississippi.	Section 1(b), Location Sections 19(b).4, Coastal Environments and 19(c), Project Impacts
Goal 3 - To protect, propagate, and conserve the state's seafood and aquatic life	Environmentally sensitive areas, including oyster reefs, submerged grass beds, and other productive shallow water areas will not be affected by project activities.	Sections 19(b), Existing Resource Conditions and 19(c), Project Impacts
Goal 4 - To conserve the air and waters of the state	• No air or water quality impacts would occur because of the use of an existing refinery that is located at an established port. • Wastes from shuttle vessels will be properly treated by a Marine Sanitation Device and discharged overboard in accordance with USCG regulations. • PAI will use a dedicated field tug to enhance safety and pollution response during offloading and other operational activities, which will minimize the chance of an oil spill affecting state waters.	Section 8, Air Emissions Information and Appendix 4, Air Emissions Spreadsheets Section 9, Oil Spill Information
Goal 5 - The beneficial use of the state's water resources and to prevent its waste.	The project does not involve the use of water resources in Mississippi. Desalination units will be used to generate the needed freshwater at the project site.	Section 7, Waste and Discharge Information
Goal 6 - To preserve the state's historical and archeological resources	To ensure any shallow hazards and historic sites are identified and avoided, a shallow hazards assessment of the seafloor was conducted at the project site. Project activities will not affect any historical or archeological sites in Mississippi coastal areas.	Section 19(b).14 Section 6(i), Archeological Report and Appendix 2, Shallow Hazards Report for Facilities

Policies	Information Required	Cross Reference
Goal 7 - To preserve the natural scenic qualities in the coastal area	The project is located 270 miles from Mississippi and areas with natural scenic qualities will not be affected.	Section 1(b), Location
Goal 8 - To assist local governments in the provision of public facilities services	The project does not involve the use of public facilities.	Section 1, Introduction

The proposed activities of the Cascade/Chinook Development Project are supported by sufficient data and information concerning the potential impacts associated with the proposed actions. The proposed activities will cause no direct impact to the land, water uses, or natural resources of the coastal zone of Mississippi, pursuant to the enforceable policies of the state's coastal program. PAI has therefore determined that the proposed activities associated with this project are consistent with the Mississippi Coastal Program.

ALABAMA

COASTAL ZONE MANAGEMENT
CONSISTENCY CERTIFICATION

DEVELOPMENT

TYPE OF PLAN

WALKER RIDGE BLOCKS 205, 206, 249, 250, 425, 426, 469, and 470

AREA AND BLOCKS

The proposed activities described in detail in this Development Operations Coordination Document for Walker Ridge Blocks 205 (Lease OCS-G 16964), 206 (Lease OCS-G 16965), 249 (Lease OCS-G 16969), 250 (Lease OCS-G 16970), 425 (Lease OCS-G 16987), 426 (Lease OCS-G 16988), 469 (Lease OSC-G 16997) and 470 (Lease OCS-G 16998) comply with the State of Alabama's approved Coastal Management Program and the enforceable policies of the state. The proposed activities will be conducted in a manner consistent with this program and its enforceable policies.

PETROBRAS AMERICA INC.

LESSEE OR OPERATOR

CHERYL A. SAHA
CERTIFYING OFFICIAL

June 8th, 2007

Alabama Coastal Area Management Program

The Alabama Coastal Area Management Program (ACAMP) has been in effect since 1979. The program regulates various activities on coastal lands and waters seaward of the continuous 10-foot contour in Baldwin and Mobile Counties of Alabama. Program regulations are contained in Chapter 335-8 of the Alabama Department of Environmental Management. The program provides for the review of federally permitted projects such as oil and gas development on the outer continental shelf, for consistency with the state's program.

The proposed Cascade/Chinook Development Project, located in the Central Gulf planning area, does not involve any construction within the coastal zone of Alabama. The only action that could potentially affect the State of Alabama is the transportation of produced oil to market. As described in Section 14(c), PAI will charter Shuttle Vessels to deliver the produced oil to market to terminals along the coast of the GoM. After the initial production ramp-up in the first year of operations, PAI anticipates an offloading frequency of once per week during 6-8 years of production operations for Phase 1 of the development plan. PAI has not yet determined which specific terminals will be used. The specific refineries to be utilized will depend on several factors including market conditions and available terminal capacities. Potential terminals in Alabama that could be utilized are listed below (see Figure 14-8). This list includes the ranking of each refinery in Alabama compared to all US refineries relative to their daily crude operating capacity as of January 1, 2006 (Energy Information Administration 2006).

Mobile Area

- Shell, Saraland (#73)
- Gulf Atlantic, Mobile (#123)
- Goodway Refining, Atmore (#141)

PAI has evaluated the proposed actions related to the Cascade / Chinook Development to determine if there would be any reasonably foreseeable coastal effects on the land, water uses, or natural resources of the coastal zone of Alabama, pursuant to the enforceable policies of the state's Coastal Area Management Program. Specific policies that address the potential environmental impacts to coastal uses, such as the siting of energy facilities, are briefly described in Table 18-4 with relevant cross references to this DOCD where further details are provided. The analysis upon which this effects determination has been made is provided in Section 19.

Table 18-4 – Consistency Review Summary

Policies	Information Required	Cross Reference
Coastal Resource Use Policies		
1. Coastal Development	Existing terminals in the Mobile area may be used but no development or dredging and filling will occur in or near state waters.	Section 14, Related Facilities and Operations Information
2. Mineral Resource Exploration and Extraction	The project will not result in any energy exploration or production activities in the coastal waters of Alabama.	Section 1(b), Location
3. Commercial Fishing	The project will not affect any commercial fishing in the state.	Section 19(b).8, Commercial and Recreational Fisheries
4. Hazard Management	The project will involve safety and pollution prevention features that will mitigate the potential for any hazards associated with the plan.	Sections 1(c), Safety and Pollution Prevention Measures and 1(f), Additional Safety and Pollution Prevention Measures
5. Shoreline Erosion	Existing terminals and shipping channels in the Mobile area may be used; therefore, no shoreline erosion is expected to occur.	Section 14, Related Facilities and Operations Information
6. Recreation	The project site is located more than 286 miles from the Alabama coastline and existing terminals in the Mobile area may be used. Thus, the project will not affect recreational resources in Alabama.	Section 19(b), Existing Resource Conditions
7. Transportation	Oil transportation to market will be achieved through the use of dedicated Shuttle Vessels that PAI will charter. After production ramp-up, the FPSO will offload oil to a Shuttle Vessel approximately once a week and the Shuttle Vessel will transport the product to the terminals of choice, potentially including terminals in Alabama. Existing transportation conditions in Alabama will not be affected.	Section 14, Related Facilities and Operations Information

Policies	Information Required	Cross Reference
Natural Resource Protection Policies		
1. Biological Productivity, 2. Water Quality, and 3. Water Resources	• No drilling muds or cuttings or other waste products will be discharged near or within the state's coastal waters. • No discharge of untreated produced waters will occur as a result of the proposed actions and the project does not involve any energy exploration or production activities in the coastal waters of Alabama. • There is no additional oil spill risk resulting from bringing the crude product to shore. The various refineries will likely operate at capacity whether or not this proposed project is approved. If the shuttle vessels proposed for this development are not used, it is anticipated that some other tanker, likely carrying foreign supplied oil, would be used in its place.	Section 7, Waste Discharge Information Section 9, Oil Spill Information Section 14, Related Facilities and Operations Information
4. Air Quality	The air emissions analysis shows that the project will not exceed emission thresholds established by the MMS. The project would not affect air resources in Alabama.	Section 8, Air Emissions Information, and Appendix 4, Air Emissions Worksheets
5. Wetlands and Submerged Grassbeds, 6. Beach and Dune Protection, 7. Wildlife Habitat Protection, and 8. Endangered Species	The project will not involve dredging, new coastal construction or discharges to coastal waters. Therefore, there will be no effect to environmentally sensitive areas, wetlands, oyster reefs, submerged grass beds, other productive shallow water areas, beaches, dunes, or wildlife habitat, or state or protected species.	Section 19(b), Existing Resources Conditions and Section 19(c), Project Impacts
9. Cultural Resources Protection	To ensure any shallow hazards and historic sites are identified and avoided, a shallow hazards assessment of the seafloor was conducted at the project site. No historical or archeological sites located in Alabama coastal areas will be affected by the proposed action.	Section 19(b).14 Section 6(i), Archeological Report and Appendix 2, Shallow Hazards Report for Facilities

The proposed activities of the Cascade/Chinook Development Project are supported by sufficient data and information concerning the potential impacts associated with the proposed actions. The proposed activities will not cause any direct impact to the land, water uses, or natural resources of the coastal zone of Alabama, pursuant to the enforceable policies of the state's Coastal Area Management Program. PAI has therefore determined that the proposed activities associated with this project are consistent with the ACAMP.

19 Environmental Impact Analysis (EIA)

19(a) Impact Producing Factors (IPFs) from the Proposed Activities

The MMS Notice to Lessees (NTL) 2006-G14, *Information Requirements for Submitting Exploration Plans and Development Operations Coordination Documents*, issued on June 12, 2006, provides guidance on preparing DOCDs required by 30 CFR 250, Subpart B regulations. The NTL requires that the environmental impact analysis (EIA) identify impact-producing factors (IPF) associated with the proposed action that could affect environmental, archeological, socioeconomic, or other important resources in the area. This section describes activities associated with the Cascade / Chinook Development Project that may have the potential to affect environmental, archeological, and socioeconomic resources. Information on existing resource conditions in or near the development is presented in Section 19(b). Identified impacts to these resources from the development plan are described in Section 19(c).

An executive summary of the development activities associated with Phase 1 of the development plan is included in Section 1 of the DOCD. Section 2(e) provides further detailed information specific to facilities that are considered new technology to the GoM. Section 14(b) provides further detailed information for other related facilities.

PAI has identified the following Impact Producing Factors (IPFs) which could potentially impact the environment as a result of our proposed development activities :

- Air emissions
- Seafloor disturbance from anchoring and structures emplacement
- Ocean discharges
- Onshore waste disposal
- Accidental events such as oil spills or blowouts

19(b) Existing Resource Conditions

19(b).1 Air Quality

National Ambient Air Quality Standards

As mandated by the Clean Air Act (CAA) of 1970, EPA has established ambient air quality standards to protect public health (primary standards) and public welfare (secondary standards). Primary standards are based on observable human health responses, and are set at levels that provide an adequate margin of safety for sensitive segments of the population. Secondary standards are intended to protect non-health based public interests such as structures, vegetation, and livestock. The more stringent of the primary or secondary standards are applicable to projects under EPA jurisdiction.

Pollutants for which ambient air quality standards exist are referred to as criteria pollutants. The criteria pollutants are: sulfur dioxide (SO_2), particulate matter with aerodynamic diameters less than 10 micrometers or microns (PM_{10}) and 2.5 microns ($PM_{2.5}$), nitrogen dioxide (NO_2), carbon monoxide (CO), photochemical oxidants as ozone (O_3), and lead (Pb). Nitrogen oxides (NO_x) and Volatile Organic Compounds (VOCs) are regulated as precursors to ozone. The PM_{10} National Ambient Air Quality Standards (NAAQS) was promulgated July 1, 1987 at the federal level to replace the existing standards limiting Total Suspended Particulates (TSP). On July 19, 1997, EPA promulgated a new Fine Particulate ($PM_{2.5}$) NAAQS.

The NAAQS have been developed for various durations of exposure. The short-term (24-hours or less) NAAQS for SO_2 and CO refer to exposure levels not to be exceeded more than once per year. The short-term standard for PM_{10} may not be exceeded more than once per year on average over 3 years. For $PM_{2.5}$ the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 micrograms per cubic meter ($\mu g/m^3$; effective December 17, 2006). The 1-hour ozone standard is attained when the expected number of days per calendar year with the maximum hourly average concentrations above 0.12 parts per million (ppm), is less than or equal to 1. As of June 15, 2005, EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone non-attainment areas. The 8-hour ozone standard is attained when the 3-year average of the fourth highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year does not exceed 0.08 ppm.

Long-term NAAQS for SO_2, NO_2, and Pb refer to limits that cannot be exceeded for exposure averaged over three months (Pb) or annually (SO_2 and NO_2). To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$. The NAAQS are listed in Table 19-1.

Table 19-1 - National Ambient Air Quality Standards

Pollutant	Averaging Period	Primary NAAQS $\mu g/m^3$ (ppm)	Secondary NAAQS $\mu g/m^3$ (ppm)
NO_2	Annual(1)	100 (0.053)	100 (0.053)
SO_2	Annual(1)	80 (0.03)	None
	24-hour(2)	365 (0.14)	None
	3-hour(2)	None	1,300 (0.5)
PM_{10}	24-hour(3)	150	None
$PM_{2.5}$	Annual(4)	15	15
	24-hour(5)	35	35
CO	8-hour(2)	10,000 (9)	10,000 (9)
	1-hour(2)	40,000 (35)	40,000 (35)
O_3	8-hour(6)	157 (0.8)	157 (0.8)
	1-hour(7)	235 (0.12)	235 (0.12)
Pb	Quarterly(1)	1.5	1.5

Source: Code of Federal Regulations (CFR) Title 40 Part 50, *National Primary and Secondary Ambient Air Quality Standards.*

Key:

(1) Not to be exceeded

(2) Not to be exceeded more than once per year

(3) Not to be exceeded more than once per year on average over 3 years.

(4) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 $\mu g/m^3$.

(5) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 $\mu g/m^3$ (effective December 17, 2006).

(6) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(7) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is ≤ 1, as determined by appendix H.
(b) As of June 15, 2005 EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone non-attainment.

Monitored ambient air quality data in coastal areas is depicted in Table 19-2, which shows that there are no exceedances of the NAAQS with the exception of ozone. Ozone non-attainment status occurs in the port areas of Galveston/Houston and Beaumont/Port Arthur, Texas. Further information related to climatology and air quality can be found in MMS (2006a).

Table 19-2 – Coastal Ambient Air Quality

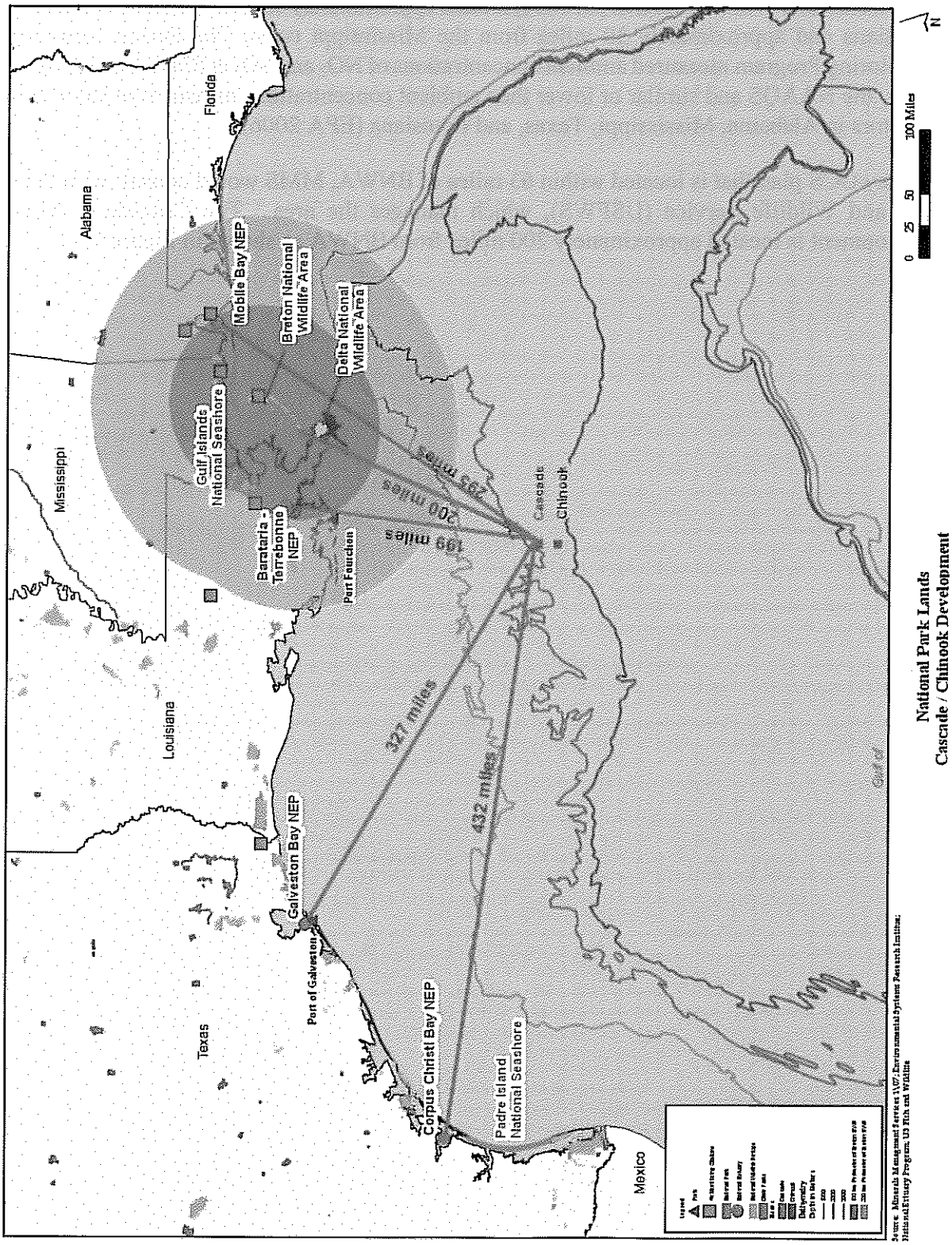
Year	O_3 (ppm)	SO_2 (ppm)			NO_2 (ppm)	$PM_{2.5}$ (µg/m^3)		PM_{10} (µg/m^3)	CO (ppm)	
	Highest 4th High 8-hr	Highest 2nd High 3-Hr	Highest 2nd High 24-hr	Highest Annual Mean	Highest Annual Mean	Highest 98th Percentile 24-hour	Highest Annual Mean	Highest 2nd High 24-hour	Highest 2nd High 1-hour	Highest 2nd High 8-hour
Baldwin County, Alabama										
2006	0.081					26	11.2			
2005	0.074					26	11.8			
2004	0.080	-	-	-	-	28	11.4	-	-	-
2003	0.078	-	-	-	-	29	12.2	-	-	-
2002	0.072	-	-	-	-	23	10.4	-	-	-
Mobile County, Alabama										
2006	0.085	0.014	0.005	0.002		23	12	69		
2005	0.073	0.019	0.008	0.002		29	17	135		
2004	0.077	0.017	0.007	0.002	-	36	13.0	116	-	-
2003	0.082	0.017	0.009	0.002	-	31	12.8	82	-	-
2002	0.079	0.017	0.006	0.001	-	28	12.5	105	-	-
Jackson County, Mississippi										
2006	0.082	0.035	0.008	0.002	0.007	28	13.1	40		
2005	0.081	0.031	0.012	0.003	0.007	28	11.9	40	-	-
2004	0.079	0.034	0.008	0.003	0.007	32	12.1	51	-	-
2003	0.084	0.017	0.007	0.002	-	26	12.0	33	-	-
2002	0.073	0.046	0.020	0.003	-	23	11.0	26	-	-
Breton Aerometric Monitoring Program – Offshore										
2001	-	0.017	0.005	0.002	0.003	-	-	-	-	-
East Baton Rouge Parish, Louisiana										
2006									4.4	3.3
Orleans Parish, Louisiana										
2005									2.7	1.7
2004	-	-	-	-	-	-	-	-	5.2	3.4
2003	-	-	-	-	-	-	-	-	6.5	3.5
2002	-	-	-	-	-	-	-	-	5.6	3.6
Jefferson County, Texas										
2006	0.085	0.150	0.034	0.004	0.009	27	11.1	-	-	-
2005	0.083	0.070	0.019	0.004	0.009	36	15.0	-	-	-
2004	0.091	0.149	0.032	0.004	0.010	27	11.6	-	-	-
2003	0.086	0.236	0.034	0.004	0.010	26	11.8	-	-	-
2002	0.095	0.105	0.030	0.004	0.010	36	11.3	-	-	-

Source: EPA 2006; Sonoma Technology 2004 (actual period of data collection October 2000-November 2001).

The closest Federal Class I area, which prohibits impairment from manmade air pollution, is Breton National Wilderness Area (BNWA) located approximately 40 miles offshore southeastern Louisiana and approximately 30 miles from the Mississippi coast. The Breton Aerometric Monitoring Program measured ambient concentrations of NO_2 and SO_2 at BNWA that were well below the NAAQS and similar or lower than ambient concentrations measured at shore-based monitors in Alabama, Mississippi, Texas, and Louisiana (EPA 2006).

For any OCS plan that is located within 63 miles of BNWA, MMS would consult with the US Fish and Wildlife Service (USFWS), which manages the area. The Cascade / Chinook development is located approximately 200 miles from BNWA as shown in Figure 19-1.

Figure 19-1 - National Park Lands



The CAA specifies air quality jurisdictional boundaries between the EPA and the Department of the Interior in the GoM OCS. Projects on the OCS east of 87.5° West longitude (approximately the Eastern Planning Area boundary) are subject to EPA air quality regulations. Projects located west of 87.5° West longitude, which includes the Cascade / Chinook Development, are regulated by MMS.

Air quality over federal OCS waters is unclassified because no provisions exist under the Clean Air Act for designating such areas outside the boundaries of state waters. Only areas within state boundaries are classified as attainment, non-attainment, or unclassifiable (Minerals Management Service [MMS] 2002). The 1990 CAA Amendments required that MMS evaluate cumulative, onshore, air quality non-attainment areas, and impacts from OCS petroleum resource development. The Secretary of Interior and the EPA Administrator have determined that no new air quality requirements are necessary for the area under MMS jurisdiction.

No specific air quality data exist for the Walker Ridge area. However, due to the distance from shore based pollution sources, offshore air quality is expected to be better than the NAAQS for all criteria pollutants (MMS 2001). The MMS uses a two level approach to evaluate a project's potential impacts to onshore areas. If the proposed activities exceed the criteria at the first (exemption) level, the proposed project must be evaluated to determine if it exceeds the second (significance) level criteria. The initial evaluation compares the worst-case emissions to the MMS exemption criteria. The Cascade / Chinook Development does not exceed the MMS exemption level criteria and therefore would not be expected to have an impact on onshore areas. Refer to Section 8 and Appendix 4, Air Emissions Worksheets, for more specific details on the projected air emissions associated with the proposed activity.

19(b).2 Water and Sediment Quality

The primary factors influencing coastal and marine offshore waters are temperature, salinity, oxygen, nutrients, potential of hydrogen (pH), oxidation-reduction potential, pathogens, and turbidity or suspended load. Trace constituents such as metals and organic compounds can also affect water quality.

The continental shelf effectively isolates the deeper waters of the GoM from the direct influences of many coastal processes. Limited information is available regarding water quality in the deepwater environment. Water depths greater than 4,593 feet have been found to be relatively homogeneous with respect to temperature, salinity, and oxygen (MMS 2002).

Measuring the quantity of dissolved oxygen in water is one method to determine marine environment water quality and to identify water masses and their sources. Dissolved oxygen values are described in Boehm *et al.* (2001) and Gallaway *et al.* (2001). Water masses, which come into the GoM through the Yucatan Channel, have relatively high dissolved oxygen concentrations and are considered to be the source of replenishment of dissolved oxygen to the deep GoM waters (Jochens *et al.* 2005). However, there is very little data on dissolved oxygen levels in waters deeper than 6,562 feet.

Detailed information related to water and sediment quality in the GoM can be found in MMS (2006a). Site specific information is not available concerning water and sediment quality on the Cascade / Chinook blocks but the seafloor and geologic assessment of the Cascade and Chinook Development (GEMS, 2007; see Appendix 2) provides a characterization of the surficial sediments at the site.

There are likely natural hydrocarbon seeps in the vicinity, which are extensive throughout the Central GoM but in general, the site is expected to have typical ocean salinity and oxygen levels, low levels of nutrients, and low levels of contaminants in water and sediments (Continental Shelf Associates [CSA] and Texas Agriculture and Mechanical [A&M] University 2001 and MMS 2002).

19(b).3 Coastal Environments

Coastal Wetlands

Coastal wetlands are highly productive ecosystems, both environmentally and economically. Approximately 150 miles of coastal wetlands exist west of Mobile Bay to the Mississippi River Delta. Louisiana accounts for 25% of the vegetated wetlands and 40% of the tidal wetlands in the contiguous US but the Louisiana coastline is eroding faster than any other coastal area of the world – losing up to 40 square miles each year (USGS 1995). The loss of coastland in all of Louisiana east of the Mississippi River from 2004 to 2005 was 72.9 square miles (MMS 2006b). The US Geological Survey assessed the water-land area within two months after Hurricanes Katrina and Rita and determined that 217 square miles of Louisiana's coast had been converted to open water compared to images taken in 2004 (Barras 2006). Detailed information related to coastal environments of the northern GoM can be found in MMS (2006a).

Protected Coastal Areas

Estuaries are critically important nursery areas with more than 95% of all commercially harvested species and 85% of all recreational species in the GoM spending a portion of their life in estuarine waters. The National Estuary Program (NEP) was established in 1987 under the Clean Water Act (CWA) of 1977 and is administered by the EPA. The program is intended to identify nationally important estuaries, to protect and improve their water quality, and enhance their living resources. The Mobile Bay NEP (Alabama), the Barataria-Terrebonne NEP (Louisiana), the Galveston Bay NEP (Texas), and the Corpus Christi Bay NEP (Texas) are located along the Gulf coast as shown in Figure 19-1.

National parks also protect and preserve unique habitats located along the Gulf coast. The National Park System includes Gulf Islands National Seashore (Mississippi), Breton and Delta National Wildlife Refuges (Louisiana), and Padre Island National Seashore (Texas).

19(b).4 Offshore Environments

Deepwater Chemosynthetic Communities

GoM chemosynthetic sites are found in water depths from several hundred meters to more than two thousand meters, generally in association with faults, seeps, and in lava-like flows of solidified asphalt (MacDonald *et al.* 2002). The northern GoM has been described as a 'leaky' hydrocarbon province characterized by faults that facilitate migration, or seeps, of oil and gas from subterranean reservoirs to the sea floor (MacDonald *et al.* 2002). A summary is provided below, but further details related to the level of information known about chemosynthetic communities and the conditions where they can be found in the GoM are provided in MMS (2006a).

These hydrocarbon seeps alter the physical properties of surface and near-surface sediments, which can be detected using geophysical techniques. Near-surface sediments produce distinct signatures on high-frequency echo-sounder and seismic reflection profiles. Seeps are recognized on echo-sounder records as they cause acoustic "wipeout," which is the absence of subsurface reflectors. Seepage effects can be identified by seismic reflection, in particular the 2D and 3D multi-channel seismic data, which is used to assess seafloor conditions in the project area. Refer to the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook in Appendix 2.

Macrofaunal assemblages that are characteristic of GoM chemosynthetic communities are dominated by tubeworms, mussels and clams (Cordes 2006). These foundation species, which are essentially sessile, form a habitat that is utilized by numerous other species. Species commonly associated with this foundation community include limpets, starfish, shrimp, crabs, snails, fish, and numerous species of polychaete worms.

While chemosynthetic communities require particular geophysical and geochemical conditions to establish, their existence also results in the development of secondary features. For example, microbial respiration increases dissolved organic carbon concentrations and alkalinity, which generates authigenic carbonates; notable as one of the macroscale geologic features of seep environments (TDI-Brooks International, Inc. 2005).

Given the lack of knowledge on the location and characteristics of deepwater chemosynthetic communities, MMS requires that a geophysical assessment of the seafloor be conducted in the project area, which would indicate whether there is the potential for chemosynthetic communities to be impacted. Findings of the seafloor and geologic assessment for the Cascade and Chinook Development (GEMS 2007) are provided in the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook included in Appendix 2.

Sigsbee Escarpment

The project area consists of three geomorphologic provinces: the Lower Continental Slope, the Upper Continental Rise, and the Sigsbee Escarpment (GEMS 2007). The Sigsbee Escarpment marks the edge between the continental slope and rise of the GoM and is the seaward limit of the Gulf salt province. This escarpment extends for more than 370 miles and is formed by the underlying salt tectonics (Lee and George 2004). The escarpment includes large submarine canyons, numerous small submarine canyons and gullies, and large slumps. Relief along the escarpment can range from a few hundred to more than 3,300 feet (Lee and George 2004). Seafloor gradients in the Cascade / Chinook Development range from nearly 0° to approximately 70° along the steeper portions of the Sigsbee Escarpment (GEMS 2007).

The salt canopy may also occur close to the seafloor and if structures requiring foundation piles are to be placed in these areas new engineering methods will be needed to accommodate the structures (MMS 2001).

The water depth of Cascade / Chinook blocks 206, 249, 250, 425, 426, 469, and 470 is between 8,200 and 8,800 feet. The Sigsbee Escarpment runs through a portion of Block 205, resulting in a dramatic change in bathymetry from 8,000 feet to 5,800 feet (2,440 to 1,770 m) in less than two miles (Petrobras America Inc. 2006). Details about the seabed of the project site can be found in the seafloor and geologic assessment for the Cascade and Chinook Development (GEMS 2007) in Appendix 2.

Furrows

The seafloor below the Sigsbee Escarpment in the Cascade / Chinook Development area is irregular due to seabed furrows and flukes (GEMS 2007). These mega-furrows are aligned parallel to the base of the escarpment, and some have been reported to extend for more than 60 miles (Lee and George 2004). The erosional nature of the furrows indicates the presence of potentially strong bottom currents along the Sigsbee Escarpment indicating that bottom currents may occur up to 3.3 feet per second (100 cm/sec) and higher (Bryant *et al.* 2004; GEMS 2007).

The furrows are irregular seabed undulations of unclear origin with a typical trough to crest spacing on the order of 50-300 feet, amplitudes on the order of 10-30 feet, and slopes in the range of 5° to 20° from horizontal. These furrows are generally trending northeast to southwest. Approximately 49,000 feet of the Chinook flowline route is within the furrows. Dense seafloor furrows are present in the southeastern portion of the Cascade area. The furrows are evident in the multi-beam data as linear features trending parallel to the escarpment. In general individual furrows average about 100 feet wide and 30 feet deep and have relatively steeply dipping walls. The furrows are tightly spaced, averaging between 75 and 100 feet apart.

In the northwestern corner of Walker Ridge block 425, the furrows are more tightly spaced, often with less than 25 feet between them. To the southeast (in the central portion of Walker Ridge block 425) the furrows become more spread out, up to 200 feet apart. These furrows also appear to branch and merge with each other. The exact nature of the seafloor current responsible for the varying appearance of the furrows in this area is not well understood at this time; however, it is possible that the dominant direction and/or intensity of the currents may vary over time. Further details concerning the geomorphology of this area can be found in the seafloor and geologic assessment for the Cascade and Chinook Development (GEMS 2007) as described in Appendix 2.

19(b).5 Marine Mammals

Twenty-eight species of cetaceans are known to occur in the GoM comprising seven mysticetes (baleen whales) and 21 odontocetes (toothed whales and dolphins) as described in Table 19-3. Other marine mammals include one introduced pinniped (California sea lion; *Zalophus californianus*) and one sirenian species (West Indian manatee; *Trichechus manatus*). The West Indian manatee is divided into two subspecies: the Antillean manatee (*T. manatus manatus*), which is not known to exist in the northern GoM, and the Florida manatee (*T. manatus latirostris*), which occurs mainly in Florida waters, but will travel to the west coast of Louisiana in extreme cases (US Fish and Wildlife Service [USFWS] 2000).

Table 19-3 – Marine Mammals in GoM

Common Name	Scientific Name	Status	Abundance and Distribution[1]	Estimated Number of Individuals[2]	Likelihood of Occurring Near Site[3]
Mysticetes					
Northern right whale	*Eubalaena glacialis*	E	Rare and likely of accidental occurrence.	Extralimital	Unlikely
Blue whale	*Balaenoptera musculus*	E	Rare and likely of accidental occurrence.	Extralimital	Unlikely
Fin whale	*Balaenoptera physalus*	E	Rare and likely of accidental occurrence.	Rare	Unlikely
Sei whale	*Balaenoptera borealis*	E	Rare and likely of accidental occurrence.	Rare	Unlikely
Bryde's whale	*Balaenoptera edeni*	*	Common; sightings occurred only near 100-meter (328-foot) isobath	40	Unlikely
Minke whale	*Balaenoptera acutorostrata*	*	Although not coastal they rarely venture more than 169 km (105 miles) from shore.	Rare	Unlikely
Humpback whale	*Megaptera novaeangliae*	E	Rare and likely of accidental occurrence.	Rare	Unlikely
Odontocetes					

Common Name	Scientific Name	Status	Abundance and Distribution[1]	Estimated Number of Individuals[2]	Likelihood of Occurring Near Site[3]
Sperm whale	*Physeter macrocephalus*	E	Common; occurs from 900 to 2,000 meters (2,953 to 6,562 feet) and deeper with possible resident population near Mississippi River delta.	1,349	Likely
Pygmy or dwarf sperm whale	*Kogia spp.*	*	Widely distributed in deep waters of Gulf.	742	Likely
Beaked whale	*Ziphiid*	*	Widely distributed from 1,000 meters (3,280 feet) and beyond.	241	Likely
Pygmy killer whale	*Feresa attenuata*	*	Uncommon but widely distributed in Northern Gulf.	408	Possibly
Pilot whale	*Globicephala sp.*	*	Uncommon on slope.	2,388	Unlikely
Risso's dolphin	*Grampus griseus*	*	Frequently sighted along between 200 and 1,000 meters (656 and 3,280 feet), but concentrated near Mississippi River delta.	2,169	Possibly
Melon-headed whale	*Peponocephala electra*	*	Uncommon in northeastern Gulf but possible in deeper waters.	3,451	Possibly

Common Name	Scientific Name	Status	Abundance and Distribution[1]	Estimated Number of Individuals[2]	Likelihood of Occurring Near Site[3]
Bottlenose dolphin	*Tursiops truncates*	*	Common; widely distributed between 100 and 750 meters (328 and 2,460 feet).	27,559	Likely
Rough-toothed dolphin	*Steno bredanensis*	*	Common; widely distributed on mid-slope.	2,223	Possibly
Striped dolphin	*Stenella coeruleoalba*	*	Most common cetacean; widely distributed on slope.	6,505	Likely
Pantropical spotted dolphin	*Stenella attenuata*	*	Common; widely distributed around 1,000-meter (3,280-foot) isobath.	91,321	Likely
Clymene dolphin	*Stenella clymene*	*	Common; widely distributed in water depths from 250 to 5,000 meters (820 to 16,404 feet).	17,355	Likely
Atlantic spotted dolphin	*Stenella frontalis*	*	Common; widely distributed on slope but rarely beyond the shelf edge near 100-meter (328-foot) isobath.	30,947	Possibly
Spinner dolphin	*Stenella longirostris*	*	Common; widely distributed on slope.	11,971	Possibly
Fraser's dolphin	*Lagenodelphis hosei*	*	Uncommon but widely distributed.	726	Possibly

Common Name	Scientific Name	Status	Abundance and Distribution[1]	Estimated Number of Individuals[2]	Likelihood of Occurring Near Site[3]
Killer whale	*Orcinus orca*	*	Uncommon but mainly found southwest of the Mississippi River delta.	133	Unlikely
False killer whale	*Pseudorca crassidens*	*	Uncommon throughout Northern Gulf, but mainly southwest of Mississippi River delta in pelagic waters.	1,038	Unlikely

Source: Davis *et al.* 2000; MMS 2000; Baumgartner *et al.* 2001; University of Michigan 2003; and Department of the Navy 2003.

Notes:

[1]Accurate depth ranges could not be found in the literature but "deep" is probably 1,000 meters (3,280 feet) and deeper.
[2]Extralimital: known on the basis of only a few records that probably resulted from unusual wanderings of animals into the region (Würsig *et al.* 2000). Rare: present in such small numbers throughout the region that it is seldom seen (Würsig *et al.* 2000).
[3]The likelihood determination was based on a compilation of surveys that indicated the number of individuals and occurrences of cetaceans close to the project site (Department of the Navy 2003), as well as a consideration of the distribution discussed in other literature.

Key:

> = greater than.
* = Protected under the Marine Mammal Protection Act.
E = Endangered under the Endangered Species Act.
km = kilometers.

Six species of whales (northern right [*Eubalaena glacialis*], blue [*Balaenoptera musculus*], fin [*B. physalus*], sei [*B. borealis*], humpback [*Megaptera novaeangliae*]), and sperm whale [*Physeter macrocephalus*]), are listed as endangered. All cetaceans occurring in the GoM, however, are protected under the MMPA of 1972, as presently amended. Except for the sperm whale, the other endangered cetaceans are known from only very few sightings and are considered to be rare or of accidental occurrence (Continental Shelf Associates [CSA] 2000; Table 19-3). While there is no federally designated critical habitat for endangered cetacean species in the Gulf, the deepwater region provides important habitat for these and other marine mammals (CSA 2000).

Habitat preference varies with each cetacean type, but seems to be related to bottom depth (Table 19-3; Baumgartner *et al.* 2001; Davis *et al.* 2000). On the continental shelf, the most frequently occurring cetaceans are the bottlenose dolphin (*Tursiops truncatus*), Atlantic spotted dolphin (*Stenella frontalis*), and possibly the Bryde's whale (*Balaenoptera edeni*; CSA 2000). The majority of cetaceans are typically found in deepwater on the continental shelf edge and slope, but much less frequently in water depths greater than 2,000 meters or in anticyclones (warm core rings). It appears that the deepwater cetaceans spend much of their time resting on the surface and then foraging at great depths (University of Michigan 2003). A marine resources report developed by the Department of the Navy (2003) describes the marine mammals of the Eastern GoM including the area around Warning Area W-92 located in the Central Gulf, north of the Cascade / Chinook Development. The movements of whales and dolphins are typically associated with feeding and breeding behavior, with some species (such as the humpback and northern right whale) making extensive annual migrations for breeding and mating (Department of the Navy 2003). In the GoM, oceanic cetaceans tend to aggregate around areas where the distribution and abundance of prey is the highest such as cyclonic eddies (Department of the Navy 2003). The high slopes and rugged topography of the Sigsbee Escarpment, as well as the occurrence of strong currents, may provide conditions that are conducive to nutrient upwelling. Infrequent but sometimes large groups of cetaceans have been sighted near the project area (Department of the Navy 2003) but the surveys are limited and there is not enough information available to determine if cetaceans regularly use the area for feeding or other purposes.

The sperm whale is the only endangered odontocete species considered common and perhaps a resident in certain deepwater areas. Sperm whales have been observed throughout the GoM from the upper continental slope near the 100-meter isobath and beyond the seaward extent of the U.S. Exclusive Economic Zone (NOAA 2002). Based on their distribution, sperm whales show a preference for continental margins, sea mounts, and areas of upwelling where food is abundant (MMS 2001). They are also known to dive for two hours up to depths of 3,200 meters or more to feed on squid (MMS 2000). The most well-known congregations occur along the shelf edge and slope in the vicinity of the Mississippi River Delta in water depths of 1,640 to 6,562 feet. Data deficiencies remain, however, such as the duration of time spent in an area, their patterns of movement and their preferred feeding areas.

The location of cyclonic features (cold core rings) in the GoM produces nutrient-enriched waters, which appears to be an important factor in determining cetacean distribution (MMS 2001). In general, cetaceans are found along the continental slope in areas of cyclonic circulation and confluence zones, which are high in primary productivity. Since cyclones in the GoM are dynamic, cetaceans will likely move in response to the movement of prey associated with these hydrographic features. Pelagic dolphin species (primarily bottlenose and Atlantic spotted) and possibly Bryde's whale, appear to occur more often in relatively shallow waters north of the influence of these cyclonic features (Baumgartner *et al.* 2001; Davis *et al.* 2000).

19(b).6 Sea Turtles

Five sea turtles, all federally protected under the ESA, are known to occur in the GoM. The Kemp's ridley (*Lepidochelys kempii*), leatherback (*Dermochelys coriacea*), and hawksbill (*Eretmochelys imbricata*) are listed as endangered; the loggerhead is listed as threatened (Davis *et al.* 2000). The green sea turtle (*Chelonia mydas*) is listed as threatened; except for breeding populations in Florida, which are listed as endangered. See Table 19-4.

Table 19-4 – Sea Turtles in GoM

Common Name	Scientific Name	Status	Abundance and Distribution in Gulf of Mexico	Likelihood of Occurring Near Site
Loggerhead	*Caretta caretta*	T	Common; widely distributed on Eastern Gulf shelf and slope; mostly near 328 ft (100 m) but some in water deeper than 3,280 ft (1,000 m).	Possibly
Leatherback	*Dermochelys coriacea*	E	Common; widely distributed on shelf and slope.	Possibly
Kemp's ridley	*Lepidochelys kempii*	E	Occasional; occurs mainly in coastal areas.	Unlikely
Hawksbill	*Eretmochelys imbricata*	E	Occasional; occurs mostly in shallow lagoons and coral reefs	Unlikely
Green	*Chelonia mydas*	T/E	Common in coastal areas.	Unlikely

Source: Davis *et al.*, 2000.
Key:
Common = Estimated abundances above 200 individuals.
T = Threatened.
E = Endangered.

Most sea turtles, with the possible exception of the leatherback, which is the most pelagic of the group, vary in their distributions depending on their life stage. Hatchlings actively swim away from their nesting beaches to zones of water mass convergence and/or floating Sargassum, which provide prey and shelter. Most then drift within prevailing oceanic currents for a number of years. Once juveniles reach a certain age/size range, they leave the pelagic habitat and travel to shallow waters on the continental shelf (CSA 2000).

It is not known if adult sea turtles or juveniles in floating Sargassum mats would occur in the vicinity of the proposed project. Based on what is known about the distribution of loggerhead and leatherback sea turtles (Table 19-4) it is possible that adults of these species could be found in the area as transients. Refer to MMS (2006a) and NOAA (2002) for the current status of knowledge and life history information pertaining to marine turtles occurring in the Gulf of Mexico.

19(b).7 Pelagic Birds

Offshore, pelagic seabirds spend most of their lives at sea; often over oceanic waters exceeding 200 meters depth. Predominate species seen in offshore areas of the GoM include terns (*Sterna*), storm-petrels (*Hydrobatidae*), jaegers (*Stercorarius*), and laughing gulls (*Larus atricilla*). Surveys have determined water depth influences the distribution of species groups and individual species of seabirds, which vary both spatially and seasonally (MMS 1996). They live far from land most of the year, roosting on the water surface, except at breeding time when they return to nesting areas along coastlines. Environmental parameters, such as sea surface productivity, also affect seabird distribution (Davis *et al.* 2000). The highest species diversity of seabirds has been associated within cyclonic eddies, while the lowest species diversity occurred on the continental shelf (Davis *et al.* 2000). Other evidence shows that seabird groups tend to concentrate at fronts defined by steep temperature gradients (Ribic *et al.* 1997).

Seabirds, especially migrating birds, are affected by offshore platforms in many ways. For most species, platforms provide a suitable stopover habitat. Birds that are fatigued from long migrations may use platforms and vessels to rest and feed. Many shorter distance migrants that spend the winter along the Gulf coast (such as wrens and sparrows) inadvertently overshoot the coastline during nocturnal migratory flights and end up over GoM waters. These birds, which are evolutionarily ill equipped to deal with the rigors of overwater migration, are among the heaviest users of platforms during certain seasons and the availability of platforms to rest probably enabled many individuals to return to land successfully (Russell 2005).

All pelagic birds are protected by the Migratory Bird Treaty Act (USFWS 2002). Populations and distributions of these birds inhabiting offshore waters (outer continental shelf and abyssal areas) in the central GoM have not been well studied. Due to the proposed project's distance offshore, it is not known whether migratory or threatened or endangered bird species occur near the project's vicinity or would use the area during migration.

19(b).8 Marine Fisheries

Offshore waters of the GoM support many economically and ecologically important shellfish and finfish fisheries. Marine habitats in the GoM support a varied and abundant fish fauna. Species found in a given area are related to variable ecological factors at the site, including salinity, primary productivity, and bottom substrate. These factors differ widely across the GoM. In addition, the pelagic, floating brown algae, *Sargassum*, has been found to support a diverse community of marine organisms including more than 100 species of fishes, as well as more than 100 species of invertebrates and four species of sea turtles around the world (Coston-Clements *et al.* 1991). Fish species associated with *Sargassum* in the North Atlantic and Gulf of Mexico are listed in Table 19-5. The primary assemblages that could occur near the proposed Cascade / Chinook site include commercial pelagic species and deepwater finfish. The following sections provide general information on these resources, along with information associated with commercial and recreational pelagic fisheries.

Table 19-5 - Fish Species Associated with *Sargassum*

Species	Common Name
Carcharhinus falciformis	Silky shark
Carcharhinus limbatus	Blacktip shark
Carcharhinus longimanus	Oceanic whitetip shark
Sardinella aurita	Spanish sardine
Cypselurus furcatus	Spotfin flyingfish
Exocoetus obtusirostris	Oceanic-two-wing flyingfish*
Hemiramphus brasiliensis	Ballyhoo
Hyporhamphus unifasciatus	Silverstripe halfbeak
Parexocoetus brachypterus	Sailfin flyingfish*
Epinephelus inermis	Marbled grouper*
Rachycentron canadum	Cobia*
Caranx bartholomaei	Yellow jack*
Caranx crysos	Blue runner*
Caranx hippos	Crevalle jack*
Caranx latus	Horse-eye jack*
Caranx ruber	Bar jack*
Decapterus macarellus	Mackerel scad*
Decapterus punctatus	Round scad*
Decapterus tabl	Roughear scad*
Elagatis bipinnulata	Rainbow runner*
Naucrates ductor	Pilotfish
Selar crumenophthalmus	Bigeye scad*
Seriola dumerili	Greater amberjack*
Seriola fasciata	Lesser amberjack*
Seriola rivoliana	Almaco jack*
Seriola zonata	Banded rudderfish*
Trachurus lathami	Rough scad*
Coryphaena hippurus	Dolphin*
Rhomboplites hippurus	Vermilion snapper*
Lobotes surinamensis	Tripletail*
Mugil cephalus	Striped mullet*

Species	Common Name
Mugil curema	White mullet*
Sphyraena barracuda	Great barracuda*
Bodianus pulchellus	Spotfin hogfish*
Thalassoma bifasciatum	Bluehead*
Unidentified Trichiuridae	Snake mackerel*
Acanthocybium solandri	Wahoo*
Euthynnus alleterattus	Little tunny
Katsuwonus pelamis	Skipjack tuna
Thunnus albacares	Yellowfin tuna
Thunnus atlanticus	Blackfin tuna
Xiphias gladius	Swordfish*
Istiophorus platypterus	Sailfish*
Makaira nigricans	Blue marlin*
Tetrapturus albidus	White marlin*

Source: Coston-Clements *et al.* 1991.

Note:

* = early life stage present (i.e. egg, larvae or juvenile).

Pelagic Fish

Fish species likely to be found in the offshore waters near the Walker Ridge Protraction Area are characterized as oceanic pelagic. Oceanic pelagic species occur mainly in deep, open ocean waters offshore from the shelf break. Oceanic pelagics occur throughout the GoM, especially at or beyond the shelf edge. They are reportedly associated with mesoscale hydrographic features such as fronts, eddies, and discontinuities. Common oceanic pelagic species include: tunas and wahoo (*Scombridae*), marlins and sailfish (*Istiophoridae*), swordfish (*Xiphias gladius*), dolphins (*Coryphaenidae*), and mako sharks (*Isurus* sp.). Refer to Benfield and Shaw (2005) for detailed information on the presence of pelagic fish.

Deepwater Fish

In addition to the large pelagic species, predatory species such as halfbeaks, flyingfishes, driftfishes, and lesser known pelagics such as snake mackerels (*Gempylidae*), ribbonfish (*Trachipteridae*) and escolar (*Lepidocybium flavobrunneum*), occur throughout the GoM; especially at or beyond the shelf edge (MMS 2001). Lantern fish (Myctophids) are among the most abundant of oceanic fish. Almost all species of myctophids vertically migrate through the water column to feed in the upper zones (150 meters) during the night and deeper zones (300 to 900 meters) during the day.

Other fish exist in the mesopelagic zone (200 to 1,000 meters) and migrate in the water column, moving each night to correspond with feeding cycles. Their feeding habitat ranges from depths of 400 to 800 meters into epipelagic waters, sometimes reaching the surface (CSA 2000).

Demersal fish are those having either direct contact with the substrate or hovering above it. The most extensive surveys of demersal fish were conducted in the 1980s from two MMS sponsored studies. The data showed a decline in diversity with depth although this was not statistically significant (CSA 2000).

Bathypelagic fish inhabit waters greater than 3,280 ft and seldom migrate into shallower waters. These fish have developed similar physiological adaptations, similar to the mesopelagic fish, in order to live in the deepwater environment. No studies to date have directly examined the bathypelagic fish in the Gulf (CSA 2000).

It is possible that important pelagic species and other deepwater fish occur in our near the Cascade / Chinook development site particularly given the topographic relief provided by the Sigsbee Escarpment.

19(b).9 Commercial and Recreational Fisheries

An estimated 2,000 species of fish are known in the GoM (MMS 2001) but only a small fraction of those are commercially harvested. Commercially important pelagic fish in the Gulf include dolphin, sharks, snake mackerels (*Gempylus serpens*), swordfish, tunas, and wahoo (*Acanthocybium solanderi*; CSA 2000). Commercial fishing efforts resulting in the highest economic returns for pelagic species include: (1) upper-ocean trolling for billfish, (2) mixed-depth long-lining for yellowfin tuna, and (3) deep-bottom trawling for royal red shrimp. However, the only type of vessel that would likely fish near the project site is related to the commercial pelagic longline fishery (CSA 2002).

The gear associated with this fishery consists of a mainline of 700-pound or greater test monofilament that typically ranges in length from 10 to 45 miles (16 to 72 km). At regular intervals along the mainline, bullet-shaped floats are suspended and long sections of the gear are marked by radio beacons. Long lines of 200 to 400-pound test monofilament that are typically 100 to 200 feet in length are suspended from the mainline and set with baited hooks (Waring *et al.* 2007).

Longline sets targeting tunas are typically set at dawn and soak throughout the day with recovery near dusk. Those sets targeting swordfish are generally set at night. The total amount of time the gear remains in the water including set, soak, and haul times is typically 10-14 hours (Waring *et al.* 2007).

The total number of vessels that reported fishing in the longline pelagic fishery in the GoM in 2004 was 69. However, the total fishing effort (i.e., number of hooks set) has increased throughout the 1990s and into this decade. The total number of hooks set in 2004 were 4.08 million, which represented 5,410 longline sets (Waring *et al.* 2007).

The pelagic longline fishery occurs year round, both inside and outside the Exclusive Economic Zone, from Florida to Texas (Waring *et al.* 2007).

Commercial landings of oceanic pelagic species of interest for Louisiana, Texas, Mississippi, and Alabama are summarized in Table 19-6. The latest data available from NOAA Fisheries is annual landings by species for 2005 (NOAA 2007a).

Table 19-6 - Commercial Landings of Oceanic Pelagic Species

Species	Pounds	Value ($)
Louisiana		
Shark (various species)	459,479	325,545
Blackfin tuna	6,666	2,082
Bluefin tuna	90,808	379,921
Yellowfin tuna	2,153,027	7,181,838
Swordfish	540,922	1,142,973
Texas		
Shark (various species)	4,837	3,112
Blackfin tuna	158	96
Bluefin tuna	N/A	N/A
Yellowfin tuna	111,855	339,869
Swordfish	2,066	4,845
Mississippi		
Shark (various species)	29,019	7,261
Alabama		
Shark (various species)	781,264	630,407
Source: NOAA 2007a.		

In 2005, more than 2.15 million pounds of yellowfin tuna were caught off Louisiana (worth $7.2 million) accounting for nearly 95% of the total catch in the region. According to the most recent data available from NOAA Fisheries Service, other tunas landed in the region for 2005 included albacore (12,680 pounds), little tunny (*Euthynnus alletteratus*; 7,532 pounds), and bigeye (*T. obesus*; 26,943 pounds; NOAA 2007a).

Significant fishing pressure has occurred to coastal and pelagic sharks as they are most often part of the bycatch from longline fisheries. Pelagic species range widely in the upper ocean zones and often travel over entire ocean basins. Coastal-pelagics are intermediate; occurring both inshore and beyond the continental shelves, but are not known to move across the oceans. Deep-dwelling species of the continental slope and beyond (to 550 meters) include most cat sharks (*Scyliorhinidae*), in water depths to 550 meters, and gulper sharks (*Centrophoridae*), in water depths ranging between 100 and 1,200 meters. Large commercial shark fisheries have occurred primarily off Louisiana (19.2% of 1998 landings in U.S.; Buck 2000).

Of the 42 managed species in the Gulf, fourteen are known to have at least one life history stage occurring in deepwater (MMS 2001). Sharks occurring in deepwater include blacktip (*Carcharhinus limbatus*), bull (*Carcharhinus leucas*), dusky (*Carcharhinus obscurus*), silky (*Carcharhinus falciformis*), tiger (*Galeocerdo cuvier*), Atlantic sharpnose (*Rhizoprionodon terraenovae*), and longfin mako (*Isurus paucus*; MMS 2001). No commercial fishing is known for any deep-dwelling shark species except for blacktip sharks, which also occur closer to shore. Other managed pelagic species and their known habitat requirements and spawning areas are provided in Table 19-7.

Table 19-7 - Pelagic Species and their Known Habitat Requirements and Spawning Areas

Common and Species Names	Habitat Preferences	Likelihood of Occurring Near Site
Atlantic swordfish (*Xiphias gladius*)	Usually found in surface waters, but occasionally diving as deep as 650 meters.	Possibly
Blue marlin (*Makaira nigricans*)	Found at great distances from the continents as well as coastal regions, near deep waters such as near the Mississippi River.	Likely
White marlin (*Tetrapturus albidus*)	Usually found in water over 100 meters deep; often associated with upwellings and weed lines, and regions with benthic geographic features such as drop-offs, canyons, and shoals.	Likely
Sailfish (*Istiophorus platypterus*)	Most densely distributed in waters close to coasts and islands but spawning and larvae are known to occur in 100 meters and deeper.	Possibly
Yellowfin tuna (*Thunnus albacares*)	Have been found to dive as deep as 1,100 meters though they generally swim at much shallower depths, averaging 75 meters.	Possibly
Skipjack tuna (*Katswonus pelamis*)	Occur beyond the 200 meter contour.	Possibly
Bluefin tuna (*Thunnus thynnus*)	Swim at depths of 200 meters while diving to depths of approximately 1,000 meters.	Possibly
Sources: NOAA 1999; Florida Museum of Natural History 2007; MMS 2001; Nakamura 1985; Dagorn *et al.* 2006; Block *et al.* 2001		

19(b).10 Protected Fish Species

No federally listed fish species are predicted to occur in proximity to the proposed FPSO site. Table 19-8 lists candidate fish species currently not protected under the ESA but concerns about their status indicate they may warrant listing in the future (NOAA 2007b). Deepwater species are speckled hind (*Epinephelus drummondhayi*) and Warsaw grouper (*Epinephelus nigritus*), which inhabit steep and rocky ledges on the continental slope with depths to 525 meters; but are not known to occur in the project area (Heemstra and Randall 1993; MMS 2001).

Table 19-8 – Protected Fish Species

Candidate Species (year added)	Scientific Name
Dusky shark (1997)	*Carcharhinus obscurus*
Sand tiger shark (1997)	*Odontaspis taurus*
Night shark (1997)	*Carcharhinus signatus*
Speckled hind (1997)	*Epinephelus drummondhayi*
Warsaw grouper (1997)	*Epinephelus nigritus*
Nassau grouper (1991)	*Epinephelus striatus*
Source: NOAA 2007b.	

19(b).11 Essential Fish Habitat

Due to the wide variation of habitat requirements for all life history stages of managed fish, essential fish habitat (EFH) for the GoM includes all estuarine and marine waters and substrates from the shoreline to the 100 fathom contour located along the break of the continental shelf (GoM Fishery Management Council 2005). As such, no designated EFH occurs near the proposed project site. The Department of the Navy (2003) contains a good description of these shelf edge features, which range in water depths from 174 to 427 feet, but are located at least 70 miles north of the project site.

Because of the broad designations associated with EFH, Habitat Areas of Particular Concern HAPCs) have been designated to help focus EFH conservation priorities. Although generally small areas within the EFH, HAPCs provide extremely important ecological functions and/or are considered to be especially vulnerable to degradation (McKay *et al.* 2002). HAPC in the Northwestern GoM are identified as: East and West Flower Garden Banks, Stetson Bank, Sonnier Bank, MacNeil Bank, 29 Fathom, Rankin Bright Bank, Geyer Bank, McGrail Bank, Bouma Bank, Rezak Sidner Bank, Alderice Bank, and Jakkula Bank (Federal Register Notice 2005). All of these areas are greater than 100 miles from the proposed development.

19(b).12 Social and Economic Conditions

This section summarizes the social and economic conditions around the proposed onshore support facilities and other ports potentially used by the Cascade / Chinook development. The project area would likely include the use of onshore support facilities in two states: Louisiana (primary) and Texas (secondary). Port Fourchon, Louisiana would serve as the primary onshore support base. Shuttle tankers may transport crude from the FPSO to terminals located in Texas, Louisiana, Mississippi, and Alabama, although it may be more likely that terminals in Louisiana and Texas will be used more frequently since Texas and Louisiana have a larger number of terminals and terminals located in said states generally have larger capacities. Wastes would be brought to shore at several existing facilities in Louisiana (primary) and Texas (secondary). Refer to Section 16 for additional details.

Population

The population near the Gulf Coast has been increasing steadily since the 1970s. From 2000 until 2030, the region is projected to experience a doubling of the population (MMS 2006a). Increased interest in deepwater production will continue to influence this trend. For every million dollars invested in offshore projects, 20 jobs are created; for every 10 jobs created offshore, 37 jobs are created onshore (MMS 2001). The MMS estimates an average deepwater project would require approximately 400 employees, on and offshore. These employees are expected to be drawn from the current labor force residing in the GoM coastal region (MMS 2001). In addition, employment demands from outside of the GoM coastal area may also be required, creating in-migration of skilled labor. Port Fourchon has seen a decrease in unemployment since 1990; largely due to the boom in the offshore industry during the 1990s (MMS 2001). The regions coastal economic zone employment projections show an across the board increase, approximately 45%, including employment in the oil and gas industry and related services (MMS 2006a).

The FPSO vessel would be staffed with 35-45 personnel during normal production operations. Others would be employed on the shuttle vessels, drilling rigs, and offshore construction vessels. The total number employed offshore on the Cascade / Chinook development would not approach a level posing a significant impact to any particular labor market.

Minority and Lower Income Groups

There are areas of low income communities and areas of significant minority population within the GoM region. Coastal cultures and populations include the Hispanic enclaves of south Texas, the Acadian "French Triangle" of south Louisiana, Amerindian peoples such as the Houma of Louisiana, and the Vietnamese communities of coastal Louisiana and Mississippi. The State of Louisiana alone contains numerous cultural groups of Native American, African, European, Asian, Latin American, and Middle Eastern origins (MMS 2006a).

Executive Order 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, mandates that federal agencies identify and address as appropriate, disproportionately high and adverse human health or environmental effects the programs may have on minority and low income populations.

19(b).13 Infrastructure

Marine Support Vessels

As of 2002, there were 376 supply vessels (platform supply vessels) and anchor handling tugs/supply vessels in the GoM (MMS 2002). Of the 376 supply vessels, 116 were built since 1996. The number of marine support and construction vessels are described in detail in Section 15.

Helicopters

Helicopters are one of the primary modes of transporting personnel between service bases and offshore platforms, drilling rigs, and barges (MMS 2001). They would also be periodically utilized to transport certain types of equipment and supplies to the FPSO, drilling rigs, and construction vessels. The number of helicopters to be used is described in detail in Section 15. Helicopters are regulated by the Federal Aviation Administration (FAA) and can stop to refuel on several offshore platforms (MMS 2002). The FPSO and drilling rigs will be setup with fueling stations onboard.

19(b).14 Onshore Infrastructure

Port Fourchon

Port Fourchon is a multiuse port located at the mouth of Bayou Lafourche, approximately 60 miles south of New Orleans. The port has several support bases supporting the offshore oil and gas industry in the GoM. The port can service deepwater supply vessels due to the channel depth, allowing these vessels to take on fuel, water, deck cargo, and other necessities efficiently at the same covered dock (Coastal Marine Institute [CMI]/MMS 2002). Port Fourchon also houses a large number of docks with crane service, loading/unloading equipment, warehouses, refrigerated warehouse, and numerous storage yards. The port is connected to the GoM via the inshore channel of Belle Pass and Bayou Lafourche, with a depth of 24 feet and a bottom width of 300 feet (MMS 2004).

Contractors or Vendors

OCS development in the GoM is supported by an extensive onshore infrastructure. In turn, this industry is supported by thousands of contractors and businesses which can be found adjacent to port facilities. Offshore support businesses include the fabrication industry; which in the last 50 years has been termed the cornerstone of the offshore oil and gas industry, with a corridor extending from the Texas/Mexico border to Alabama (MMS 2002). Other support services include construction and repair, drilling, chemical, and transportation companies. Onshore support companies include pipelaying and burial, shipbuilding, maintenance, and repair. Warehouses are also required onshore for storage, as well as, quarters for crew. The proposed development would utilize existing infrastructure at support and service facilities located in Port Fourchon, as well as the onshore transport, refining, and processing capabilities at the ports and facilities located along the Gulf coast from Texas to Alabama.

Land Use

The oil and gas industry in the GoM has resulted in an extensive network of onshore and offshore support facilities, and onshore refining, separation, and processing facilities for crude oil and natural gas. No expansion of existing facilities or construction of new facilities would be necessary as part of the proposed action. No new dredging or land use changes to coastal areas would occur as a result of the Cascade / Chinook Development.

Recreational and Commercial Fishing

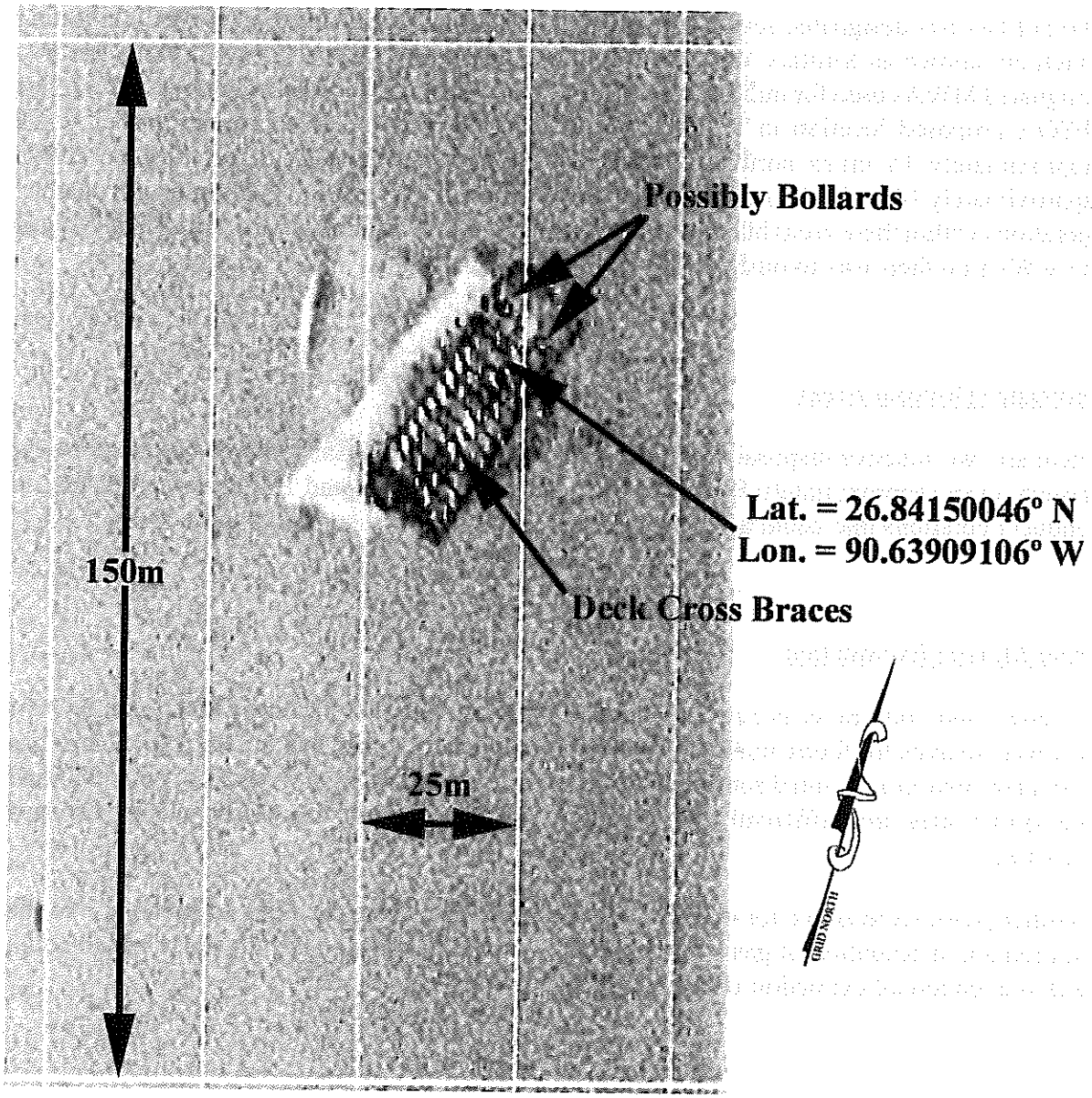
Marine Fisheries, including recreational and commercial fishing, are previously addressed in Section 19(b).8 *Marine Fisheries*. Due to the significant water depth at the project site, recreational fishing activities are not expected to occur in or around the area. Some pelagic longline commercial fishing is likely to occur near or within the area of the Cascade / Chinook fields.

19(b).15 Archeological Resources

Archaeological resources are any material remains of human life or activities that are at least 50 years of age and are of archaeological interest. Shipwreck sites on the OCS are protected by MMS through NTL 2005-G07, *Archaeological Resource Surveys and Reports*. There are more than 2,100 historic shipwrecks in the Federal waters of the GoM (MMS 2005). In addition to identifying the reported or known locations of these shipwrecks, this study also assigned a location reliability rating to each of these sites. The report lists blocks currently requiring an archaeological survey and report; and modifications to the survey lane spacing for blocks already on the list. The shipwreck database identifies two types of high-probability areas. The first area is within 10 km from shore and the second is near to historic ports, barrier islands, and other similar areas (Pearson *et al.* 2003). Based on this and other studies, MMS has determined where the highest potential for historic resources exists in the GoM per NTL 2006-G07, *Revisions to the List of OCS Lease Blocks Requiring Archaeological Resource Surveys and Report*. Details about recent discoveries, and their potential eligibility for listing under the National Register of Historic Places, can be found in Enright *et al.* (2006) and MMS (2005).

The eight lease blocks in the Cascade field are not located in an area of high shipwreck potential. To identify shallow hazards and to ensure any historic sites are identified and avoided, a shallow hazards assessment of the seafloor was conducted. The shallow hazards assessment identified a single shipwreck (approximately 131' x 51' x 16') most likely to be a modern sunken barge along one of the proposed gas export routes in Walker Ridge Block 115 in approximately 5,700 foot water depth. See Figure 19-2. The location of the shipwreck will not impact the routing of the pipeline (i.e. there is adequate space in the geophysical survey corridor to avoid the shipwreck). The finding was reported to MMS as required. Additional information is included in the GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook in Appendix 2.

See Figure 19-2 – Shipwreck in Walker Ridge Block 115



19(b).16 Other Uses of the Marine Environment

Nearshore and offshore uses of the marine environment include military use areas and commercial uses, which are described below.

Military Activities

The military has designated several areas within the GoM for training, operations, and testing which are known as Military Warning Areas (MWAs). The Central Planning Area has five designated MWAs used for military operations; four of these are located within 100 miles of the FPSO's proposed location in Walker Ridge Block 249. These areas are designated W-92 (approximately 15 miles north of the site), W-59A (approximately 102 miles), W-59BC (approximately 140 miles), and W-147AB (approximately 102 miles). PAI would not conduct operations within these areas but the supply vessels, helicopters, and tankers would likely transit the MWAs on their way to onshore support facilities.

Ordinance Disposal Areas

There are two inactive disposal areas located in the Mississippi Canyon area but these are far enough away (approximately 80 miles) from the proposed site and PAI is not proposing to conduct operations that could affect munitions that have been disposed in these areas.

Other Mineral Exploitation

To date, sand and gravel is not being mined offshore Texas in federal waters of the OCS; however, sources for future mining have been identified. In Louisiana, the Ship Shoal area has been identified as a potential source of sand for onshore restoration projects. Any potential sand and gravel sites are sufficiently far enough away to not cause any effect to the proposed activities.

Another potential resource for extraction is gas hydrates. There has been exploration into the location and distribution of gas hydrates along the continental slope of the GoM which could lead to commercial extraction within the next few years.

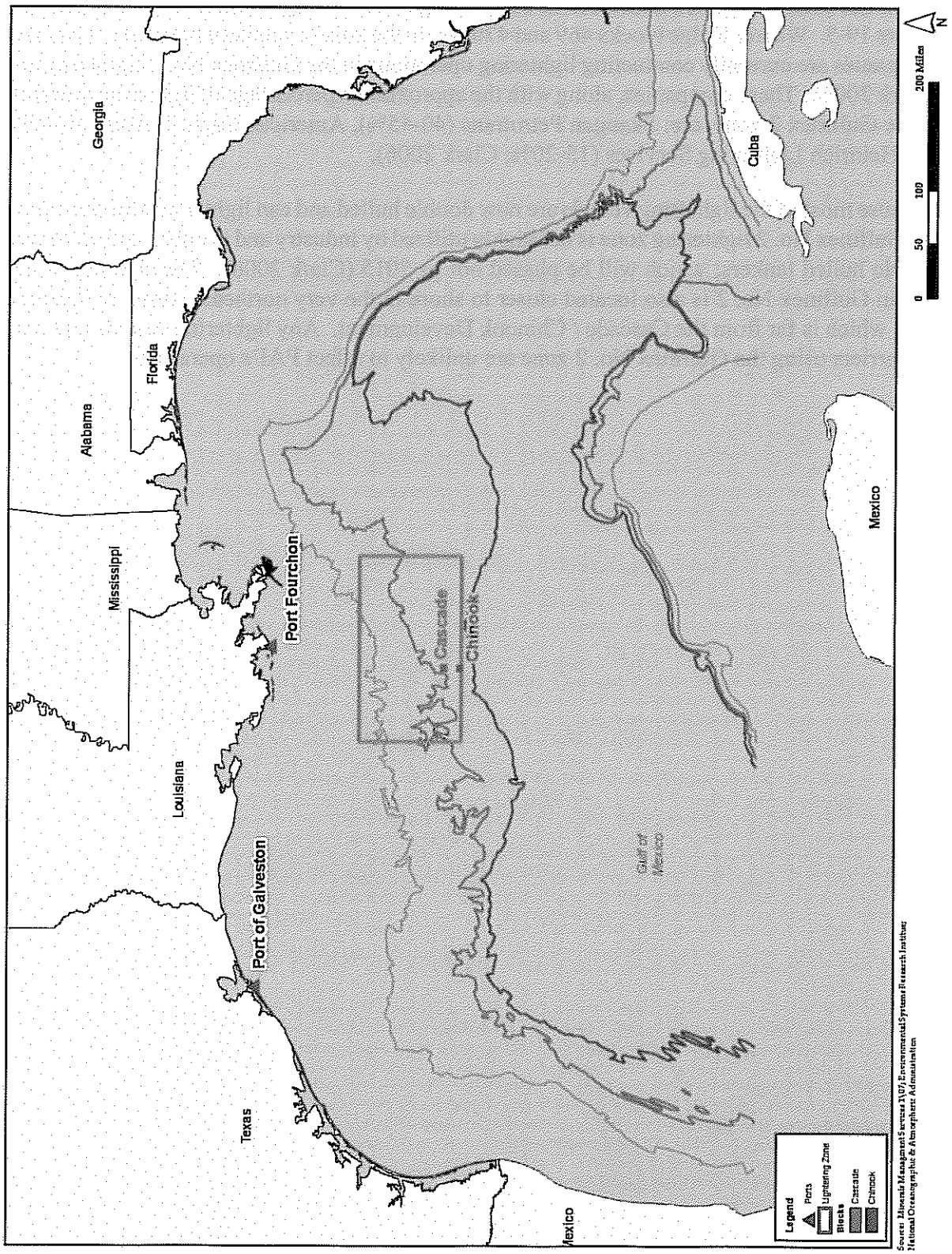
Lightering Operations

Lightering operations involve the offloading of crude oil from very large crude carriers (VLCCs) or ultra large crude carriers (ULCCs) to smaller shuttle tankers at sea. These small tankers then transport the crude to onshore terminals for offloading. For safety reasons the USCG has designated lightering areas in the GoM under 33 CFR 156.300 Subpart B; these are located more than 60 miles from the baseline of the territorial sea (Mineral Management Service 2000).

The entire area around the Cascade / Chinook development is within the Gulfmex No. 2 area, which has been designated until 2015 as a lightering zone for single-hulled tankers as shown in Figure 19-3. Walker Ridge blocks 469 and 470 are on the zone's southern boundary. Only three companies are currently conducting lightering operations in the Gulfmex No. 2 lightering zone (Clark 2006). These companies, along with the approximate percentage of lightering operations in the Gulfmex 2 zone, are: Skaugen Petrotrans (40-45%), American Eagle Tankers (40-45%) and Heinrich Lightering Services (15-20%; Clark 2006).

Because most of the lightering vessels are now double hulled and can lighter outside these areas, the Gulfmex No. 2 lightering zone is not highly utilized by industry and is only required for non-double hulled tankers; which will be phased out by 2015 (Clark 2006). The area that is used within Gulfmex No. 2 is also located closer to shore in the very northeast corner of lightering area, which is far from the Cascade / Chinook Development. Any lightering vessels and crude oil carriers using the Gulfmex No. 2 zone are unlikely to affect PAI's operations.

Figure 19-3 - Gulfmex No. 2 Lightering Area



19(c) Project Impacts

Table 19-9 and subsequent sections describe the potential impacts to marine and coastal resources that may occur from the impact producing factors that discussed in Section 19(a). If an effect was identified, it has been determined that it would likely result in a minor, temporary impact. The only impact producing factor which could have significant effects is a catastrophic oil spill, which would be an extremely unlikely event given the controls that PAI will have in place. See Section 1(f) to review the controls associated with FPSO offloading, which is the operation which provides the most credible exposure to oil spills from an FPSO.

Table 19-9 - Potential Impacts to Marine and Coastal Resources

Environmental Resources	Impact Producing Factors (IPFs)					
	Emissions (air, noise, light, etc.)	Effluents (muds, cuttings, other discharges to the water column or seafloor)	Physical disturbances to the seafloor (rig or anchor emplacements, etc.)	Wastes sent to shore for treatment or disposal	Accidents (e.g. oil spills)	New or unusual technology
Site Specific Resources						
Chemosynthetic communities	•	•	•	•	•	•
Water quality	•	√	•	•	√	•
Fisheries	•	•	•	•	√	•
Marine mammals	√	•	•	•	√	•
Sea turtles	•	•	•	•	√	•
Air quality	•	•	•	•	√	•
Shipwreck sites (known or potential)	•	•	•	•	•	•
Resources in the Vicinity						
Essential fish habitat	•	•	•	•	•	•
Marine and pelagic birds	•	•	•	•	•	•
Public health and safety	•	•	•	•	•	•
Coastal and Onshore Resources						
Beaches	•	•	•	•	•	•
Wetlands	•	•	•	•	•	•
Shorebirds and coastal nesting birds	•	•	•	•	•	•
Coastal wildlife refuges	•	•	•	•	•	•
Wilderness areas	•	•	•	•	•	•

Key:
√ = Denotes that there could be a potential impact. Refer to Section 19(c) for details of the analysis.
• = Denotes that no impact was identified.

19(c).1 Air Emissions

Emissions of air pollutants during the project would occur from the FPSO, Shuttle Vessels, drilling rigs, construction vessels, and marine support vessels. This would primarily occur from the combustion of fuels related to the engines, generators, and other pumps or motors on such vessels. Refer to Section 8 and Appendix 4 for additional details.

In some unusual situations during production operations (i.e. process upsets) gas could be flared for short durations. The FPSO would be equipped with two independent flare systems, one operating at high pressure and the other at low pressure, to collect and burn residual gases released from safety valves, pressure control valves, blowdown valves, pipelines, etc. It is possible that some emergency flaring could occur for short periods (i.e. several days per well) during well testing.

Hydrogen sulfide (H_2S) is not present in significant amounts (i.e. the amount present is less then 20 ppmv) in the Cascade and Chinook reservoirs.

Overall, the emissions of pollutants from this project are not expected to impact offshore air quality. The project site is about 165 miles from the Louisiana coast. The western portion of the GoM is influenced by the Mexican Low as well as the Bermuda High. Winds circulate clockwise around the Bermuda High and counter-clockwise around the Mexican Low, therefore, winds are predominately from the south-southeast across the area. Emissions from the facility would be rapidly dispersed by surface winds, with an annual average of 13.3 miles per hour (MMS 2001). The closest shoreline is to the north of the facility. Therefore, facility emissions traveling with the prevailing winds have to travel a greater distance before impacting the shoreline, and have a greater opportunity to be dispersed. In addition, the proposed development is located more than 124 miles from the BNWA, with the prevailing winds blowing facility emissions away from BNWA.

Near shore air emissions associated with Shuttle Vessels should not provide a significant impact as there are significantly less emissions from Shuttle Vessel unloading operations at terminals relative to Shuttle Vessel loading at the FPSO. Not only will less air emissions be generated at the terminals due to a decreased need for power utilization (i.e. holding the Shuttle Vessel on station in offshore environmental conditions), the terminals will have vapor recovery units to minimize the VOCs that could be released during unloading operations at terminals.

The project would not result in any changes to onshore infrastructure and the site is located at least 165 miles offshore. Therefore, no effects to sensitive receptors, such as schools, residential areas, and hospitals, would occur. The use of a gas export pipeline at the commencement of Phase 1 provides a positive environmental effect as MMS had contemplated the likelihood that flaring would be needed in the early stages of an FPSO development (MMS 2001).

19(c).2 Noise Emissions

Noise associated with this project will occur from the operation of the FPSO, Shuttle Vessels, drilling rigs, construction vessels, marine support vessels, and helicopters, which can transmit noise through both air and water. The classification societies will verify that the major marine vessels (e.g. FPSO, Shuttle Vessels, and drilling rigs) have acceptable noise levels prior to mobilization to the GoM in alignment with the classification society rules. PAI shall verify that noise limits are managed in accordance with regulatory requirements during the Phase 1 operations.

Given the amount of vessel traffic from all sources in the GoM, the level of noise from marine support vessels and Shuttle Vessels transiting to and from shore is expected to contribute an insignificant amount of the total ambient noise level. According to NOAA Fisheries in its assessment of oil and gas operations, it is believed that low frequency noise created by drilling activities may be detected by sperm whales, resulting in some harassment although no adverse effects would occur (NOAA 2002).

Short-term, minor impacts could occur to marine mammals in the vicinity of the project area as a result of noise produced during construction, primarily from the use of thrusters on the DP marine vessels, which would be used to construct the facilities and pipelines, as well as for drilling the one new well on Chinook.

It is possible that underwater noise during FPSO production operations could also have the potential to affect marine mammals if they are feeding or transiting through the area, but this is expected to result in less noise than during construction because neither the FPSO nor the shuttle vessels would use DP thrusters for station keeping. The dedicated field tug would assist the Shuttle Vessels during offloading operations to maintain a safe distance between the FPSO and the Shuttle Vessel.

If marine mammals are in the vicinity, they are likely to move away from the noise sources and not be significantly affected. Noise from passing service vessels could also startle cetaceans and temporarily disrupt their movements. The project would likely have minimal effects on marine mammals or other sensitive noise receptors in the GoM.

19(c).3 Effluents and Discharges

Operational wastes generated from this development would occur from the FPSO, Shuttle Vessels, drilling rigs, construction vessels, and marine support vessels. These would include water based drilling fluids, cuttings from water based drilling fluids, cuttings from synthetic based drilling fluids, mud / cuttings / cement at the seabed, well test completion fluids, produced water, sanitary wastes, domestic wastes, uncontaminated seawater, uncontaminated bilge water, uncontaminated ballast water, desalination unit water, hydrostatic water, and deck drainage. All ocean discharges will be discharged overboard in compliance with the NPDES GP requirements. All other wastes would be transported to shore for disposal in permitted or licensed commercial facilities or for recycling. Refer to Section 7 for details.

Drilling fluids and cuttings would be either water based or synthetic based (SBF); oil based fluids will not be used. The discharge of SBF is limited to a specific retention on cuttings (ROC) value required by the NPDES GP. The ROC is a film of SBF that is left on the cuttings after the cuttings dryer process. Therefore, the majority of the SBF is separated from the drill cuttings and re-circulated. While the colder temperatures and greater depths of the fields would likely result in little degradation of the synthetic components adhering to the discharged drill cuttings, SBFs are not expected to affect water quality or the benthic community, even in the event of an accidental discharge (Boland *et al.* 2004). All drilling muds and cuttings generated would be discharged according to NPDES GP limitations.

Treatment chemicals could be used, if needed, to stimulate well production, to assist product flow assurance, or to treat or prevent operational problems that may occur in the production process.

Minor, localized impacts to marine water quality would occur from the proposed discharges and effluents during the life of the project. Effects are expected to be minimal based on compliance with the NPDES General Permit.

19(c).4 Physical Disturbances to the Seafloor

All facilities associated with this development, except for Shuttle Vessel and marine support vessel transit to and from shore, will be located in water depths beyond 8,000 feet. Benthic communities such as seagrass beds, corals and live bottom habitat (typically found in waters less than 100 feet), pinnacle communities (typically located in water depths less than 1,300 feet), or deepwater corals (typically located in water depths as deep as 3,280 feet), would not be affected.

Emplacement of the subsea production facilities, installation of anchoring systems for mooring the FPSO and the non-DP drilling rig (for two Cascade wells), and the installation of the pipelines would physically disturb the seafloor. However, geophysical surveys of the project area indicate that sensitive chemosynthetic communities are not located within areas where seafloor disturbances would occur.

A DP, semi-submersible drill rig would be would be used to drill and complete the well on Chinook, which would not cause any effects to the seafloor from mooring.

The pipelines would also be installed with a DP construction vessel, which would prevent any impacts to the seafloor. Pipeline installation activities would primarily cause suspension of sediments as the pipe is laid across the seabed, which would cause a slight increase in turbidity of the water column. Suspended sediments would eventually settle within a relatively short timeframe.

Based on the surveys conducted, geophysical signatures related to chemosynthetic communities or hard-ground substrates are not present in the project area. There is no evidence of hydrocarbon seepage to the seafloor in the geophysical data. The occurrence of periodic strong bottom currents in this area have scoured and eroded the seafloor. The multibeam data reveal an eroded seafloor exhibiting furrows, anti-dunes, and flukes. The side-scan data does not indicate any areas of hard seabed or expulsion features along the pipeline routes for the flowlines and umbilicals or along the export gas pipeline route. There was also no indication of chemosynthetic communities in the areas of the well sites and other seafloor emplacements (GEMS 2007; see Appendix 2).

No impacts would occur to either hard bottom substrate or chemosynthetic communities in the project area. An ROV monitoring survey would be conducted in accordance with NTL 2003-G03, Remotely Operated Vehicle Surveys in Deepwater, to verify that no previously unknown, high-value benthic communities exist in the vicinity of proposed activities. Any potential to impact benthic resources would be further minimized by the requirement to avoid potential chemosynthetic communities by a minimum of 1,500 feet per NTL 2000-G20. Slight turbidity and burial from sediment settling would be expected but these would have short-term, localized and negligible impacts to epifaunal or infaunal communities.

The Cascade and Chinook facilities are not located within a high probability area for archeological resources. Furthermore, the shipwreck that was identified along one of the proposed gas export pipeline routes will not provide a significant impact as the pipeline corridor is large enough to reroute the pipeline to avoid the hazard.

Due to the presence of deepwater furrows along most of the Chinook flowline route, special design measures would be implemented to ensure that the pipe strains and stresses do not exceed allowable limits.

19(c).5 Impacts from Wastes Sent to Shore

The majority of wastes sent to shore would consist of municipal garbage associated with personnel on the FPSO, Shuttle Vessels, and drilling rigs. Other wastes would consist of waste oil from machinery. These wastes would be transported to onshore waste disposal facilities in Louisiana and Texas via supply boats. No expansions of the existing onshore waste disposal facilities would be required. Refer to Section 7(a) for additional details.

The Cascade / Chinook development would have no environmental effects on offshore or nearshore coastal resources as a result of the wastes sent to shore.

19(c).6 Accidents and Spills

The FPSO EIS indicates that FPSO-unique spill risks comprise only 5% of the total risk for this kind of development (MMS 2001). The remaining 95% of spill risks would not be unique to FPSO operations and would be equally likely to have similar outcomes on a tension leg platform or other deepwater production facility. Of the total potential FPSO-unique spills, it is estimated that approximately 94% of the volume would be more likely to occur during oil transfers from the FPSO to the Shuttle Vessel and from the Shuttle Vessel's transit to shore.

There is no incremental oil spill risk resulting from bringing the produced oil to terminals via Shuttle Vessels. The various terminals would likely operate at capacity whether or not this proposed project is approved. If the Shuttle Vessels proposed for this development are not used, then some other tanker (likely carrying foreign supplied oil) would be used in its place.

The risk analysis in the FPSO EIS noted that collisions with passing vessels could account for 1.2% of all FPSO-unique oil released due to the potential for a large-volume spill. However, few vessels lighter in the area of the Cascade / Chinook project site, and the project is more than 100 miles away from established shipping lanes, which occur closer to the coast.

Although PAI's operations would not occur in areas of heavy traffic, PAI plans to use a dedicated field tug to support FPSO offloading operations, which would help mitigate any accidental oil spills and would provide other safety factors needed during operations. Due to the distance from the nearest port (at least 165 miles), the availability of an attendant vessel becomes even more important in helping to mitigate several types of risks, including oil spills. For example, the availability of an attendant vessel increases the ability to respond to propulsion failures of the FPSO, Shuttle Vessel, or a passing vessel, which would lessen the chances of at-sea collisions and the resulting release of oil.

An attendant vessel with fire fighting capability could also be a significant resource in the event of a fire on the FPSO or Shuttle Vessel.

Lifesaving capabilities on an attendant vessel would be able to assist in the event of a man overboard or helicopter accident in the vicinity of the FPSO.

The FPSO would also disconnect from the mooring and riser system for hurricanes and named storms, providing a step change reduction in risks to people, the environment, and assets regarding hurricane avoidance. Refer to Sections 1(f) and 2(e) for more information regarding the disconnectable feature of the FPSO and the associated pollution prevention controls that PAI will utilize.

Small spill less than 1,000 barrels would be expected to have a short term, non-significant impact to marine water quality. Larger spills, however, could impact marine water quality more significantly. This is not expected to affect coastal resources due to the site's distance from shore and the expected response activities that would occur in event of a spill (Ji et al., 2007). Furthermore, the chance of a large spill is extremely unlikely given the controls that PAI will put in place. The accidental release of synthetic-based drilling fluids and blowouts could have temporary localized impacts on marine water quality. Refer to Sections 1(f) to review additional pollution prevention measures and Section 9 to review oil spill response planning.

Depending on the size of a spill, accidents would have the potential to result in short term adverse impacts on sperm whales but these impacts would likely be sublethal (NOAA 2002). Sea turtles may be more affected by spills, especially large ones, but this would not affect the species' population to survive and recover from any loss (NOAA 2002).

The Cascade / Chinook Development would not result in different impacts from those assessed in the FPSO EIS. Potential effects of impacts from other marine vessels would not be expected due to the small number of vessels that use the Gulfmex No. 2 lightering zone far from the project site, the distance of the project to established shipping lanes, and because a dedicated field tug would maintain a constant watch onsite to prevent such a situation from occurring.

Military Warning Areas in the Central Gulf of Mexico would be transited by marine support vessels, Shuttle Vessels, and helicopters. This would be mitigated by following the Military Areas Stipulation for these lease blocks, which requires that PAI enter into an agreement with the command headquarters prior to commencing any traffic in one of the military warning areas. This would prevent any conflicts between PAI and military operations. Therefore, no impacts to military operations are expected.

19(c).7 Other Impacts Identified

New technologies

PAI has demonstrated the safety and reliability of the technologies that are considered new to the GoM to MMS in the Deepwater Operating Plan (DWOP) and has provided summaries of such technologies in Section 2(e). Section 1(f) provides descriptions of the most important safety and pollution prevention controls associated with the technologies new to the GoM.

The technologies new to the GoM proposed for this development are not expected to have any impact on resources in the GoM. Some of the technologies new to the GoM that PAI is proposing will provide a step change reduction in risk relative to existing deepwater technologies (e.g. FPSO with disconnectable turret feature).

Emplacement of Surface Structures

An exclusion zone will utilized to prevent other vessels from approaching the FPSO marine spread. The exclusion zone will be approved by the USCG and will be large enough to address the lengths of the marine vessels that are included in the Weathervaning "system" during FPSO offloading (e.g. FPSO, Shuttle Vessel, field tug).

The presence of the FPSO facility may have a positive effect to migrating birds by serving as a resting spot. No impacts to recreational fishing are expected due to the distance from shore but there could be minor effects to commercial pelagic fishing vessels, which would need to avoid entering the exclusion zone around the FPSO.

Likewise, no impacts are expected on socioeconomic and human resources such as coastal infrastructure, navigation and port usage, or recreational resources. The direct and indirect expenditures of the project would have a minor and temporary positive impact on the economic activities around the support facility at Port Fourchon. This project would have no effects on minority or low income populations. Nor would there be any secondary impacts to coastal resources or populations as a result of land-based support activities, use of infrastructure, or traffic.

19(d) Environmental Hazards

A number of environmental hazards exist in this area of the GoM such as hurricanes or strong currents that could impact the project and are described below. Measures that will be used to mitigate these impacts are also discussed here and in other sections of the DOCD.

19(d).1 Geological Hazards

The primary geological hazards that could affect a deepwater development include variable sediment types, steep slopes, high sedimentation rates, gas hydrates at or near the seafloor, interstitial gas, faulting, carbonate areas, salt and shale mobilization, and mud flows (MMS 2001). The GEMS Shallow Hazards Report for Facilities and the Summary of Environmental Conditions for Cascade / Chinook in Appendix 2 describes the potential hazards and how they will be mitigated.

19(d).2 Hydrogen Sulfide Determination

The Cascade / Chinook fields have been analyzed and H_2S is not present in significant quantities. The reservoirs will be designated "H_2S Absent" subject to MMS approval.

19(d).3 Loop Current and Deep Ocean Currents

The Loop Current is the dominant circulation feature in the GoM, entering through the Yucatan Channel and exiting through the Florida Straits.

The MMS-funded DeSoto Canyon Eddy Intrusion Study (Hamilton *et al.* 2000) was undertaken to take current and temperature measurements at British Petroleum's Atwater block 618, which is located at the base of the Sigsbee Escarpment in water depths of approximately 6,561 feet. This is approximately 50 miles north-northeast of the Cascade / Chinook Development area. The data showed unusual deep current flows that were typical of topographic Rossby waves (TRWs); however, the energy levels of TRWs in the study area were exceptional, while their duration was short compared to other areas of the Gulf (Hamilton *et al.* 2003). There are suggestions that deepwater currents are a result of TRWs that are generated westward by Loop Current fluctuations, Loop Current eddy shedding events, or the movement of Loop Current eddies (Hamilton *et al.* 2003). These waves are most likely to affect the central and eastern portions of the GoM but the generation mechanisms for them are not well understood (Hamilton *et al.* 2003).

The Sigsbee Escarpment was the primary focus of the above study, and similar conditions are expected in the Walker Ridge area. It is known that significant currents (up to 2 knots) occur along the base of the Sigsbee Escarpment (Bryant *et al.* 2004). The evidence for this is also found in the form of mega-furrows, which occur throughout the Cascade / Chinook development area and are the result of high speed currents that have built up these sediments over thousands of years. Refer to the geophysical report in Appendix 2 for additional information. In addition to TRWs, density currents associated with the leaching of exposed salt along the escarpment add to the complex current conditions in this area (Bryant *et al.* 2004). Refer also to Section 19(c).4.

The FPSO will be designed to remain on station for 1.) a 100 year return winter storm with a 1 year return loop current and 2.) a 100 year return loop current with a 1 year return winter storm. PAI would have access to data collected on the Loop Current and would know days in advance if a significant Loop Current event, such as a topographic Rossby wave, is expected to occur near the site and could respond accordingly by disconnecting if the thresholds are met. PAI would also measure ocean currents at the site as required by NTL 2007-G17, *Deepwater Ocean Current Monitoring on Floating Facilities.*

19(d).4 Hurricanes and Named Storms

Hurricane season in the Atlantic basin officially runs from June 1 through November 30; however, about 75% of the Category 3 or stronger hurricanes occur in August and September. Over the last few years, oil and gas activities in the GoM have been significantly disrupted by several major hurricanes, including Lili (in 2002), Ivan (2004), Katrina (2005), and Rita (2005).

At one point just prior to Katrina's landfall, 79% of Gulf platforms were evacuated and 1.4 million barrels of oil per day (95% of normal Gulf OCS daily production) and 8.8 billion cubic feet of gas per day (88% of normal Gulf OCS production) were shut in. Katrina destroyed 44 platforms as it passed over the region, including some deepwater projects that were under construction. As Rita passed over, 93% of platforms were evacuated with the shut-in of 100% and 81% of normal daily oil and natural gas production, respectively. Sixty-nine platforms were destroyed by Hurricane Rita (Energy Information Agency 2006).

In addition to upstream impacts, the hurricanes had significant impacts on midstream and downstream infrastructure. Four hundred fifty-seven underwater pipelines were damaged, and the Louisiana Offshore Oil Port temporarily stopped accepting shipments during the 2005 storms. Some onshore crude oil refineries and natural gas processing facilities also suffered heavy damage. After Katrina hit Louisiana, nearly 2 million barrels per day of refinery capacity were shut down either due to direct damage or interruption of power supplies. More than 4.9 million barrels per day of refinery capacity were shut down after Hurricane Rita hit the Texas coast (Energy Information Agency 2006; *see also* MMS 2006b). Hurricanes Rita and Katrina resulted in the destruction of more than 100 platforms, which were all in shallow water except for a facility located in Green Canyon block 237 (French *et al.* 2006).

MMS recently issued NTL 2007-G18, which provides operators with additional guidance to ensure that production platforms, drilling and workover rigs, and other equipment and facilities on the OCS are secured during the 2007 hurricane season in the GoM.

PAI will utilize an FPSO which will have a single point mooring system which will allow for full passive weathervaning. The single point mooring system will have a disconnectable feature which will allow the FPSO to disconnect and motor away from named storms and hurricanes under her own power, returning for re-connection when it is safe to do so. The disconnectable feature provides a step change reduction in risk regarding the protection of people, the environment, and assets. After disconnection, the turret buoy (which is attached to the FPSO mooring lines, FSHRs, and umbilicals) will be left behind in a submerged condition out of harms way of the environment conditions at the surface. See Section 2(e) for a more detailed description of the FPSO disconnectable feature.

19(d).5 Operating Environmental Criteria for Product Offloading

PAI has defined more conservative environmental operating criteria for FPSO offloading relative to the maximum operational conditions for GoM lightering operations as specified in 33 CFR 156.320. Parameters for shuttle approach and connection as well as offloading are summarized in Table 2-7 located in Section 2(e).

19(e) Alternatives

PAI evaluated an alternative to installation of the gas export pipeline in Phase 1 during early conceptual design. Rather than seek MMS approval for low volume gas flaring for the early stages of Phase 1, PAI decided to install the gas export pipeline during the early stages of Phase 1 to eliminate such flaring. The gas export line will be ready for utilization at first oil production and will minimize impact to the environment.

19(f) Mitigation Measures

Section 1(f) describes the most important safety and pollution prevention features that PAI will utilize to mitigate the potential for any adverse effects to GoM resources. Such controls are generally aimed at minimizing the frequency and magnitude of oil spills. The effective implementation of such industry proven controls will effectively eliminate the potential for large oil spills which could have an impact to GoM resources.

19(g) Consultation and Coordination

Meeting Contacts

Minerals Management Service (MMS), 2006, Meeting between MMS Gulf of Mexico Region staff (Russell Hoshman; Michael Tolbert, Plans; Manny Gagliano, Pipelines; Ronald Bowser; Holly Karrigan; Christy Bohannon; Mike Conner, Field Operations; B.J. Kruse, Field Operations; Mike Saucier; Houma District; Bryan Domangue, Houma District; Glenn Woltman; Nick Wetzel, Plans; Carole Current, Leasing and Environment; Stephen Kovacs; Dennis Chew, Leasing and Environment; and Ed Richardson, NEPA lead) and PAI staff (Luiz Souza, FPU Production and Operation Manager; Gus Cassity, Phase 1 Coordinator; Mike Bigler, Corporate HSE Coordinator; Cheryl Saha, Land Manager; Partha Ganguly, Millennium Technical Consultants; Wanda Richmond, J. Connor Consulting, Inc.; and Carliane Johnson, Ecology and Environment, Inc.) on September 6, 2006 in New Orleans, LA to provide an introduction to the
Cascade / Chinook project and discuss the regulatory framework for FPSOs.

State of Louisiana, 2007, Meeting between Louisiana Department of Natural Resources (DNR) Coastal Management Division (CMD) staff (Brian Marcks; Jeff Harris; Agaha Brass; and Gregory DuCote) and PAI staff (Mike Bigler, Corporate HSE Coordinator and Carliane Johnson, Ecology and Environment, Inc.) on February 12, 2007 in Baton Rouge, LA to provide an introduction to the Cascade / Chinook project and to better understand any concerns by the State of Louisiana.

State of Texas, 2007, Meeting between State of Texas staff (Tammy Brooks, Texas General Land Office; Jesse Solis, Texas General Land Office; Leslie Savage, Railroad Commission of Texas; David Nuckels, Texas Department of Transportation; Jarrett (Woody) Woodrow, Texas Parks and Wildlife Department; and Cherie O'Brien, Texas Parks and Wildlife Department) and PAI staff (Mike Bigler, Corporate HSE Coordinator and Carliane Johnson, Ecology and Environment, Inc.) on March 19, 2007 in Austin, TX to provide an introduction to the Cascade / Chinook project and to better understand any concerns by the State of Texas.

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Table 19-10 identifies E&E representatives who contributed to the preparation of this EIA.

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Jennifer Harris	Planner	Socioeconomic Analysis
Anne-Elizabeth Warlick	Biologist	Coastal Zone Consistency Assessment
David Trimm	Fisheries Biologist	Fisheries
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20 Administrative Information

20(a) Exempted Information Description

PAI has determined that the following information in Table 20-1 is considered proprietary and will therefore not be included in the public version of the DOCD.

Table 20-1 – Proprietary Information

Description	Section
BHL, TVD, and MD information in Plan Information Forms	1(a)
Production rates	2(c)
Geological and geophysical information	3
Well information to justify Hydrogen Sulfide designation	4(b)

20(b) Bibliography

The following citations were used in the DOCD. This list excludes citations that were used in the EIA contained in Section 19.

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APPENDIX 1

SOP Activity Schedule

United States Department of the Interior

MINERALS MANAGEMENT SERVICE
Gulf of Mexico OCS Region
1201 Elmwood Park Boulevard
New Orleans, Louisiana 70123-2394

In Reply Refer To: MS 5322

July 31, 2006

Mr. Scott H. Cornwell
BHP Billiton Petroleum (GOM) Inc.
1360 Post Oak Blvd., Suite 150
Houston, Texas 77056

Dear Mr. Cornwell:

By letter dated July 26, 2006, BHP Billiton Petroleum (GOM) Inc. requests approvals for the proposed Walker Ridge Block 206 Unit (Cascade) and the Walker Ridge Block 425 Unit (Chinook). For each unit proposal, your submittal included three original executed copies of the Unit Agreement, two original executed copies of the Unit Operating Agreement, and requests for suspensions of production (SOP's). In addition, nonrefundable payments totaling $25,000 have been received. The proposed unit areas consist of the blocks and leases listed below.

Walker Ridge Block 206 Unit: Walker Ridge Block 205, Lease OCS-G 16964
Walker Ridge Block 206, Lease OCS-G 16965
Walker Ridge Block 249, Lease OCS-G 16969
Walker Ridge Block 250, Lease OCS-G 16970

Walker Ridge Block 425 Unit: Walker Ridge Block 425, Lease OCS-G 16987
Walker Ridge Block 426, Lease OCS-G 16988
Walker Ridge Block 469, Lease OCS-G 16997
Walker Ridge Block 470, Lease OCS-G 16998

We are also in receipt of supporting maps, cross-sections, and other technical data provided at our meeting on February 15, 2006, and the follow-up technical review on March 22, 2006.

We agree that both of the unit areas are logically subject to unitization and the formation of these units will ensure conservation of the natural resources of the Outer Continental Shelf, in accordance with 30 CFR 250.1300. The executed Unit Agreements are hereby approved effective May 1, 2006. The Walker Ridge Block 206 Unit and the Walker Ridge Block 425 Unit have been assigned Unit Agreement Numbers 754306012 and 754306013, respectively.

In accordance with Articles IX, XVI, and XVII of the Unit Agreements and 30 CFR 250.174, we hereby approve SOP's for the Walker Ridge Blocks 206 and 425 Units from August 1, 2006, through November 30, 2007. You are expected to follow the enclosed SOP activity schedule and

TAKE PRIDE IN AMERICA

to notify this office in writing (progress report) by the end of each month in which a deadline is scheduled. The SOP activity schedule and any approved revisions made thereto will satisfy the Article 9.3 requirements of each Unit Agreement for a plan of operations. As each unit commences production, individual plans of operations pursuant to the Unit Agreement will be required on an annual basis.

Enclosed for each unit is an approved copy of the Unit Agreement with our Certification-Determination bearing the Unit Agreement number and a copy of the Unit Operating Agreement. Thank you for your submittal, and if we can be of further assistance, please contact Mr. Mark Hanan at (504) 736-2650.

Sincerely,

J. Michael Melancon
Regional Supervisor
Production and Development

Enclosures

ACTIVITY SCHEDULE/PLANS OF OPERATIONS
WALKER RIDGE BLOCK 206 UNIT (CASCADE PROSPECT)
WALKER RIDGE BLOCK 425 UNIT (CHINOOK PROSPECT)

ACTIVITY	DEADLINE
Complete Concept Engineering and Commence Definition Engineering for Cascade Phase I.	October 2006
Commence Procurement of Cascade Phase I Long Lead Subsea Equipment.	March 2007
Award Cascade and Chinook Christmas Tree and Subsea Control System Contract.	May 2007
Complete Cascade Phase I FEED and Commence Chinook Concept Engineering.	June 2007
Award FPSO Contract and Drilling Rig Contracts for Cascade and Chinook. **(SOP's for Walker Ridge Blocks 206 and 425 Units expire November 30, 2007)**	November 2007
Award Cascade Phase I Subsea Equipment Long Lead Supply and Installation Contracts.	January 2008
Award Cascade and Chinook Shuttle Tanker Supply Contract.	March 2008
Commence Cascade and Chinook FPSO Modifications.	September 2008
Award Cascade and Chinook Gas Export Supply, Construction and Installation Contract, and Commence Chinook Definition Engineering and Facilities Procurement.	November 2008
Commence drilling Cascade Phase I Development Well No. 1.	January 2009
Award Chinook Tie-back Pipeline Installation Contract (Chinook to Cascade Pipeline).	March 2009
Order Chinook Christmas Trees, and Commence Installation of Cascade Phase I Facilities.	July 2009
Commence drilling Chinook Development Well No. 1.	September 2009

Commence production from Cascade.	November 2009
Award Chinook Tie-back Pipeline Construction Contract.	January 2010
Commence Completion Operations on Chinook Development Well No. 1.	November 2010
Commence Installation of Chinook Riser, Pipeline, Umbilicals, and Subsea Equipment.	December 2010
Commence production from Chinook.	April 2011

APPENDIX 2a

GEMS Summary of Environmental Conditions for Cascade and Chinook

GEOSCIENCE EARTH & MARINE SERVICES, INC.
GEMS

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June 10, 2007

Summary of Environmental Conditions for the Petrobras America Inc. Cascade and Chinook Field Developments

Introduction

Petrobras America Inc. (PAI) intends to co-develop their Cascade and Chinook field developments, located in the Walker Ridge area, Gulf of Mexico. Chinook will be a subsea completion that ties back to the Cascade development via tie-back flowlines and associated umbilicals. Cascade will utilize a split-development production system. The first phase of this system will implement the use of a Floating Production Storage and Offloading unit (FPSO), the first of it's kind for the Gulf of Mexico. Two drill centers will tie-back to free-standing risers, coupled to the FPSO turret, via infield flowlines and associated umbilicals. Formation fluids will be processed and stored on the FPSO for transmission to offloading tankers. Produced gas is intended to be routed via a gas export pipeline. The export pipeline routes are intended to tie-in to the existing Mardi Gras and Anaconda pipeline infrastructure in Green Canyon Blocks 829 and 606, respectively. The second phase of the program, some years down the road, tentatively call for replacement of the FPSO with a permanent Floating Production Unit (FPU).

Co-developing Chinook and Cascade, through the implementation of a central FPSO, a first in the Gulf of Mexico, requires an in-depth evaluation of the geologic, geotechnical, engineering, and environmental considerations. Petrobras recognizes that proposing the first-use of an FPSO in the Gulf of Mexico provides increased visibility to the project, which in turn, must be met with added diligence in both acquiring and reviewing engineering and environmental conditions such that there is no conflict between the engineering needs of the development and the need and requirement to protect and preserve the environment. This short report provides a summary of the results of the data analyses as it relates to environmental condition as well as background on the data acquired by PAI to meet that goal.

Available Data

PAI, in conjunction with Geoscience Earth and Marine Services, Inc. (GEMS), designed both the geophysical and geotechnical data acquisition programs for Chinook, Cascade, and the Cascade Gas Export Routes. The objectives of the program were too provide excellent geophysical and geotechnical datasets with which to assess the geologic, geotechnical, and environmental conditions in the respective development areas. This in turn ultimately leads to "getting it right" the first time. Geologic and geotechnical conditions are captured to develop best-designed engineering solutions within the field development concept. Environmental and process conditions are identified such that the field development concept engineering and layout is implemented in a manner that follows both regulatory and best-practice methodologies.

Geophysical data available for assessing environmental conditions at the developments consists of both 3D seismic data and 2D High-Resolution Hugin AUV survey data. The 3D data was provided by PAI. The 2D High-Resolution survey was designed to provide coverage over the entire footprints of the Chinook, Cascade, and Cascade Gas Export field architecture. Even as the field architecture was changing during survey, the survey was modified to ensure complete coverage and meet federal requirements for a survey of this type.

Geotechnical data that has been collected consists of box core, 20 ft piston core, Jumbo Piston Core (JPC), Rotary Soil Borings, and Seabed and downhole Wisson Piezo-Cone Penetrometer (PCPT). The sample locations and criteria were selected to meet both regulatory and internal engineering requirements for soil samples to conduct proper engineering of the subsea field architecture. These data also provide ground-truthing to the environmental assessment from the geophysical interpretations and provide a measure of confidence that the assessed conditions from the geophysical data are consistent and accurate.

Together, this is an excellent dataset to assess the geologic, geotechnical, and environmental conditions at the Chinook, Cascade, and Cascade Gas Export development areas, as is evident from the attached GEMS Phase I Integrated Report for Cascade and Chinook. The body of work in that report forms the basis for the summary assessments for each segment of the development contained in the following paragraphs.

Primary Environmental Concerns

A primary concern in the development of any subsea field is the avoidance by the field architecture of biologically sensitive areas defined and protected by the U.S. Federal Dept. of the Interior Minerals Management Service (MMS). In the deepwater Gulf of Mexico, the primary concern is the protection of chemosynthetic organisms and fragile benthic habitats. There is precedent to employ the use of 3d seabed peak seismic amplitude data to infer the presence of conditions that may be conducive to chemosynthetic communities and sensitive benthic habitats. We have reviewed the 3d seismic coverage provide by PAI. However, we defer to the available High-Resolution 2d data.

The High-Resolution geophysical data consists of multibeam bathymetry (3m bins), side-scan sonar, and chirp subbottom profiler data. These data provide information on the character of seabed reflectance which is inferred to be soil type or soil hardness. This is excellent for identifying areas of potential harder substrate that may be an indication of the presence of chemosynthetic organisms or sensitive habitat. The subbottom profiler provides further evidence for harder substrate, or, hydrocarbon indicators necessary as the source for chemosynthetic communities. The multibeam bathymetry also provides indirect evidence for hydrocarbon mounds or organic mounds from the topography of the seafloor. Used in combination, these data provide the best geophysical means to identify and define areas where there is potential for chemosynthetic communities to occur and forms the basis for the assessment of the seabed and shallow conditions with respect to the protection of these sensitive benthic communities.

Cascade Development Assessment

The Cascade development will consist of an FPSO with associated anchors and riser bases, infield flowlines and umbilicals, as well as two drill centers. The multibeam data reveal a scoured and eroded seabed where the Cascade infrastructure is planned to be developed. The seabed is comprised of furrows and flukes resulting from seabed currents. The darker areas on the side-scan data correspond with outcrops of firmer strata exposed by erosion due to the periodic strong currents in the area. The subbottom data confirms the side-scan revealing generally parallel and continuous clay stratigraphy that is eroded at the seabed. There are no hydrocarbon indicators suggesting hydrocarbon migration or seepage near the planned field development. Several gas expulsion mounds are observed in the northeast portion of WR 160, but are several miles away from any field architecture and will not be impacted by the development of the Cascade filed.

Geotechnical soil samples consisting of box core, 20 ft piston core, JPC, and 40m Seabed PCPT, have been collected throughout the Cascade area. The soils in the area are generally very soft to soft, highly plastic, normally consolidated clays. The soils are fairly uniform over the province as is expected from soils that have been differentially eroded due to currents. None of the samples acquired contained significant gas or oil, or, recovered any biologically derived material beyond foraminiferal sands with some shell fragments. The foram sands and shell fragments are common below the Sigsbee Escarpment in seabed current erosion zones. The geotechnical data correlates well with the geologic observations from the AUV data of erosion and exposure of older, stronger strata.

Apart from the mounds observed in WR 160 there does not appear, in the geophysical or geotechnical data, to be shallow gas or active venting of fluids to the seafloor in this province. Seafloor currents have, and continue to, erode and redeposit the seabed sediments below the Sigsbee Escarpment. It is unlikely that organisms would find suitable locations with the necessary firm substrate to anchor themselves to the seabed and therefore, the potential for encountering chemosynthetic communities is remote.

Chinook Development Assessment

The Chinook development will be a complete sub-sea completion that ties back to Cascade via a set of tie-back flowlines. The multibeam bathymetry data reveals a scoured and eroded seabed. The seabed is comprised of furrows and anti-dunes, both resulting from seabed currents. The sidescan confirms the multibeam, revealing furrows and illustrating eroded stratigraphy exposed at the seabed. There are no indications of mounds, expulsion features, or stronger reflectance suggestive of more granular or hard substrate. The subbottom profiler shows generally parallel and continuous clay stratigraphy that is eroded at the seabed. There are no hydrocarbon indicators suggestive of hydrocarbon migration and seepage. Geotechnically, the soils have been sampled by box core, 20 ft piston core, JPC, and 40m Seabed PCPT. None of the samples acquired contained significant gas or oil, or, recovered any biologically derived material beyond foraminiferal sands with some shell fragments. The foram sands and shell fragments are common below the Sigsbee Escarpment in seabed current erosion zones.

With the presence of periodically strong currents, absence of evidence for hard substrate or existing chemosynthetic communities, and no significant hydrocarbon indicators, there is no potential for the Chinook development area to contain environmentally sensitive areas.

Cascade Gas Export Routes

An autonomous underwater vehicle (AUV) survey was conducted to assess the seabed and shallow geologic conditions within the two export rout options. The survey was designed to acquire data for identifying geologic and environmental constraints to pipeline engineering. The survey meets or exceeds the requirements set forth in Notice-to-Lessees 2007-G01. The multibeam swathe bathymetry was binned at 3m. The sidescan sonar was reviewed and mosaicked at 1.0m resolution. The chirp subbottom profiler provides an assessment of the shallow stratigraphy do a depth of ~ 125 ft below the seafloor (bsl). GEMS is in the process of producing a comprehensive shallow hazards report for both route options which will also address the possibility for chemosynthetic communities within 500 ft. of each pipeline location. Presented here is a summary of conditions along the pipeline routes.

Cascade Gas Export Route Option 1:

The Cascade Gas Export Route Option 1 is planned to start at the Cascade FPSO located in Walker Ridge block 149 and end in Green Canyon block 829. The route is below the Sigsbee Escarpment along its entire length. The seabed consists of flukes indicative of erosion by bottom currents and hummocks indicative of shallow buried slump and landslide deposits. The sidescan confirms the multibeam, revealing eroded stratigraphy exposed at the seabed and amorphous to chaotic reflections buried beneath more recent parallel and continuous clay stratigraphy. There are no indications of mounds or hydrocarbon indicators suggestive of hydrocarbon migration and seepage within the route corridor. The soils along the route have been sampled by box core and 20 ft piston core. None of the samples acquired contained significant gas or oil, or, recovered any biologically derived material beyond foraminiferal sands with some shell fragments. The foram sands and shell fragments are common below the Sigsbee Escarpment in seabed current erosion zones.

Below the Sigsbee Escarpment seabed seafloor currents have, and continue to, erode and redeposit the seabed sediments. It is unlikely that organisms would find suitable locations with the necessary firm substrate to anchor themselves to the seabed and therefore, the potential for encountering chemosynthetic communities within route option 1 is considered remote.

Cascade Gas Export Route Option 2:

The Cascade Gas Export Route Option 2 is planned to start at the Cascade FPSO located in Walker Ridge block 149 and end in Green Canyon block 605. At the start of the pipeline the seabed consists of flukes and furrows indicative of erosion by bottom currents. The sidescan and the multibeam reveal eroded stratigraphy exposed at the seabed. There are no indications of mounds or hydrocarbon indicators suggestive of hydrocarbon migration and seepage within the route corridor. The soils along the route have been sampled by box core and 20 ft piston core. None of the samples acquired contained significant gas or oil, or, recovered any biologically derived material beyond foraminiferal sands with some shell fragments. The foram sands and shell fragments are common below the Sigsbee Escarpment in seabed current erosion zones.

The route is planned to cross the Sigsbee Escarpment. It is difficult to distinguish, in the side-scan data areas of potential chemosynthetic communities from outcrops of older, firmer strata as both will display a darker texture in the mosaic. Previous ROV studies, in other areas, have observed very local, small, dense chemosynthetic communities on the steep slopes of the Escarpment. When necessary to place subsea architecture on the Escarpment, operators in the past have selected to perform site specific ROV investigations to confirm the sites are clear. PAI will perform an ROV survey of the areas if this routing option is chosen.

APPENDIX 2b

GEMS Shallow Hazards Report for Facilities

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Seafloor and Geologic Assessment Cascade and Chinook Development Areas Blocks 160-162, 203-208, 247-252, 293-295, 337-338, 381-382, 425-426, & 469-470 Walker Ridge Area Gulf of Mexico

Report submitted to
Petrobras America Inc.
Houston, Texas
by
Geoscience Earth & Marine Services®, Inc.
Houston, Texas

PUBLIC COPY

Project No. 0106_1257b

GEOSCIENCE EARTH & MARINE SERVICES, INC.®

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June 6, 2007

Project No. 0106_1257b

Petrobras America Inc.
Walker Ridge EPS-Subsea Engineering
2101 City West Blvd. Bldg 3, Suite 300
Houston, Texas 77042

Attention: Mr. Kazuhiko Kochi

SEAFLOOR AND SHALLOW GEOLOGIC ASSESSMENT
CASCADE AND CHINOOK DEVELOPMENT AREAS
BLOCKS 160-162, 203-208, 247-252, 293-295, 337-338, 381-382, 425-426, & 469-470
WALKER RIDGE AREA, GULF OF MEXICO

Geoscience Earth & Marine Services®, Inc., (GEMS) is pleased to provide Petrobras America Inc. (PAI) with our geophysical and geotechnical evaluation of the Cascade and Chinook development areas in the Walker Ridge Area (WR) of the Gulf of Mexico. The purpose of this report is to define seafloor and shallow geologic/geotechnical conditions and constraints relevant to future development of the Cascade and Chinook areas, as well as along proposed tie-back and export flowlines and umbilicals routes. The Cascade development is composed two drill centers, located in WR Blocks 206 and 249, that tie-back to a floating production, storage, and offloading vessel (FPSO) in WR Block 249, having anchors in WR Blocks 250, 293, and 294, and pipelines and umbilicals traversing portions of WR Blocks 206, 249, 250 293, and 294. The Chinook development is composed of a drill center located in WR Block 425. Dual flowlines, with associated umbilicals, crossing WR Blocks 293, 337, 371, and 425, will tie-back ~11.5 miles to the Cascade FPSO.

The report complies with requirements set forth by the United States Minerals Management Service (MMS) in government publications Notice-to-Lessees 2000-G20 (MMS, 2000), Notice-to-Lessees 2002-G01 (MMS, 2002), and Notice-to-Lessees 2007-G01 (MMS, 2007). This report is in accordance with Purchase Order 7000000549 dated 14 November, 2006. We appreciate the opportunity to be of service to PAI on this project and look forward to working closely with you as this landmark project progresses.

Sincerely,

GEOSCIENCE EARTH & MARINE SERVICES®, INC.

James F. Keenan
Geoscientist

John R. Brand, Ph. D
Senior Geologist / Projects Manager

Michael J. Kaluza
President

Distribution: Mr. Kazuhiko Kochi, Petrobras America Inc., Houston, Texas (5)

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SUMMARY

Petrobras America Inc. (PAI) contracted Geoscience Earth & Marine Services®, Inc., (GEMS) to evaluate the geologic and stratigraphic conditions in the Cascade and Chinook development areas in Walker Ridge (WR), Blocks 160-162, 203-208, 247-252, 293-295, 37-338, 381-382, 425-426, and 469-470. The purpose of this study was to assess the seafloor and shallow geologic conditions at the planned floating production, storage, and offloading (FPSO) facility in WR 249, at the Cascade and Chinook drill centers in WR 206, 249, and 425, along infield pipelines and umbilicals in portions of WR Blocks 206, 249, 250 293, and 294, and along the proposed flowline and umbilical routes between the Chinook drill center in WR 425 and the FPSO in WR 249. The study was conducted using AUV, 3-D seismic, and shallow geotechnical to assess the upper 150 ft BML of sediment in the Cascade and Chinook development areas.

General Conditions in the Cascade Development Area

- The geologic and geotechnical conditions observed at Chinook appear favorable for field development.
- Water depths in the Cascade Development area range from 5,637 ft in the northeastern corner of WR 247 to 8,510 ft in the north-central part of WR 338.
- The area consists of three geomorphologic provinces, the Lower Continental Slope, the Sigsbee Escarpment, and the Upper Continental Rise with the Escarpment crossing the northeastern portion of the area.
- The proposed Cascade facilities will be placed below the Escarpment on the Upper Continental Rise.
- The seafloor above the Escarpment, on the Lower Continental Slope, is generally smooth and featureless. The Escarpment seafloor is rugged. The seafloor below the Escarpment is irregular due to seabed furrows and flukes.
- Seafloor gradients range from near 0° above the Sigsbee Escarpment on the Lower Continental Slope to approximately 70° along the steeper portions of the Escarpment. The Upper Continental Rise has a low general gradient, however, furrows and flukes results in locally high gradients.
- The seafloor and shallow stratigraphy over the area consists generally of parallel bedded hemipelagic clays. Local slump deposits exist at the base of the Escarpment and sands are present along the floors of the furrows.
- Periodic strong seabed currents are responsible for the formation of the furrows and flukes on the Upper Continental Rise. Evidence of significant erosion is also evident on both the Escarpment and Lower Continental Rise. PAI is aware of these conditions and is addressing the placement of seafloor architecture in these areas from a siting and design standpoint.
- Past slope instability along the Escarpment has resulted in deposition of debris aprons which extend up to 1 mile downslope of the base of the Escarpment. The nearest proposed facility to the Escarpment is the Cascade East drill center located approximately 1 mile downslope of the Escarpment. PAI intends to conduct a future, detailed slope stability of the Escarpment with respect to locations of the Cascade facilities.
- Several gas expulsion mounds are identified on the Lower Continental Slope in northeastern WR 160, miles away from the proposed facilities.
- In the area of the Upper Continental Rise, where the Cascade facilities are planned, there are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact field development.

- There is no potential for encountering chemosynthetic communities near the planned infrastructure.

General Conditions in the Chinook Development Area

- The geologic and geotechnical conditions observed at Chinook appear favorable for field development.
- Water depths in the Chinook Development area range from 8,607 ft in the northwestern corner of WR 425 to 9,260 ft in the southeastern corner of WR 470.
- Seafloor gradients range from close to 0° over much of the southwestern two-thirds of the area with locally high gradients, approaching 50°, along the sides of furrows in the northeastern third of the area.
- The shallow stratigraphy over the area consists generally of parallel bedded differentially eroded hemipelagic clays. Sands are present along the floors of the furrows.
- Seafloor furrows are present in the north and seafloor anti-dunes are present in the south and southeastern portion of the area. Periodic strong seabed currents are responsible for the formation of the furrows and anti-dunes.
- There are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact field development.
- There is no potential for encountering chemosynthetic communities in this area.

General Conditions in the Chinook Pipelines Tie-Back Corridor

- The geologic and geotechnical conditions appear favorable for flowline installation and performance with appropriate engineering design.
- There are two proposed tie-back pipelines routes and one production umbilical in a corridor between the Chinook development area in WR 425 and the planned Cascade FPSO in WR 249.
- Water depths in the corridor range from -8,820 ft at the planned Chinook wellsite to -8,170 ft at the end of the pipeline route near the Cascade FPSO facility.
- The shallow stratigraphy over the area generally consists of differentially eroded parallel-bedded hemipelagic clays. Sands are present along the floors of the furrows.
- Seabed gradients in the corridor range from nearly 0° to locally approaching 32° along the sides of furrows. The average gradient along the west and east tie-back routes is 9° and 10° respectively.
- Irregular seafloor consisting of anti-dunes, furrows, and flukes are present at various locations along the entire length of the corridor.
- Sonar Contact No. 24 lies very near the proposed East Gas Pipeline Route at about Sta. 385+37.94. This target, which has no measurable height, is 4-ft wide, and 10-ft long, and may be modern debris. No other sonar contacts lie directly along the proposed pipeline or umbilical routes.
- ROV pre-lay survey will confirm the presence of the identified potential man-made debris with respect to Sonar Contact No. 24. The debris can be removed if necessary.
- There are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact pipeline lay operations. The potential for encountering chemosynthetic communities is remote.

SECTION 1: INTRODUCTION

Petrobras America Inc. (PAI) is evaluating development of the Cascade and Chinook fields in the Walker Ridge protraction area (WR) in the Gulf of Mexico (Figures 1 and 2). PAI has proposed placing a floating production, storage, and offloading facility (FPSO) in Block 249 that will service production from the Cascade and Chinook drill centers. The Chinook drill center will be a sub-sea tie-back to the Cascade FPSO. The FPSO will also export produced gas along a future gas export pipeline route. Included in this report is an assessment of the general shallow geologic and geotechnical conditions and engineering constraints in the Cascade and Chinook development areas, and, along the proposed Chinook tie-back and Cascade FPSO gas export pipeline routes.

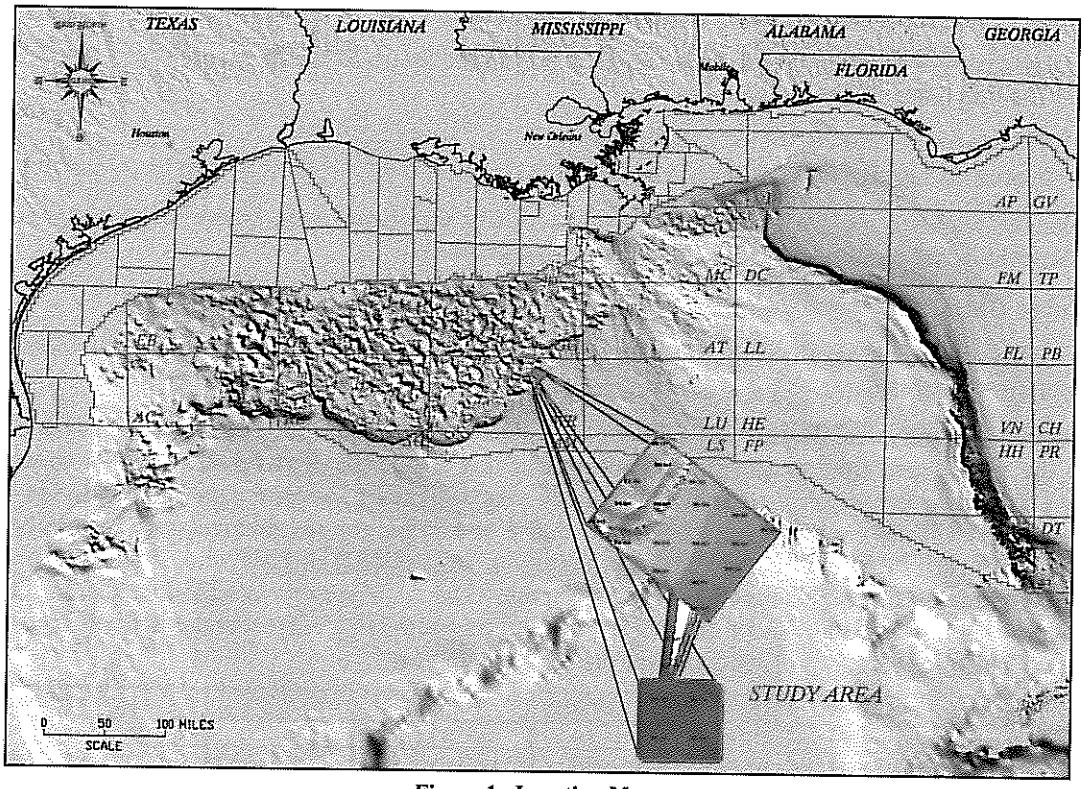


Figure 1. Location Map.

The Cascade and Chinook development areas, and the tie-back corridor, encompass the following Federal lease blocks in the north-eastern portion of the Walker Ridge area:

Block 117 (OCS-G-21846)
Block 160 (OCS-G-21854)
Block 161 (OCS-G-18651)
Block 162 (Relinquished)
Block 203 (OCS-G-23038)
Block 204 (OCS-G-18658)
Block 205 (OCS-G-16964)
Block 206 (OCS-G-16965)
Block 207 (OCS-G-20297)
Block 208 (Open)
Block 247 (OCS-G-20305)
Block 248 (OCS-G-18669)
Block 249 (OCS-G-16969)
Block 250 (OCS-G-16970)
Block 251 (OCS-G-18670)
Block 252 (Open)
Block 292 (OCS-G-20309)
Block 293 (OCS-G-18681)
Block 294 (OCS-G-18682)
Block 295 (Open)
Block 337 (Open)
Block 338 (Open)
Block 381 (Relinquished)
Block 382 (Relinquished)
Block 425 (OCS-G-16987)
Block 426 (OCS-G-16988)
Block 469 (OCS-G-16997)
Block 470 (OCS-G-16998)

Purpose

This study identifies the seafloor and shallow subsurface geologic and geotechnical conditions and evaluates engineering constraints within the Cascade and Chinook development areas. This report also provides identification of conditions and evaluations of constraints specific to the Cascade drill centers, FPSO riser bases and anchors, and infield flowlines and umbilicals, as well as at the Chinook drill center, the proposed tie-back pipeline corridor between the two development areas, and along two possible Cascade FPSO gas export pipeline options.

The results of this study will assist PAI in the planning of all seafloor and shallow-founded architecture within, and between, the Cascade and Chinook development areas. This report can also be used for permitting of the tie-back flowline and umbilical route.

The report complies with requirements set forth by the United States Minerals Management Service (MMS) in the following government publications:

- Notice-to-Lessees 2000-G20 (MMS, 2000)
- Notice-to-Lessees 2007-G01 (MMS, 2007a)

The planned facilities are not located within a historically significant area, where archaeological surveys and assessments are required per NTL 2006-G07 (MMS, 2006).

Available Data

This assessment results from the analysis of both proprietary data specific to the development areas and publicly available data.

Proprietary Geophysical Data. An autonomous underwater vehicle (AUV) survey was conducted to assess the seabed and shallow geologic conditions in this area. GEMS worked with PAI to design the survey layout over the respective areas. The survey was designed to acquire data for identifying geologic constraints to facilities engineering. The survey meets or exceeds the requirements set forth in Notice-to-Lessees 2007-G01. PAI contracted C&C Technologies, Inc., (C&C) of Lafayette, Louisiana, to conduct the data acquisition for the planned geophysical survey. The AUV survey was conducted from December 12, 2006 to January 26, 2007 and collected 1,770 miles of multi-beam echo sounder bathymetry, side-scan sonar, and chirp subbottom profiler data over the following areas:

Area	Total Line Miles	# Inlines	Spacing (m)	# Tie-Lines	Spacing (m)
Cascade Development	1124.60	74	200	31	600
Chinook Development	472.00	67	200	33	400
Chinook Tie-Back Corridor	278.00	13	centers, 50m offset, 100	2	6,800

Table 1. Table of AUV data coverage.

The multibeam swathe bathymetry was binned at 3m. The sidescan sonar was reviewed and mosaicked at 1.0m resolution. The chirp subbottom profiler provides an assessment of the shallow stratigraphy do a depth of ~ 125 ft below the seafloor (bsl).

In addition to the AUV data PAI provided a 3-D exploration seismic depth volume in a SEG-Y format to assist in the study. These data cover approximately 163 square miles in the Walker Ridge area including all or portions of Blocks 160-163, 204-207, 248-251, 293-295, 338, 339, 382, 383, 426, 427, 470, and 471 (Figure 2, page 3, and Figure 3, page 5). The 3-D volume has an inline spacing of 65.62 ft, a crossline spacing of 81.18 ft, was sampled at 16 ft increments, and has a record length of 48,000 ft (0 to 48,000 ft).

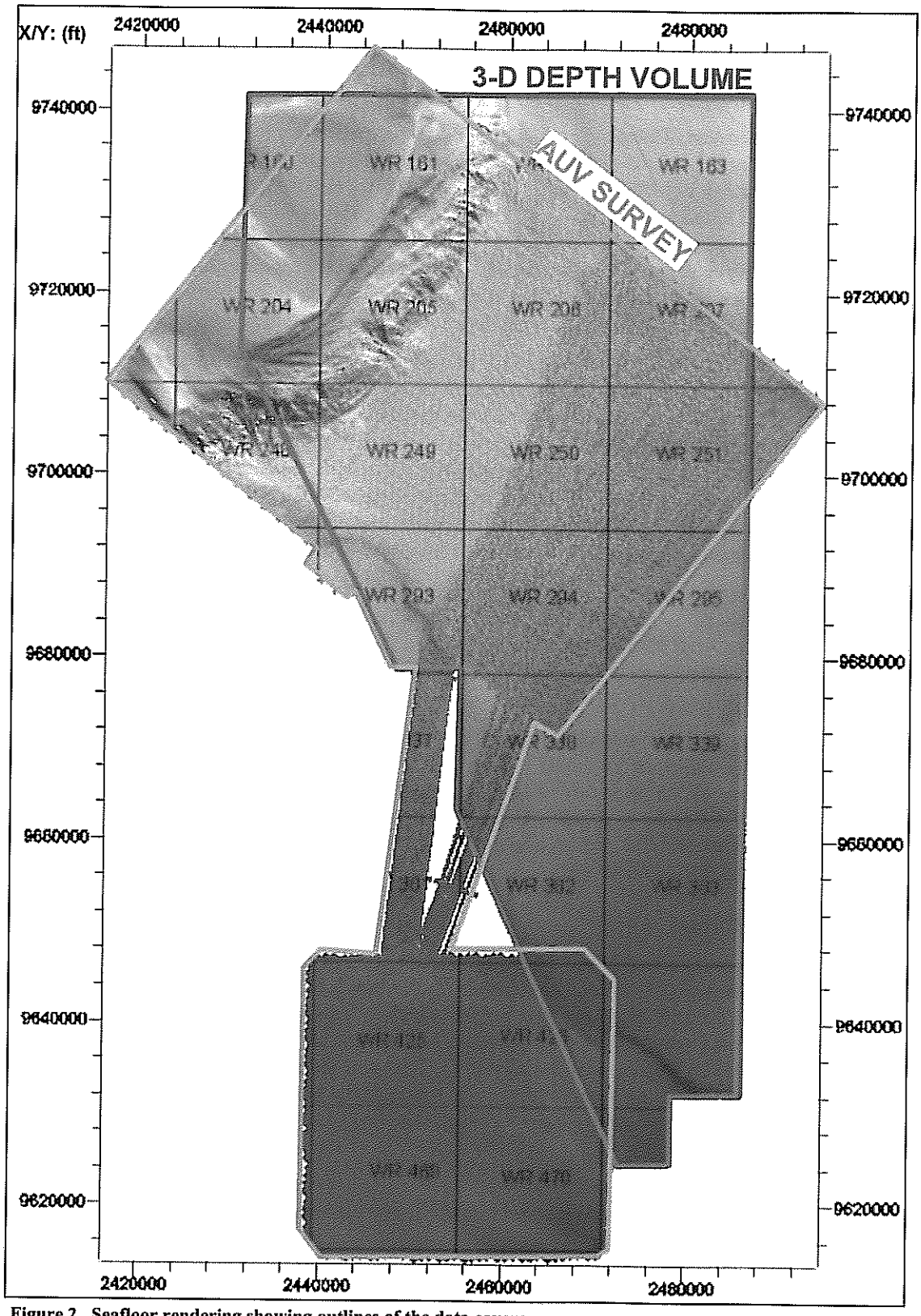


Figure 2. Seafloor rendering showing outlines of the data coverage.

The 3-D data was used to push the geologic interpretations from the AUV survey deeper and ensure complete review of the potential shallow foundation zone. The data confirmed the observations of the AUV and provided information on deeper stratigraphy as well as geologic structure of the Escarpment, the latter of which is essential for planning geotechnical programs for future slope stability studies.

Proprietary Geotechnical Data. GEMS planned a geotechnical program that would define the geotechnical properties throughout the Cascade-Chinook Development areas to support facilities layout and engineering. The primary objective of this study was to process and interpret the appropriate geotechnical data as required to: 1) define the spatial soil conditions along the various pipeline segments and mudmat locations; 2) interpret soil parameters needed for pipeline, SCR, and mudmat foundation analyses; 3) make recommendations relative to spatial soil variability and relevant soil properties that should be considered in the foundation analyses to be performed for the planned production infrastructure; and 4) integrate with existing geophysical data to assess overall feasibility of the proposed field layout.

The scope of the project was to acquire seafloor soil samples with the piston corer and 0.5 m box corer around the proposed Cascade-Chinook Development and perform geotechnical laboratory testing. TDI-Brooks collected 58 piston cores and 57 box cores for the Cascade-Chinook Development in Walker Ridge and Green Canyon Areas for PAI in November and December of 2006. The piston core samples were obtained using a maximum 20-ft long core barrel with an outside diameter of approximately 3.0 in. A 0.3x0.3x0.5 m box corer was used to collect mudline samples. Core locations and water depths are included on the individual cores logs that follow this report in Appendix B. TDI-Brooks provided a map of core locations for each leg of the investigation which are also reproduced in Appendix B.

The field investigation was conducted in two legs: the first leg occurred from 25 October to 10 November 2006 using the R/V *Justo Sierra,* and the second leg occurred from 10 to 18 December 2006 using the R/V *Ferrel.* Water depths at the core locations ranged from 4,187 to 8,794 ft. Navigation of the vessel was provided with dual differential GPS signals: Thales Geosolutions (Racal) Skyfix and US Coast Guard DGPS.

Public Data. The regional framework for this study was established by referencing public sources such as the MMS and various published technical papers. References are included in Appendix C. GEMS has compiled a database of information including Federal lease blocks of reported chemosynthetic communities, shallow water flow, shipwrecks, obstructions, and infrastructure. Regional bathymetry data is from the National Oceanic and Atmospheric Administration (NOAA) swath bathymetry with additional data from the Texas A&M Sea Grant program.

Project Responsibilities

The field operations and office reporting were conducted under the management of GEMS. Dr. John Brand was the overall GEMS project manager for this project. C&C conducted the AUV geophysical data acquisition from the *M/V* Northern Resolution. The C&C Technologies field party manager was Mr. Chas Honea. PAI contracted GEMS to provide QA/QC for the field operations and to interpret all collected data. Mr. James Keenan was the GEMS QA/QC personnel on the vessel. Mr. Keenan was also the lead geologist performing the interpretations and report of the geophysical data. Dr. Brand, Mr. Sanjay Shinde, and Ms. Jill Rivette reviewed the geotechnical data and contributed to the integrated reporting.

Report Format

The remainder of this report is divided into the following sections:

Section 2:	Regional Geologic Setting	Page 6
Section 3:	Shallow Geologic Conditions in the Cascade Development Area	Page 14
Section 4:	Shallow Geologic Conditions in the Chinook Development Area	Page 30
Section 5:	Shallow Geologic Conditions of the Chinook	

	Tie Back Pipeline Corridor	Page 35
Section 6:	Findings and Recommendations	Page 39

Appendices follow the main text of this report. Appendix A contains tables and images of the side-scan sonar targets. Appendix B contains the geotechnical core logs. Appendix C is a list of the references cited. Appendix D describes the mapping and interpretive procedures performed for this assessment. Appendix E contains the Vessel and AUV geophysical survey information. Full-size maps are folded and placed in pockets at the end of each section of the report.

SECTION 2: REGIONAL GEOLOGIC SETTING

The Cascade and Chinook development areas are on the Upper Continental Rise, just west of the continental slope edge, in the northeastern portion of the Walker Ridge protraction area (Figures 1 and 2). The Sigsbee Escarpment delineates the boundary between the continental rise and the continental slope and occupies the northwestern portion of the Cascade area (Figures 1 and 2). The escarpment is the expression of the lobate frontal edge of allochthonous salt masses which form a complex system of salt ridges, overthrust tongues, and steep-sided massifs (Martin and Bouma, 1978). Upslope of the Escarpment the Lower Continental Slope displays a hill and basin seafloor morphology. Below the Escarpment the continental rise is relatively flat but does display a scalloped and furrowed seafloor due to erosion from bottom currents. The following section defines the study area within the context of the regional morphological and geologic conditions. Man-made features, including exploration and production activity in the general area, are also discussed.

Location

The Cascade and Chinook development areas are approximately 132 and 150 nautical miles south-southwest of New Orleans, Louisiana respectively, (Figure 1). The survey areas includes three distinct geomorphologic regions: (1) The Lower Continental Slope, (2) The Sigsbee Escarpment and, (3) The Upper Continental Rise (Figures 3 and 4).

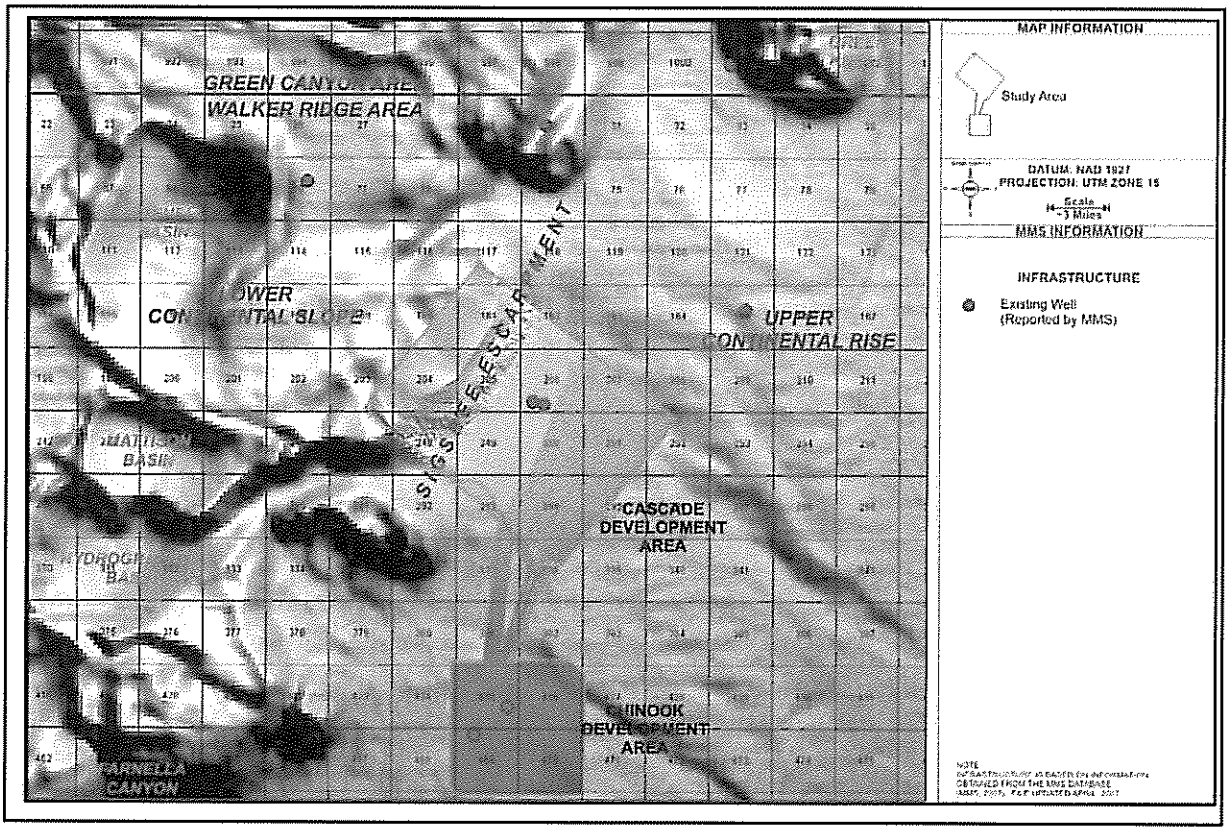


Figure 3. Regional seafloor rendering of the northwestern Walker Ridge area showing the development areas in relation to major seafloor topographic features.

PROPRIETARY

Figure 4 illustrates the basic stratigraphy and structure of the different provinces. These provinces are discussed in the following sections.

Lower Continental Slope

Much of the Lower Continental Slope along the northern Gulf of Mexico margin lies within the Tabular Salt-Minibasin Province as defined by Diegel et al., (1995). This province is described as a region containing extensive salt sheets with intervening deepwater, sediment-filled basins. This morphology is consistent to the southern edge of the province, which is the Sigsbee Escarpment.

Structure. Salt tectonics is the dominant process controlling the geologic structure of the Lower Continental Slope. A thick accumulation of the Jurassic aged (160 to 140 million years, B.P.) Louann Salt layer underlies much of the Texas-Louisiana continental slope (Lehner, 1969). Initial deformation of the salt layer occurred in the Eocene (55 to 37 million years, B.P.) to early Oligocene (37 million years, B.P.) sediments began the initial deformation of the salt. Additional loading of the salt during the lower and middle Miocene (14 to 2.3 million years, B.P.) caused a remobilization of the salt and created spreading across the slope in the form of large amalgamated salt canopies seaward to the Sigsbee Escarpment. The salt masses attempt to achieve isostatic equilibrium with the surrounding sediments, forcing both horizontal and vertical responses. Updip extensional regions are characterized by growth (extensional) faulting. Downdip contractional regions exhibit folding and thrusting at the base of the slope.

The mobilization of the salt affected the surrounding sediments by causing deformation (e.g., faults and/or folds) and by placing a structural control on subsequent sediment depositional patterns. Topographic highs can block the downslope transport of sediments. Structural lows around diapirs or salt ridges can act as conduits for the transport of sediment downslope and out onto the continental rise. Salt withdrawal basins (Intraslope Basins) can act as traps for the ponding and accumulation of large volumes of sediment (Apps et al., 1994).

Stratigraphy. Most of the shallow stratigraphy on the Lower Continental Slope is correlated to the Pleistocene (1.8 million years to 11,550 years B.P.) Mississippi River. The Pleistocene Mississippi River depositional province spans a large portion of the central Gulf of Mexico and has been classified into two major depositional systems: the Western Deposystem and the Eastern Deposystem (Winker and Booth,

2000), Figure 5. Shifts in the depositional focus of the Mississippi River have been attributed to sea level fluctuations and river meander, which has had a direct impact on the facies assemblages observed across the continental slope (Prather et al., 1998; Winker and Booth, 2000; Damuth et al., 2003).

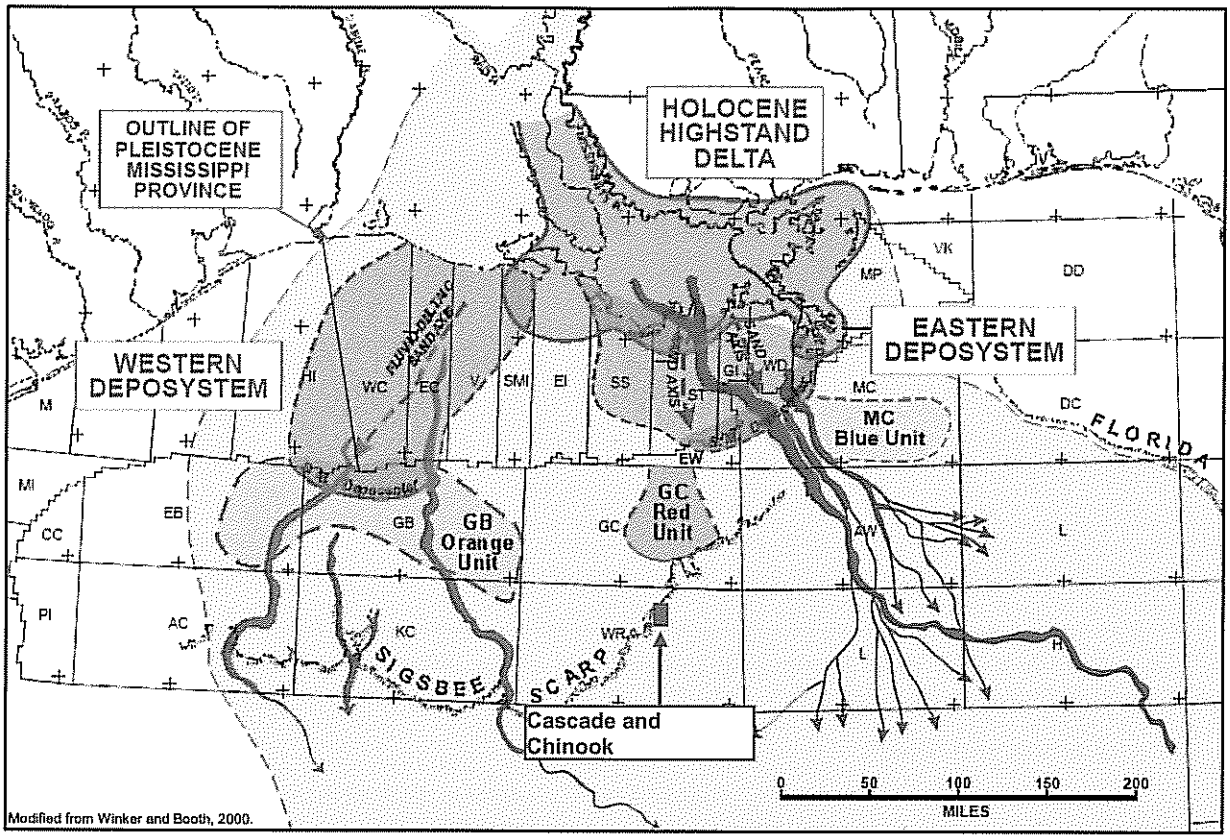


Figure 5. Regional illustration of the Study Area in relation to the major Pleistocene Mississippi River depositional provinces.

Both the Western and Eastern Deposystems exhibit intraslope fans and shelf margin deltas, as well as subsequent incised valleys and canyons (Winker and Booth, 2000). The sediments were delivered downslope through a fill and spill process of linked intraslope basins (Steffens, 1993; Prather et al., 1998; Winker and Booth, 2000; Damuth et al., 2003).

Prather et al., (1998) and Winker and Booth (2000) classify the sedimentary sections within intraslope basins as bypass and ponded facies. Many basins show a cyclic succession of bypass and ponded facies with the more chaotic bypass facies overlying the layered ponded facies. Bypass facies are generally dominated by mass-transport complexes, channel fill, and overbank deposits. These units are, in large part, sand poor and are thickest in a proximal setting to the major Pleistocene depocenters. Ponded facies generally consist of slope fan deposits and sand-enriched turbidites. The ponded facies dominate down slope in a distal setting from the Pleistocene depocenters. The Cascade and Chinook development areas are located downslope and approximately mid-way between the two major late Pleistocene slope fan units (i.e., the GB Orange and GC Red units of Winker and Booth, 2000). Therefore, the layered or ponded units in the shallow section are likely to be predominantly clay-rich and generally sand poor. This is supported by the overall continuity and amplitude character of the stratigraphic section for the Lower Continental Slope in Figure 4.

Sigsbee Escarpment

The Sigsbee Escarpment is a continuous scarp marking the boundary between the Lower Continental Slope and the Upper Continental Rise along the northern margin of the Gulf of Mexico (Figures 3 through 5). It extends continuously over 300 miles from the Perdido Foldbelt in the southeast to the Mississippi Fan in the northwest.

Structure. The Sigsbee Escarpment is a complex topographic and morphologic feature which represents the seaward limit of mobile allochthonous salt (Jackson and Hudec, 2004). Formation of the Escarpment results from sediment loading on the upper slope causing mobilization of the viscous salt. Through this process, the salt attempts to achieve isostatic equilibrium with the surrounding sediments, forcing both horizontal and vertical responses. Beneath the Escarpment face the vertical movement of salt results in growth (extensional) faulting. Downdip, contractional forces resulting from the horizontal movement of salt result in folding, and more commonly, thrust faulting at the toe of the Escarpment (Figure 4).

The Escarpment is underlain by a series of coalescing salt tongues and sheets known as the Sigsbee Nappe. The Escarpment face is characterized by steep slopes and contains numerous faults, slumps, and gullies. Many of the slumps have created mounded debris aprons that extend out onto the adjacent Upper Continental Rise as shown in Figure 6. Several canyons are identified along the Sigsbee Escarpment within the Walker Ridge area. Two such canyons are, Farnella Canyon located approximately 18 miles to the southwest, and Green Canyon located approximately 15 miles to the north of the development areas (Figure 2). The Farnella Canyon and Green Canyon salt re-entrants are relict sediment pathways for Mississippi River-derived sediments. The canyons were abandoned during episodes of sea level rise and/or geographic shifts in the Pleistocene Mississippi River depocenter.

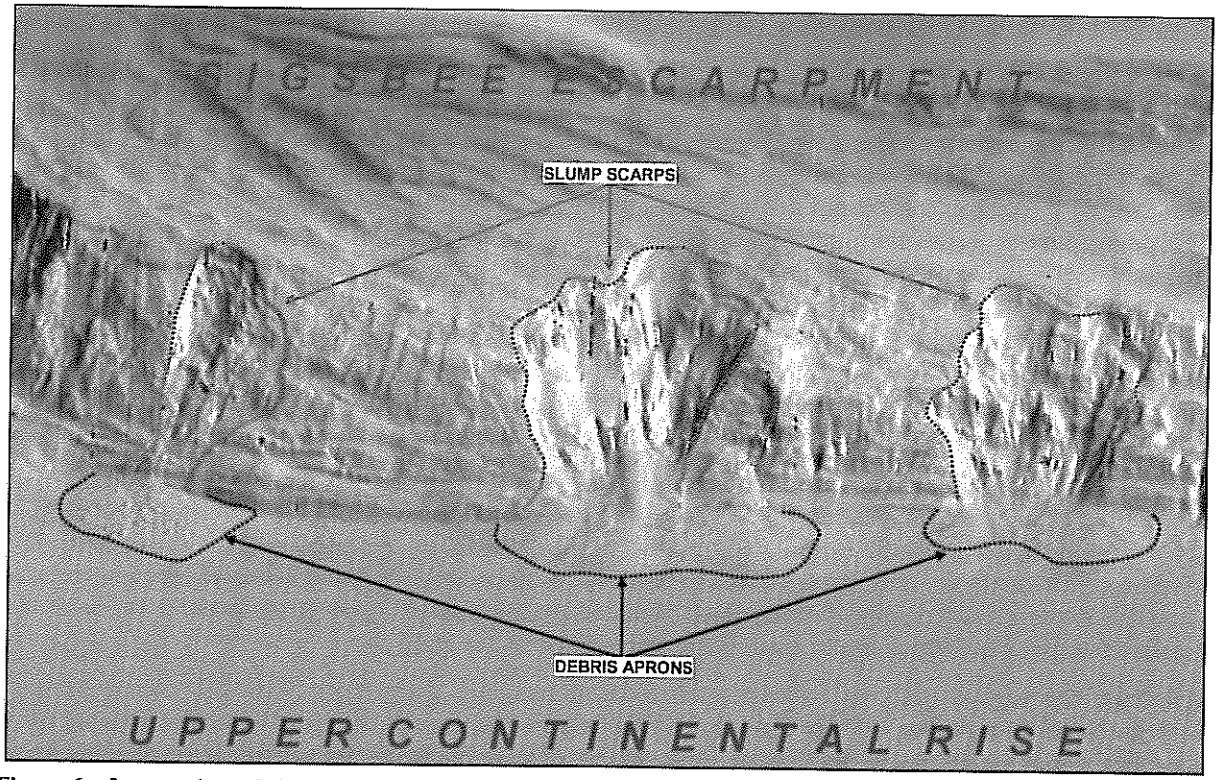


Figure 6. Isomet view of the Sigsbee Escarpment in the Cascade area showing slump scarps on the Escarpment and associated debris aprons on the Upper Continental Rise. View is looking northwest. The proposed Cascade facilities are located southeast out of the frame.

Stratigraphy. The stratigraphy along the Escarpment is highly variable consisting of recently deposited draped and ponded sediments, fault- or failure-exposed older strata, and slump and landslide deposits. The ponded drape deposits will likely be soft to very soft Holocene clays overlying stiffer Pleistocene/Pliocene

clays. Stiff to very stiff clays are most likely exposed along fault scarps. Multiple episodes of slumps or debris slides have deposited debris aprons at the base of the Escarpment (Figure 6). These sediments will generally exhibit high variability both laterally between adjacent deposits and vertically within individual deposits.

Upper Continental Rise

The Upper Continental Rise extends from the base of the Sigsbee Escarpment out to the abyssal plane. Regionally extensive seafloor bed forms consisting of furrows, anti-dunes, and other erosion related features on the seafloor have recently been identified along the base of the Sigsbee Escarpment in the Green Canyon area (Bryant et al., 2001). These seafloor features are typically longitudinal bed forms that occur in fine-grained sediment caused by erosion from bottom currents (Scott et al., 2001). The erosional nature of the furrows indicates the presence of potentially strong bottom currents along the Sigsbee Escarpment. Bottom currents of two knots have been reported to the east in AT 618 and experimental work near the Bryant Fan to the west indicates the occurrence of at least two-knot bottom currents (Scott et al., 2001).

Structure. The only dominant structural process affecting the Upper Continental Rise in the development areas is thrust faulting at the base of the Sigsbee Escarpment (see Figure 4). The thrusts are usually duplexes and are typically characterized by reverse displacements that eventually die out up-section of the basement decollement.

Stratigraphy. The deep water stratigraphy on the Upper Continental Rise generally consists of alternating units of thick, chaotic reflection sequences with well-stratified, parallel reflection sequences as evident in Figure 4. The chaotic sequences are "expanded" sections of rapidly deposited slumps and landslides sourced from both the Sigsbee Escarpment and distal Lower Continental Slope mass-transport systems during times of lowered sea level. The parallel (bedded) sequences are "condensed sections" composed of hemipelagic and pelagic sediments deposited during times of stable or rising sea level.

The near-surface sediments, or Late Pleistocene-Holocene drape, along the rise is likely very similar to the drape deposits found on the slope above the Escarpment. These sediments consist of very soft, high water content, silty clays, and normally consolidated to slightly under-consolidated (Booth and Dunlap, 1977). This drape was deposited during the Late-Pleistocene-Holocene epochs. A generic slope soil profile shows a gradual, linear increase in strength with depth along with a corresponding decrease in water content. Actual geotechnical properties, however, can differ greatly from the generic profile, due to the presence of buried landslides, turbidity flow deposits, faulting, possible presence of gas hydrates, and erosion of the seabed.

Faults

Extensional faults dominate the northern Gulf of Mexico basin. These faults are primarily listric growth faults that sole into a salt layer and show an increase in displacement with increasing depth. Rowan et al., (1999) describe many salt-related, extensional fault families, including several salt-rooted growth fault families and faults over crests of fold structures, i.e., anticlines. In many instances, growth faults root into the crests of salt diapirs, forming fault-bounded graben and half-graben structures. Many of these graben families can form complex interconnected patterns on the seafloor.

Faults at the edge of the salt structures are contractional, i.e., thrust faults near the downdip limit of allochthonous salt bodies. These "toe-thrust" faults counterbalance the updip extension created by the basinward-dipping normal faults (Rowan et al., 1999). Thrust faults are typically characterized by reverse displacement that eventually dies out up-section.

Although not as common as extensional faults, strike-slip faults are also observed in the Walker Ridge area Gulf of Mexico. These faults are salt-rooted and oriented roughly parallel to the regional seafloor dip. The position and geometry of the strike-slip faults suggest that the deformation may connect the extensional normal faults further landward to the contractional structures basinward (Rowen et al., 1999).

Slope Stability

Uplifting of underlying salt can put stress on low-shear strength surface sediments. With continual uplifting and rotation, the surface materials may eventually fail downslope from the uplift. Increases in pore-pressure due to loading and salt motions also contribute instability. These failures are characterized by their arcuate shapes with irregular seafloor downslope of the feature. Many of these failures throughout the continental slope region are covered with a drape of Holocene-aged pelagic sediments (Doyle et al., 1992). The presence of a drape over a slump scar and debris field would indicate that the slump event is an ancient feature. A lack of drape would indicate that the landslide is a relatively recent feature and slope stability could be of a concern for the area. The exception to this is where strong currents may erode, or prevent, the deposition of overlying drape, resulting in "fresh-looking" slide deposits that may in fact be quite old in the geologic record. Detailed studies of the Escarpment suggest an increase in failures during periods of low-sea level and reduced events during periods of high sea-level.

Seafloor Currents

The Loop Current is the dominant water circulation in the Gulf of Mexico. The current formed in the Middle Miocene when circum-equatorial currents were blocked by the formation of the Isthmus of Panama, thus redirecting the flow of the Caribbean current into the Gulf of Mexico. Modern-day sea surface currents associated with the Loop Current are well documented and are monitored by satellite observations of seafloor altimetry due to their significant impact on deep-water drilling operations. However, the nature of the deep-water currents is more difficult to observe and are not fully understood.

Regional mapping of the seafloor in portions of the Green Canyon and Walker Ridge areas has uncovered regionally extensive bed forms consisting of furrows, anti-dunes, and other related features on the seafloor along the Sigsbee Escarpment (Bryant et al., 2001). These seafloor features are typically longitudinal bed forms that occur in fine-grained sediment caused by erosion from bottom currents (Scott et al., 2001). The furrows extend for miles along the base of the Escarpment and, in some places, are present on and above the Escarpment. The erosional nature of the furrows demonstrates the presence of potentially strong bottom currents along the Sigsbee Escarpment in the Walker Ridge area. These currents may, at least in part, originate from strong eddies that spin off the Loop Current and "feel" bottom along the Escarpment. Another hypothesis is that the currents are a result of deep-ocean Rossby waves propagating along the Escarpment.

Hydrocarbon Migration and Related Seafloor Features

Hydrocarbon seepage on the northern Gulf of Mexico slope is widespread (Anderson et al., 1983; Brooks et al., 1985). Thermogenic hydrocarbons are generally believed to form at depths greater than 5 km (>16,400 ft) in the Gulf of Mexico (Kornacki et al., 1994). Biogenic gas can be generated at shallower depths from the decomposition of organic matter or the degradation of migrating hydrocarbons. Hydrocarbons can migrate vertically along diapiric salt bodies and faults and accumulate at a shallower level if a stratigraphic or structural "trap" is encountered. If nothing traps migration, the hydrocarbons will reach the seafloor and be expelled into the water column, in some cases resulting in significant topographic features.

Hydrocarbon Vents. The greater the depth of the gas accumulation beneath the mudline, the more likely pressures greater than hydrostatic may occur (Dutta, 2002). In general, shallow zones (less than a few hundred feet below the mudline) are not expected to have a significant pressure gradient because the low shear strength of the soils at these shallow depths generally prevents any appreciable buildup of pressure. In some instances, pressure in shallow soils may reach a point where they exceed the seal capacity of the soil; thus, releasing gas from the formation that vents upwards and bleeds off pressure.

The venting process can be slow and imperceptible at the seabed, or it can be dynamic, forming large topographic features. On the continental slope of the Gulf of Mexico, large blowout craters, mud volcanoes, and mud diapirs have been attributed to the venting of gas and other fluids (Prior et al., 1989;

Neurauter and Bryant, 1989; Neurauter and Roberts, 1992). These features are relatively common around salt bodies and major fault scarps.

Active hydrocarbon seepage at the seafloor is a possible indication of overpressured sediments in the subsurface. Penetrating shallow gas in the near-surface may create difficult well control conditions, such as, gas kicks, loss of circulation, or well blowouts. It is important to identify shallow trapped gas accumulations so that these areas can be either avoided or mitigated through an appropriate casing and/or mud program.

Hydrates. Hydrates are a solid form of light gases that have been compressed into an ice matrix of water molecules (Kvenvolden and Barnard, 1983). Hydrates may form near gas vents under proper temperature and pressure conditions. Gas hydrates have been found in water depths exceeding 1,500 ft in the northern Gulf of Mexico (Brooks et al., 1989). Gas hydrates can sometimes be detected on seismic data by the presence of bottom simulating reflectors (BSRs). BSRs mimic the seafloor, cross-cut stratigraphy, and are caused by the impedance contrast at the hydrate-gas phase boundary (Holbrook et al., 2002). It is important to note, however, that hydrates can also exist where BSRs are not observed.

The presence of gas hydrates in shallow sediments can affect the geological and physical properties of the seafloor including shear strength, porosity, permeability, fluid composition, and fluid flow (Dillon et al., 1989). Changes to pressure or temperature can allow the gas hydrates to dissociate, which could become a triggering mechanism for slope failures (Max and Chandra, 1998; Moridis and Kowalsky, 2006). The slumps and slides could pose a threat to pipelines and other bottom founded structures on the seafloor. Drilling into hydrates could alter the temperature regime in the shallow sediments, allowing the hydrates to disassociate and create uncontrolled gas releases, cement failure, collapsed casing, and well control problems (Szczepanski et al., 1998; Collett and Dallimore, 2000; Moridis and Kowalsky, 2006).

Various reports indicate the presence of hydrates along the continental slope in the Gulf of Mexico. Milkov and Sassen (2001) estimate an area of potential gas hydrate resources that covers portions of the East Breaks, Garden Banks, Green Canyon, Atwater Valley, Mississippi Canyon, and Walker Ridge protraction areas. Water depths in this portion of the Gulf of Mexico are suitable for hydrate formation.

Authigenic Carbonates. Venting gases may react with the interstitial, near-surface pore water in shallow sediments to produce carbon dioxide and bicarbonates (Roberts et al., 1990). Under proper conditions, this reaction catalyzes the production of calcium and magnesium carbonates. The result is an accumulation of authigenic carbonates creating large caps, or seals, over gaseous sediments and the formation of boulder-like cemented, hard rock outcrops. These lithified surfaces could pose problems for casing penetration or anchor holding.

Authigenic rock outcrops have been recognized in many areas along the continental slope in association with diapiric uplifts and seafloor fault scarps. At the seafloor, such hard rock outcrops are commonly associated with textural changes and seafloor amplitude variations on seismic sections.

Chemosynthetic Communities

No block in the Walker Ridge area has been designated by the MMS as having a significant chemosynthetic community (MMS, 2007b). However, there are published accounts of seepage locations within the Walker Ridge area (McConnell and Kendall, 2002; Sassen, 2000). In water depths greater than 400 meters (1,312 ft) in the Gulf of Mexico, there have been an increasing number of chemosynthetic communities found associated with gas seeps and rock outcrop zones (MMS, 2000). Chemosynthetic communities are organisms that have a food source, at least in part, from chemosynthesis rather than organic carbon derived from plankton or marine photosynthetic algae. These organisms can form colonies consisting of dense assemblages of tubeworms, clams, and mussels, while others consist of mats of traces of the bacteria *Beggiatoa* (Brooks et al., 1987; Brooks et al., 1989; Kornacki et al., 1994). The biologic variety and density of chemosynthetic communities has been associated with the flux rate at which hydrocarbons are expelled at the seafloor (Roberts et al., 2001). The MMS has outlined measures that

require the operator to protect high-density chemosynthetic communities from potentially harmful anthropogenic activities (MMS, 2000).

Shallow Water Flow

Shallow water flow phenomenon has more frequently been observed while drilling through shallow overpressured formations at deepwater sites in the Gulf of Mexico (Ostermeier et al., 2000). Encountering overpressured sands in the shallow section has been a problem because of the low formation strengths and fracture gradients. It is difficult for drillers to control formation pressures with mud weights when the surrounding formation has a fracture gradient at or less than the mud weight. Water flow originating from these overpressured zones can cause large and long lasting uncontrolled flows, well damage, foundation failure, formation compaction, damaged casing, and re-entry and control problems (Ostermeier et al., 2000).

No shallow water flow events have been reported in the Walker Ridge area (MMS, 2007b). As previously stated, the Walker Ridge area lies downslope and between the GB Orange and GC Red units (Figure 5, page 7), two late Pleistocene slope fan systems that have been the source of shallow water flow in wells along the upper continental slope (Ostermeier et al., 2000). Because of the distance from the fan systems, this area probably has a low potential for water flow in the shallow stratigraphic section.

Exploration Activity and Man-Made Structures

There are no pipelines or platforms in the study area (MMS, 2007b). The following table lists the wells and proposed locations within and near the study area.

AREA/BLOCK	OPERATOR	WELL No.	STATUS*	API #
WR 206	PETROBRAS	2	TA	608124001601
WR 206	PETROBRAS	1	PA	608124000801
WR 425	PETROBRAS	1	PA	608124000200
WR 425	PETROBRAS	2	PA	608124000500
WR 469	PETROBRAS	1	TA	608124001000
WR 165	MARATHON	1	PA	608124000100
WR 29	CHEVRON	3	DSI	608124002300
WR 29	CHEVRON	1	PA	608124001900
WR 29	CHEVRON	2	TA	608124002004
WR 30	MARATHON	1	TA	608124000602
WR 70	CHEVRON	1	PA	608124000000
GC 1001	MARATHON	1	PA	608114029502

Borehole Status as of 04/10/07: DSI = Drilling Suspended; PA = Permanently Abandoned; TA = Temporarily Abandoned

Table 2. Table of existing and proposed wells.

The proposed Cascade and Chinook facilities have been planned to either fully avoid or utilize the existing wells within the development areas.

SECTION 3: SHALLOW GEOLOGIC CONDITIONS IN THE CASCADE DEVELOPMENT AREA

Petrobras America Inc. (PAI) is evaluating development of the Cascade area in Walker Ridge Area (WR) in the Gulf of Mexico. PAI has proposed placing a floating production, storage, and offloading facility (FPSO) in Block 249 that will service the Cascade and Chinook drill centers. The FPSO will be the first of its kind in the Gulf of Mexico. The FPSO will also serve as a host for gas export pipelines, the routing of which is still to be determined. The area surveyed for the Cascade Development area includes all or portions of WR 117, 160-162, 203-207, 247-251, 292-295, and 338 (Map 1A). All of the Cascade facilities are planned to be placed on the Upper Continental Rise, south of the Sigsbee Escarpment.

Bathymetry and Seafloor Gradient

Water depths in the Cascade Development area range from 5,637 ft in the northeastern corner of WR 247 to 8,510 ft in the north-central part of WR 338 (Map 2A). Above the Escarpment water depths vary from 5,637 ft to about 5,960 ft and are generally shallowest near the Escarpment and deepen to the west and northwest. This occurs due to the uplift of stratigraphic section at the Escarpment due to the local, shallow emplacement of salt. Water depths deepen rapidly across the Escarpment, averaging a change in elevation of between 2,000 ft and 2,500 ft. Below the Escarpment the water depth generally deepens to the southeast reaching a maximum of 8,510 ft in WR 247.

Seafloor gradients range from nearly 0° on the Lower Continental Slope up to approximately 70° along the steeper, more rugged portions of the Sigsbee Escarpment (Map 3A). Seabed gradients on the Upper Continental Rise, where the facilities are intended, are generally low the central portion of the area. Seafloor gradients above 20° are common in the southeastern third of the area associated with the side-walls of seafloor furrows.

Physiographic Provinces, Seafloor Morphology, and Stratigraphy

The Cascade area displays a variety of seafloor and geologic features resulting from past salt related structural deformation as well as past and present seafloor erosion. The most prominent feature is the Sigsbee Escarpment, which runs roughly north to south through the western part of the area (Map 4A). The Escarpment divides the relatively smooth and gently dipping Lower Continental Slope from the Upper Continental Rise. Seafloor currents have significantly eroded the Upper Continental Rise in the Cascade area, resulting in furrows and flukes on the seafloor. The Escarpment itself has variable gradients and thickness of sedimentary cover overlying older very stiff to hard soils. Faulting in many places along the Escarpment results in a rough topography, has uplifted and exposed older strata, and contributed to numerous past failures.

Three physiographic provinces have been identified in the Cascade area as illustrated in Figure 7 (next page).

- Lower Continental Slope (LCS) – Shallow seabed dip over most of the area. Soils are normally to slightly over-consolidated clays exhibiting high plasticity and low sensitivity. Occasional faulting and erosion by currents have scour the very soft, surficial sediments near the top of the Escarpment.
- The Sigsbee Escarpment (SE) – Characterized by high slope angles and rugged topography. Ponded hemipelagic and debris flow sediments occur in benched portions of the Escarpment while stronger sediments are exposed along steep slopes.
- The Upper Continental Rise (UCR) – Generally parallel and continuous undisturbed clay rich stratigraphic section. Seabed topography is variable as a result of erosion by seafloor currents. Seafloor furrows exist to the east and give way to flukes toward the Escarpment, suggesting a change in current velocity regime. Soils in this province are differentially eroded, very-soft to soft, highly plastic clays with low to medium

sensitivity. A thin drape of foraminiferal sand may be present at the seabed. The Cascade facilities will be placed in this province.

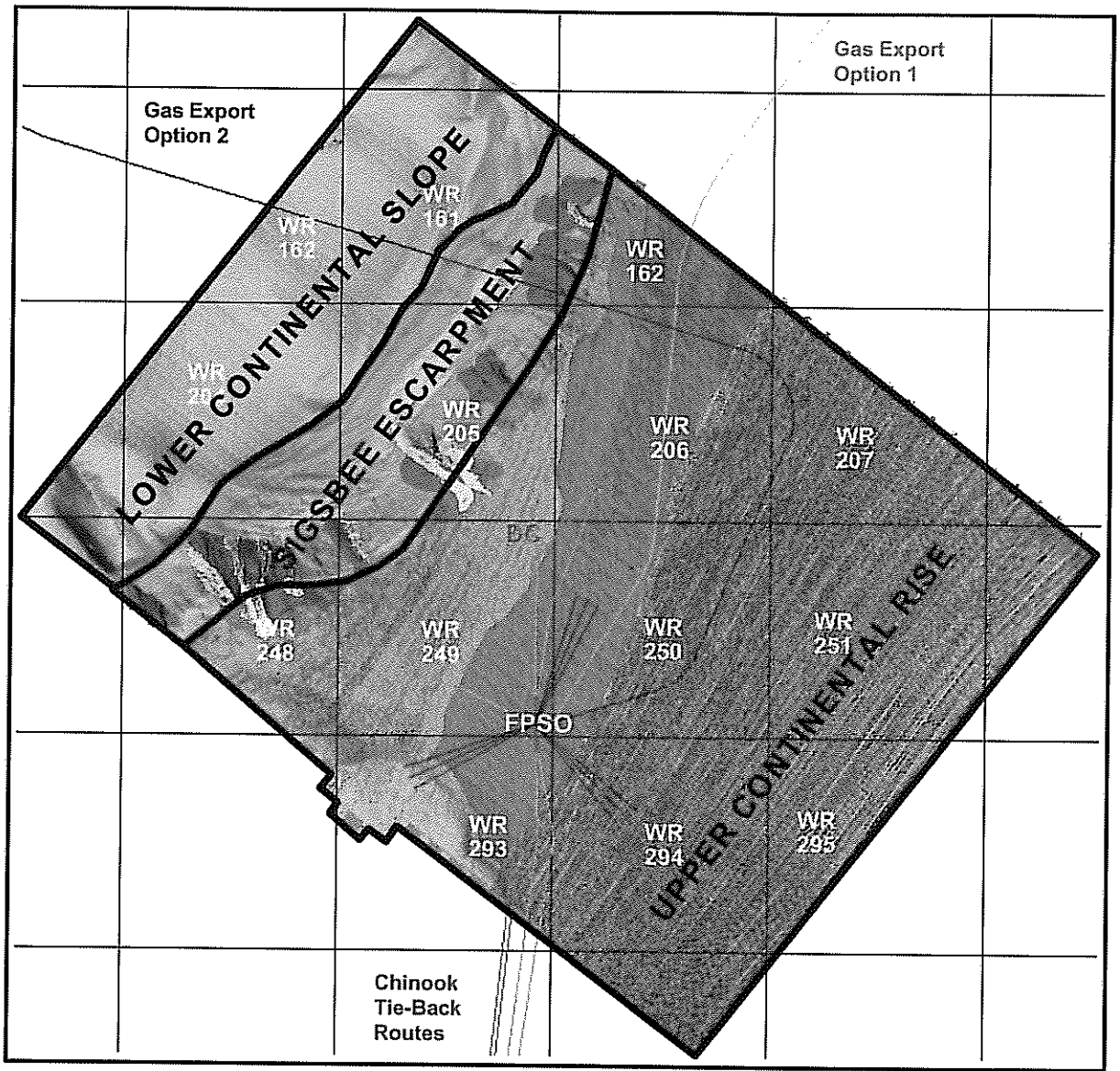
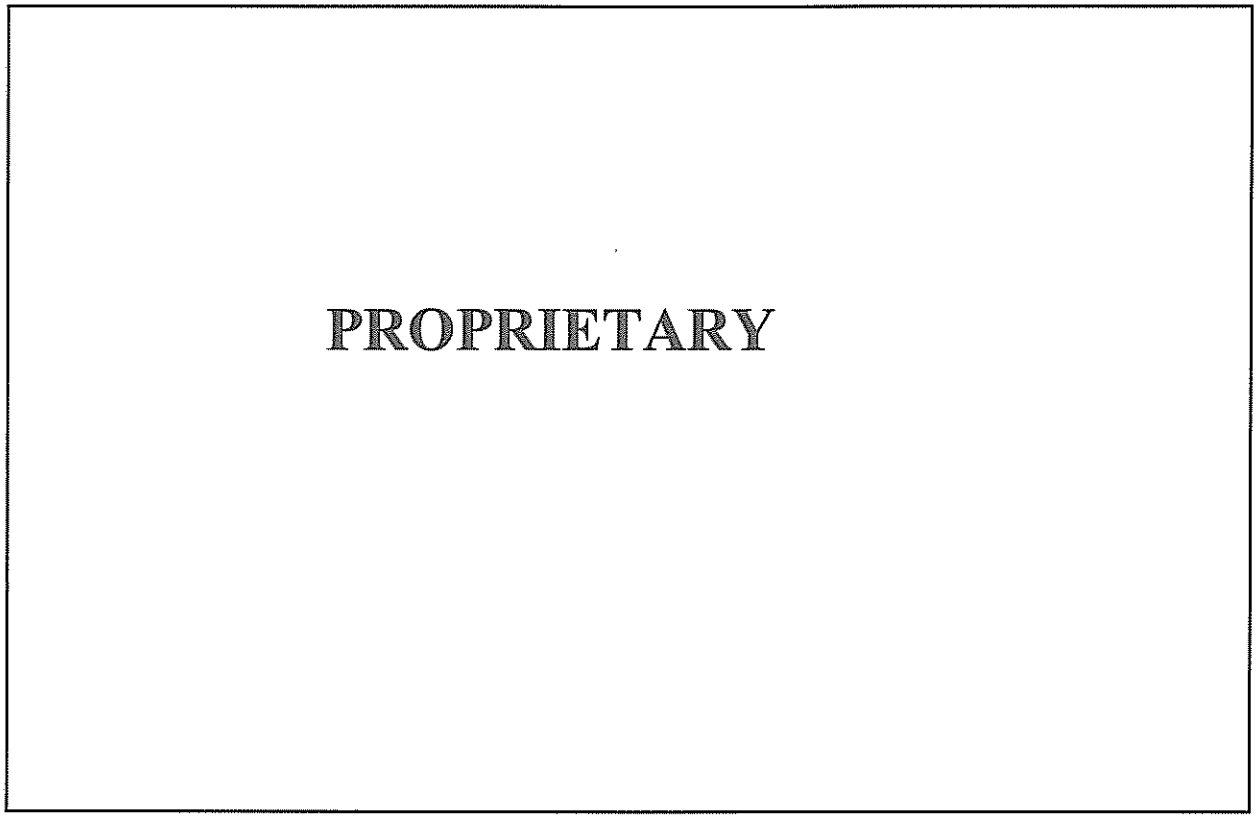


Figure 7. Physiographic provinces within the Cascade Development area. FPSO located in WR 249. DC denotes Drill Center. Gas Export Route will be determined in the future.

Each of the three above provinces displays seafloor morphology and shallow structure and stratigraphy quite different from the other provinces. Shallow stratigraphic units are primarily defined from the subbottom profiler data collected by PAI while deeper stratigraphy and structure were defined utilizing the 3-D depth volume also provided by PAI.

Lower Continental Slope (LCS). The LCS province is a benign setting relative to the other two provinces. Seafloor gradients are generally below 6° over most of the province. The shallow stratigraphy, to approximately 260 ft below the mudline (bml) consists of well layered to amorphous reflectors (Map 5 and Figure 8, next page). The base of the surficial unit is identified as the "Triplet" as defined by Brand et al., 2003. Carbon-14 dating of the three distinct silt-rich layers indicate that the layers were deposited between ~18.9 – 20.2 ka (1ka=1,000 yrs) slightly before the end of the last lowstand, i.e., Pleistocene/Holocene boundary (Brand et al., 2003). The Triplet is an important marker horizon in the area because it both marks the base of the transitional late Pleistocene (low-stand) and current Holocene (high-

stand) sediments and can be mapped both above and below the Sigsbee Escarpment. Although the stratum is parallel and continuous, the thickness of sediments above the triplet is variable across the LCS province. Faults are present, caused by the underlying salt movement, and have resulted in the uplift and offset of the sediments above the Triplet primarily in the northern and southern portions of the province (See Map 5A). The soils are also differentially eroded due to the presence of seabed currents. Below the Triplet the stratigraphy is characterized by intact, parallel continuous reflectors.



A number of box cores and short piston core samples were recovered from this physiographic province (Appendix B). Typically the piston core samples were less than 20 ft in length. **Error! Reference source not found.** lists the cores in the LCS province. Results of the standard geotechnical testing are presented in Figure 9.

Piston Core	Box Core
C-ESC-PC-5	CEXP2-BOX5
C-ESC-PC-6	CEXP2-BOX6
CEXP2-PC-3	CEXP2-BOX7
CEXP2-PC-4	CEXP2-BOX8
CEXP2-PC-5	CEXP2-BOX9
CEXP2-PC-9	CEXP2-BOX10
CEXP2-PC-11	CEXP2-BOX13
CEXP2-PC-13	CEXP2-BOX14
CEXP2-PC-14	CEXP2-BOX15
	CEXP2-BOX18
	CEXP2-BOX20
	CEXP2-BOX21
	CEXP2-BOX22
	CEXP2-BOX23

Table 3. List of cores for the LCS province.

PROPRIETARY

Soils in the area are generally very soft, highly plastic, normally to slightly over-consolidated clay. The soils are fairly uniform over the province as is expected from soils that have been differentially eroded and slightly scoured in locations due to currents. There is excellent correlation between the geologic observations and the ground-truth soils data.

As can be seen in Figure 9, the moisture content data follows a decreasing trend from generally over 120% at the seafloor to about 70% at 18 ft. Liquidity index (LI) also decreases with depth. Shear strength was measured with miniature vane testing. The results fall within a narrow range and are linearly increasing with depth. The strength of the surficial sediments varies between 40 and 70 psf and increases to about 155 psf at 18-ft depth. The soil sensitivity generally ranges between 2 and 5 which is typical of very soft, normally consolidated GOM clay. Soil sensitivity is the ratio of undisturbed to remolded strength and is typically used to indicate sample disturbance. Values below 2 can indicated sample disturbance. Figure 9 does show occasional sensitivity results below 2, but in general the sample quality is good with little disturbance.

The only potential future facility planned for the LCS is the Export Option 2 Route (see Figure 7). The route has yet to be selected; therefore, this may not occur. The conditions on the LCS are favorable for pipeline installation and performance.

The Sigsbee Escarpment (SE). The Sigsbee Escarpment crosses the entire Cascade area and separates the LCS province from the UCR province (Figure 7). The Escarpment represents the distal limit of the salt province in the Cascade area with salt located to the west and absent to the east (Map 6A). The topography of the Escarpment is highly variable (Figure 10, next page). Vertical and horizontal movement of the underlying salt has deformed the shallow stratigraphy and initiated slope failures. The result of the uplift and deformation is the formation of an escarpment consisting of a relatively flat bench separating an upper and lower scarp.

The upper and lower scarps are rugged, faulted, and steeply dipping. Faults are salt rooted, trend parallel to the Escarpment face, and are typically downthrown to the southwest (Map 8A). Throw across the faults is highly variable, but is as much as 20 ft. Numerous slump scarps and gullies incise the lower scarp with debris aprons extending up to about 1 mile out onto the Upper Continental Rise.

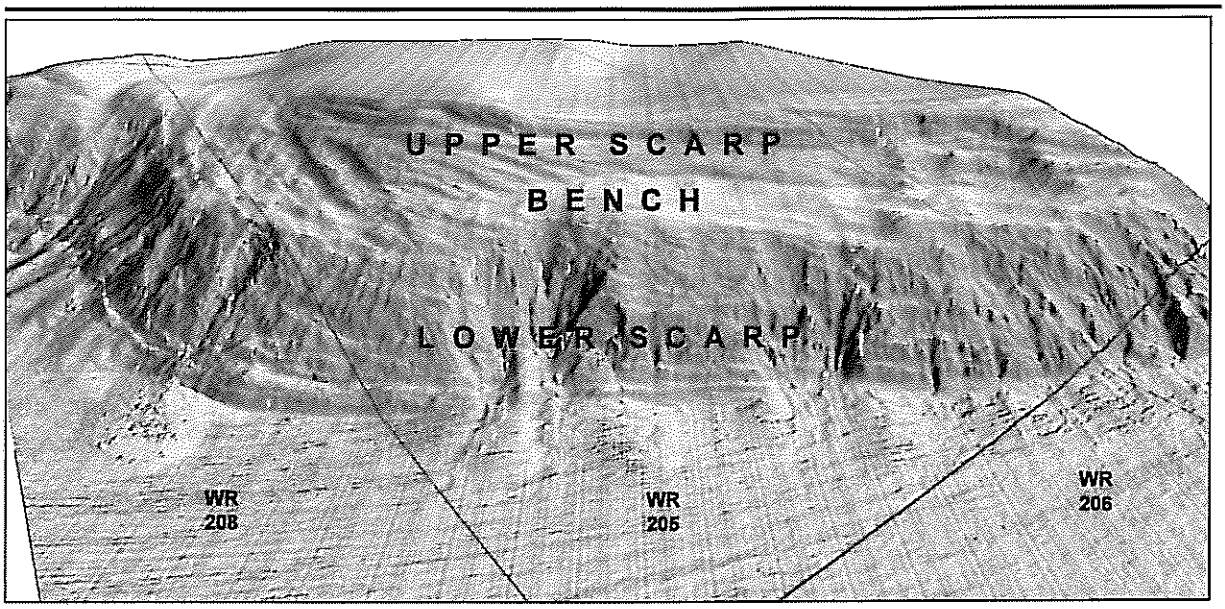


Figure 10. Isometric view of the Sigsbee Escarpment within the Cascade Development area showing a bench separating an upper and lower scarp. View is looking northwest. The proposed Cascade facilities are southeast of the frame.

Deposition of hemipelagic and mass-transport sediments has covered the Escarpment with a surficial layer of varying thickness. The geophysical data show parallel layered reflectors and amorphous intervals within ponded sediments underlying the bench (Figure 11). Thin to absent drape, or outcropping strata, characterize upper and lower scarps. The multibeam data show furrows present on the Escarpment, indicating seabed currents are actively eroding and re-depositing the surficial sediments.

PROPRIETARY

Based on the geology, the soil properties of the SE province should cumulatively be either normally consolidated, very soft to soft drape soils, or, overconsolidated stiff to hard older strata. We present the discussion of the soil properties based on the following mapped Escarpment sub-provinces: the Upper Scarp, the Bench, and the Lower Scarp.

The Upper Scarp. Two shallow piston cores were recovered from this portion of the SE province. Sample recovery was 5 to 12.5 ft in length. Table (next page) lists the cores in the Upper Scarp for the SE province. Results of the standard geotechnical testing are presented in Figure 12.

Piston Core	Box Core
C-ESC-PC-4	
C-ESC-PC-7	

Table 4. List of cores for the upper scarp of the SE province

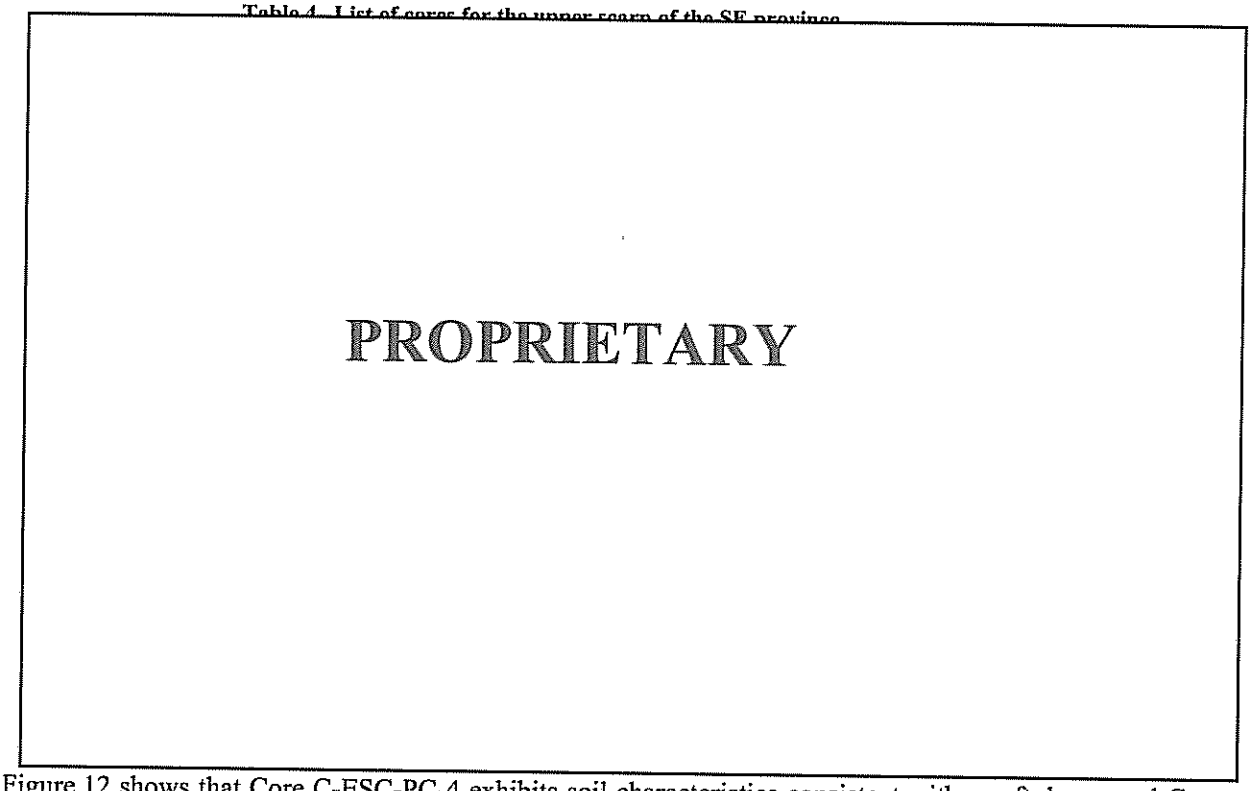


Figure 12 shows that Core C-ESC-PC-4 exhibits soil characteristics consistent with a soft drape, and Core C-ESC-PC-7 has soil characteristics consistent with exposed, overconsolidated strata (Appendix B). As mentioned earlier a normally consolidated, soft, ponded soil drape of variable thickness occurs over higher strength overconsolidated soils. Erosion from currents is also likely to redistribute the soft soil drape. The geotechnical data correlates with the geologic conditions observed from both the shallow high-resolution AUV data and the 3D-seismic data.

The moisture content data in Figure 12 follows a slightly decreasing trend. The soft drape soils of the Upper Scarp will have a higher moisture content with surficial results in excess of 100%, but the moisture content will drop rapidly as the old overconsolidated strata are encountered. The LI also show decreasing trends with depth. The lower LI values correspond to the higher strength soil. Shear strength was measured with miniature vane testing. The results show two types of soil conditions: soft drape soils and exposed, overconsolidated soils. Soil sensitivity ranges from 2 to 7 indicating good sample quality with minimal sample disturbance.

The Bench. The formation of a relatively flat bench separates the Upper Scarp from the Lower Scarp. The Bench has occurred from extension, via normal faulting, of the supra-salt section behind the underlying advancing salt front (see Figure 4). Some of the material eroded by seafloor currents is likely deposited on the bench due to drop in the current velocity as it traverses over the bench. The overall low gradient of the Bench also allows the preservation of the softer soils.

Two piston core samples were recovered from the Bench (see Table , next page). Sample recovery was 11 to 12 ft in length. Results of the standard geotechnical testing are presented in Figure 13.

Piston Core	Box Core
C-ESC-PC-3	
C-ESC-PC-8	

Table 5. List of cores for the bench of the SE province.

PROPRIETARY

As expected, the drape sediments of the Bench are normally to slightly overconsolidated, the same as observed on the Upper Scarp. This material is underlain by the stronger, overconsolidated layer, which is the continuation of the stratigraphic sequence observed in the Upper Scarp.

The moisture content and LI results tend to decrease with depth corresponding to the increasing shear strength. Very soft to soft normally consolidated clay was present at both core locations with Core C-ESC-PC-8 encountering the underlying stiffer, overconsolidated soils at ~11 ft (Appendix B). The 3D-seismic data from the Escarpment (shown in Figure 4) suggests as one moves down the Escarpment, and thus deeper in the exposed stratigraphic section, soil strengths should increase. Soils underlying the drape on the Bench are similar to those of the Upper Scarp, with strengths slightly stronger at ~1,000 psf. Soil sensitivity ranged between 2 and 4 with good sample quality. The geotechnical data correlates well with the geologic conditions observed from both the shallow high-resolution AUV and the 3D-seismic data. The trend should continue into the Lower Scarp area.

The Lower Scarp. The Lower Scarp sits over the snout of the underlying salt front, as shown in Figure 4. The shallow soil characteristics of the material encountered on the Lower Scarp are expected to be similar to those observed for the Upper Scarp and Bench.

Two shallow piston core samples were recovered from the Lower Scarp (see Table , next page). Sample recovery was about 2 and 15 ft in length. Results of the standard geotechnical testing are shown in Figure 14 as well as a more detailed presentation in Appendix B.

Piston Core	Box Core
C-ESC-PC-2	
C-ESC-PC-9	

Table 6. List of cores for the lower scarp of the SE province.

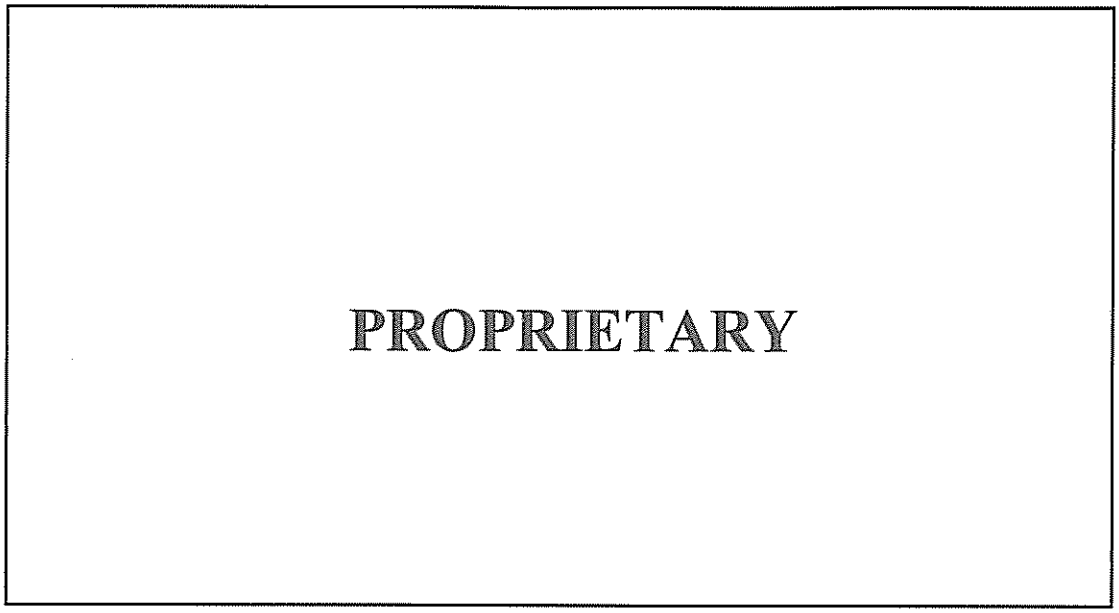
PROPRIETARY

The moisture content and LI data decrease with depth in each individual core corresponding to an increasing shear strength. The measured soil strengths are similar to those observed for the drape and underlying stiffer soils in both the Upper Scarp and Bench area. Core C-ESC-PC-9 illustrates a normally consolidated strength profile expected of the overlying soft drape to about 15 ft. In addition, this core penetrates the underlying stiffer overconsolidated material at depth. Core C-ESC-PC-2 also sampled the stiffer, overconsolidated soils of the outcropping strata which appear to be stronger for the Lower Scarp than in the previous two area of the SE province. Soil sensitivity ranged between 2 and 4 with good sample quality. The geotechnical data correlates well with the observed geometry of the stratigraphy and expected relative increase in soil strength within strata exposed near the base of the Escarpment.

The only potential future facility that may be placed on the Escarpment is the Gas Export Option 2 pipeline. The final selection of the route is yet to be determined. Engineering of a pipeline route on the Escarpment is feasible. If Option 2 is selected, more detailed studies of the crossing with respect to topography, soils, slope stability, and chemosynthetic communities should be undertaken.

Upper Continental Rise. The Upper Continental Rise in the Cascade area is defined as an erosional environment. Seafloor currents have scoured and removed a significant amount of surficial sediments from the area resulting in a seafloor comprised of furrows and flukes. This province is subdivided into four sub-provinces (Map 7A) based on the following types of observed seafloor morphology: Seafloor Furrows, Seafloor Flukes, a combination of Seafloor Flukes and Furrows, and a Topographic Low

Seafloor Furrows. Dense seafloor furrows are present in the southeastern portion of the Cascade area. The furrows are evident in the multi-beam data as linear features trending parallel to the Escarpment (see Map 4a). In general individual furrows average about 100 ft wide and 30 ft deep and have relatively steeply dipping walls. The furrows are tightly spaced, averaging between 75 and 100 ft apart.



The right of the figure illustrates the subbottom profiler expression of the furrows while the left side of the figure illustrates the flukes. The furrows incise into the otherwise undisturbed stratigraphic section. They are amorphous on the profiler as they act as closely-nested point sources that attenuate the profiler signal creating beam spreading and focusing. This is further expressed by the interference evident in the otherwise parallel and continuous stratigraphy below the furrows. The side-scan data show a striped seafloor of alternating light and dark areas illustrating the shadowing effect produced by regularly spaced, parallel linear furrows (see Map 7A). The soil properties are presented in Figure 16 below.

A number of box core and short piston core samples were recovered from this region. Typically the piston core samples were less than 20 ft in length. Table 1 lists the cores recovered from the furrowed region of the UCR province. Results of the standard geotechnical testing are shown in Figure 16 with a more detailed presentation of results in Appendix B.

Piston Core	Box Core
CPC-1 and CPC-1R	CBOX-1
CPC-2 and CPC-2R	CBOX-2
CPC-3	CBOX-3
CPC-4	CBOX-4
CPC-10	CEXP1-BOX1
CPC-14	CEXP1-BOX2
CPC-15	CEXP1-BOX3
CPC-16	CEXP2-BOX1
CEXP1-PC1	CEXP2-BOX2
CEXP1-PC2	CEXP2-BOX3
CEXP2-PC-1	
CEXP2-PC-2	

Table 7. List of cores for the seafloor furrows of the UCR province.

PROPRIETARY

The near surface soils within this area are generally very soft, highly plastic, normally consolidated clays. The soils are fairly uniform over this region of the province as is expected from soils that have been differentially eroded and slightly scoured due to currents. There is excellent correlation between the geologic observations and the ground-truth soils data.

As can be seen in Figure 16, the moisture content data follows a decreasing trend from generally over 120% at the seafloor to about 80% at 18 ft. The LI also decreases with depth. Shear strength was measured with miniature vane testing and fall within a narrow range that increases with depth. The strength of the surficial sediments varies between 25 and 75 psf increasing to 150 to 200 psf at 18-ft penetration. Soil sensitivity generally ranges between 2 and 4. Figure 16 does show occasional sensitivity results below 2 indicating some sample disturbance at depth. In general the sample quality was good.

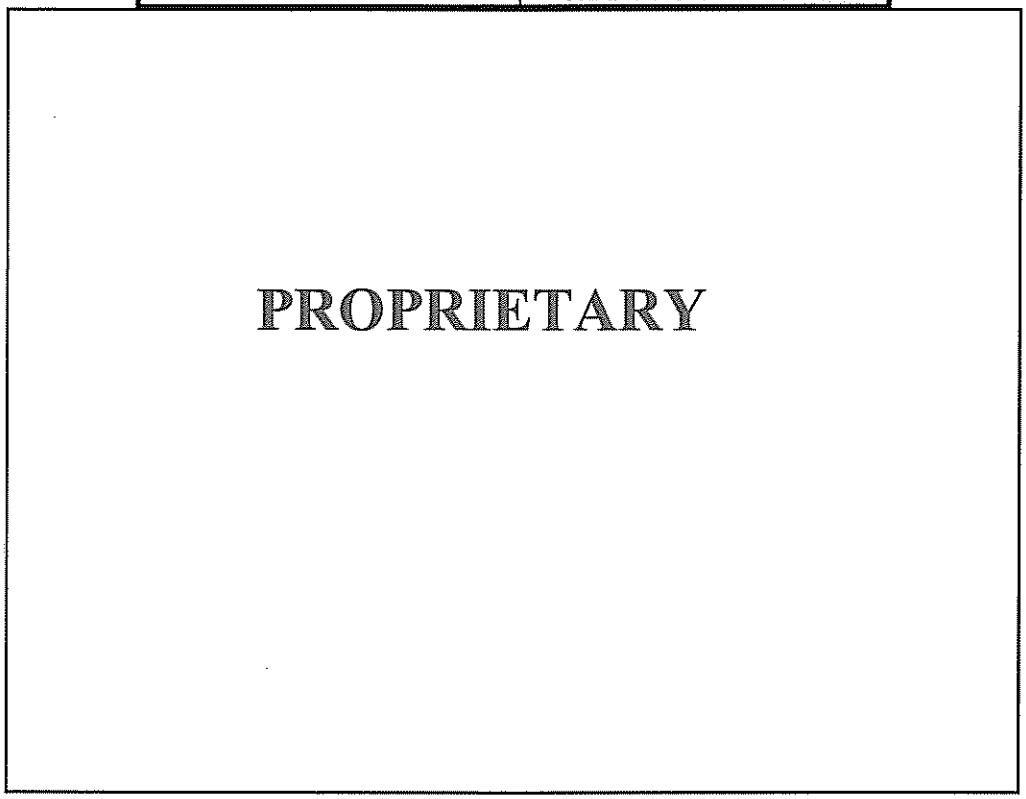
Future facilities planned for this region of the UCR include one FPSO mooring cluster and the potential Gas Export Option 2 pipeline. The final selection of the pipeline route is yet to be determined; therefore, this may not occur. The conditions in Seafloor Furrows area of the UCR are favorable for FPSO clusters and pipeline installation and performance. Attention should be given to the placement of the individual moorings with respect to the crests and troughs of the furrows.

Seafloor Flukes. An area of seafloor flukes is observed between the Escarpment and the furrowed region. Individual flukes are about 150 to 200 ft in length and can be up to 10 ft in height, but more typically average between 5 and 8 ft high. The flukes are randomly distributed but do tend to cluster in linear to sub-linear grouping perpendicular to the Escarpment and the northeasterly to southeasterly direction of current flow.

The current velocity is thought to be stronger in fluked regions relative to furrowed regions. This arises from observations of bedforms generated in marine clays in flume tests (Allen, 1950). The increase in current velocity in this area may arise from a jet effect as the currents compress around a bend in the Escarpment to the north. The subbottom profiler data in Figure 15 shows ~ 20ft of the shallow stratigraphic section has been removed from this region exposing older, presumably stiffer clays at the seafloor. The side-scan sonar data show a mottled appearance indicating a high variability in strength or composition of surficial sediments. Darker areas on the side-scan mosaic (Map 7A) indicate areas where erosion has exposed sediments down to the level of the Triplet.

Several box cores and short piston core samples were recovered from the Seafloor Flukes area of the UCR province (see Table). Typically the piston core recovery was about 15 to 18 ft in length. Results of the standard geotechnical testing are shown in Figure 17 with a more detailed presentation in Appendix B.

Piston Core	Box Core
CPC-5 and CPC-5R	CBOX-5
CPC-6	CBOX-6
CPC-7	CBOX-7
CPC-9	CEXP1-BOX4
CPC-10	CEXP1-BOX5
CPC-12	CEXP1-BOX6
CPC-13	CEXP1-BOX7
CEXP1-PC3	CEXP1-BOX11
CEXP1-PC4	CEXP1-BOX13
CEXP1-PC8	CEXP1-BOX14
CEXP1-PC9	CEXP1-BOX15
	CEXP1-BOX16



The soils in this area are very soft to soft, highly plastic, normally consolidated clays. The soils are fairly uniform over the province as is expected from soils that have been differentially eroded due to currents. The geotechnical data correlates well with the geologic observations from the AUV and 3D-seismic data of erosion and exposure of older, stronger strata.

The moisture content and LI results tend to decrease with depth corresponding to the increasing shear strength. The measure shear strengths for this sub-province are very similar but slightly higher than the Furrowed area of the UCR. The surficial strength of the Fluked sediments ranges from 25 to 100 psf and increases to 150 to 300 psf at 18-ft depth. Soil sensitivity ranges from 2 to 5 indicating good sample quality with little sample disturbance.

Future facilities planned for this region of the UCR include the FPSO, riser bases, two mooring clusters and the East Drill Centers and infield flowlines. The conditions in Seafloor Flukes area of the UCR are favorable for installation and performance of these facilities. Attention should be given to the locally

increased gradients on the sided of the flukes and the periodically intense seafloor currents resulting in the erosion and formation of the flukes.

Seafloor Flukes and Furrows. Seafloor flukes with furrows superimposed on them are evident at the base of the Escarpment. This "furrowed flukes" region is more extensive along the base of the Escarpment in the south of the Cascade area, extending out from the Escarpment about 3.5 miles, while, to the north the region thins, limited to the seafloor within about 2,000 ft of the Escarpment. The furrows in this region are similarly formed as the furrow in the southeastern "furrowed" region, however; their appearance is quite different. In the multibeam data the furrows are observed as linear features trending sub-parallel with the Escarpment in the south and merging with the Escarpment in the north. A hypothesis is that this is a transitional current velocity zone with slightly lower current velocities in the shadow of the bend in the Escarpment to the north.

A combination of thrust fault related uplift, local slump deposition derived from the Escarpment, and seafloor erosion result in a high degree of variability in seafloor soils and shallow stratigraphy. Dark, sub-circular areas seen in the side-scan data indicate slump derived debris aprons extending up to approximately 1 mile out from the Escarpment (Map 7A). Linear, dark and light striping in the side-scan represent variable soils exposed along the walls and floors of furrows. Thrust faulting at the toe of the Escarpment has uplifted and exposed older strata which, further from the Escarpment's base, become buried in areas by slide deposits derived from the Escarpment.

The soils within the Seafloor Furrowed Flukes area of the UCR province was sampled with the box corer and short piston corer (see ***Table*** for listing). Typically the piston core samples were less than 20 ft in length. Results of the standard geotechnical testing are shown in Figure 18 with a more detailed presentation in Appendix B.

Piston Core	Box Core
CPC-8	CBOX-8
CPC-11 and CPC-11R	CEXP2-BOX4
C-ESC-PC-1	
C-ESC-PC-10 and C-ESC-PC-10R	

Table 9. List of cores for the seafloor furrowed flukes region of the UCR province.

PROPRIETARY

The soils in this area are very soft to soft, highly plastic, normally to slightly overconsolidated clays. The soils within this area as expected are similar to those observed in the two other area of the UCR province except where encountering a local slide deposit or exposure of stronger stratigraphy above the thrust front. There is excellent correlation between the geologic observations and the ground-truth soils data.

The moisture content and LI results, presented in Figure 18, show a general decreasing trend with depth. The strength of the surficial sediments varies between 75 and 150 psf and increases with depth to about 300 psf at 17 ft. Two cores (C-ESC-PC1 and E-ESC-PC10R) have a shear strength peak at ~9 ft. This is likely to arise from either encountering a shallow-buried debris flow or stronger soils related to uplifted strata above the thrust front. Soil sensitivity results are generally between 2 and 4. Figure 18 does show occasional sensitivity results below 2 indicating some disturbance due either to sampling or possibly slide deposits.

The West Drill Center is the only future facility planned for this region of the UCR. The geologic and geotechnical conditions observed appear to be favorable for placement of this facility.

Topographic Low. A ridge, with approximately 50 ft of seabed relief, is located along the southwestern edge of the Cascade area (Maps 2A and 4A). The ridge represents the northern limit of a topographic low which extends southward out of the survey area. The low is possibly the now-filled remnant of a paleo-channel that focused mass transport events coming from above, or on, the Escarpment. The flukes and furrows are present within the low; however, their effect on the seafloor is less pronounced than it is in the "furrowed" and "fluked" regions to the north.

The subbottom profiler data, shown in Figure 19 below, shows a series of shallow anticlines in the shallow subsurface. Mass-transport deposits underlie the drape within synclines between the anticlines and older strata, down to the Triplet in places, are exposed across the crests of the anticlines at the seafloor. These outcrops are evident as darker areas in the side-scan mosaic (Map 7A). The anticlines likely arise from dewatering of the larger, deeper slide deposits and differential compaction of the overlying stratigraphic section.

PROPRIETARY

No shallow piston core or box core samples were specifically taken in the area. However, the soils are expected to be consistent with those observed for the Seafloor Furrowed Flukes area of the UCR province. A composite of soil properties for the UCR province is presented in Figure 20 to provide a general range of expected properties for the Topographic Low sub-province.

PROPRIETARY

As mentioned above mass-transport sediments underlie the drape within the synclines and the older strata in this area. A Jumbo Piston Coring program was recently completed that sampled this area. The JPC core

is undergoing laboratory testing. In addition to the JPC program, a soil boring and PCPT program have recently been completed for this area.

Future facilities planned for this region include an FPSO mooring cluster. We believe the conditions will prove to be favorable for placement of the mooring. Consideration should be given to the potential for soil variability until the results from the additional geotechnical programs mentioned above are available. These additional data will subsequently be integrated to further assist in facilities layout and foundation engineering.

Chemosynthetic Communities

LCS Province. Several mound features, possible gas expulsion mounds, are identified in WR 160 as shown on Map 8A and in Figure 21.

PROPRIETARY

The mounds are potentially favorable locations for chemosynthetic communities to exist. The planned Cascade field development will not impact this area of as the entire development is below the Escarpment on the Upper Continental Rise. Darker regions of the side-scan sonar mosaic (Map 7A) correspond with outcrops of the Triplet. There does not appear to be any other locations, away from the mounds, in this province which could support significant, high density chemosynthetic communities. The potential Gas Export Option 2 route is over a mile to the south-southwest from this area.

SE Province. The Escarpment is heavily faulted and most of the faults are salt rooted. The possibility for migration of fluids along these faults to the seafloor exists. It is difficult to distinguish, in the side-scan data (Map 7A) areas of potential chemosynthetic communities from outcrops of older, firmer strata as both will display a darker texture in the mosaic. Previous ROV studies have observed very local, small, dense chemosynthetic communities on the steep slopes of the Escarpment. The Cascade infield facilities layout does not get near the Escarpment. However, the potential Gas Export Option 2 route crosses the Escarpment and potential future MODU anchors are laid out to fall on the Escarpment. When necessary to place subsea architecture on the Escarpment, operators in the past have selected to perform site specific ROV investigations to confirm the sites are clear.

UCR Province. There does not appear to be any areas of significant, high density chemosynthetic communities in this province, nor areas that have conditions conducive to supporting those communities. Seafloor currents have, and continue to, erode and redeposit the seabed sediments throughout this province.

Therefore, it is unlikely that organisms would find suitable locations with the necessary firm substrate to anchor themselves to the seabed. Additionally, there does not appear, in the geophysical or geotechnical data, to be shallow gas or active venting of fluids to the seafloor in this province. The darker regions of the side-scan mosaic (Map 7A) correspond to areas where the Triplet outcrops. The proposed Cascade field layout is entirely on the UCR and should not encounter or be constrained by chemosynthetic organisms.

SECTION 4: SHALLOW GEOLOGIC CONDITIONS IN THE CHINOOK DEVELOPMENT AREA

Petrobras America Inc. (PAI) is evaluating development of the Chinook area in Walker Ridge Area (WR) in the Gulf of Mexico. PAI has proposed placing a subsea drill center in Block 425 and tie-back flowlines extending from the drill center to the Cascade FPSO (Section 3). The area surveyed for the Chinook Development area includes WR Blocks 425, 426, 469, and 470 (Map 1B).

Bathymetry and Seafloor Gradient

Water depths in the Chinook Development area range from 8,607 ft in the northwestern corner of WR 425 to 9,260 ft in the southeastern corner of WR 470 (Map 2B). Water depths increase relatively uniformly across the area from northwest to southeast. An exception to this is in central WR 426 and northeastern WR 470 where water depths increase into a topographic low (Map 2B).

Seafloor gradients range from nearly 0° over much of the southwestern two-thirds of the area to locally 50° along the walls of furrows in the northeastern third of the area (Map 3B). Seafloor gradients up to about 6° are common in the southeastern third of the area associated with seafloor anti-dunes. A discussion of these features is presented later in this section.

Physiographic Province, Seafloor Morphology, and Stratigraphy

The Chinook Development area is located on the Upper Continental Rise (UCR) approximately 12 miles south-southeast of the Sigsbee Escarpment (see Figure 3). The area exists entirely within the UCR province as defined in Section 3 of this report. The following three sub-provinces, as shown in Figure 22 have been identified within the Chinook area based on the occurrence of seafloor features: (UCR) Seafloor Furrows; (UCR) Seafloor Anti-Dunes; and (UCR) Topographic Low.

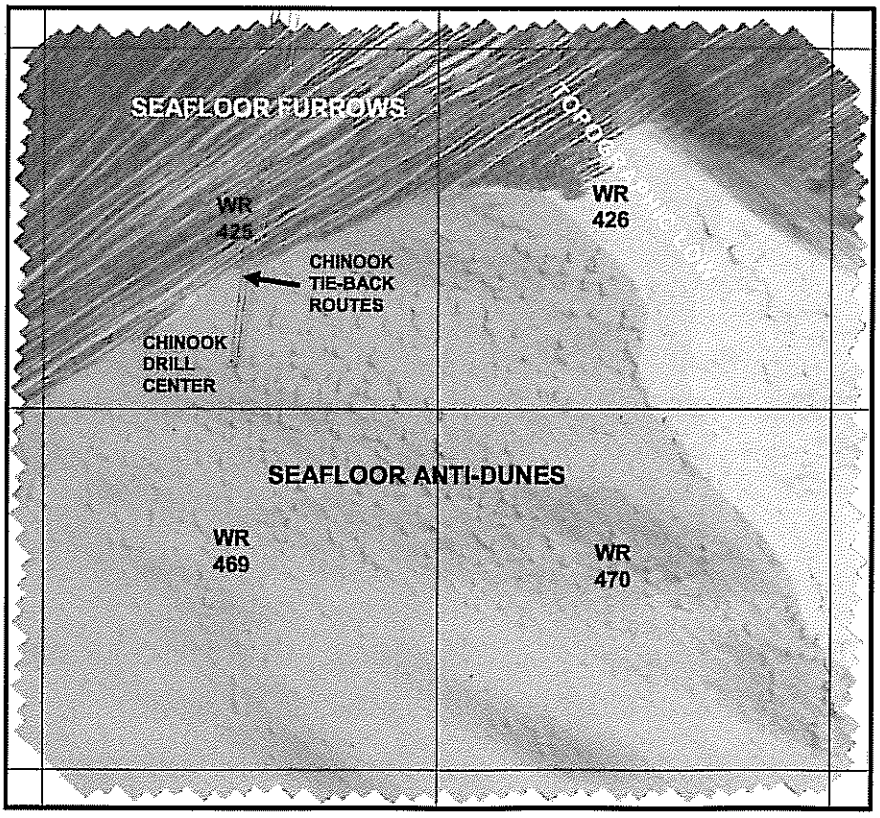
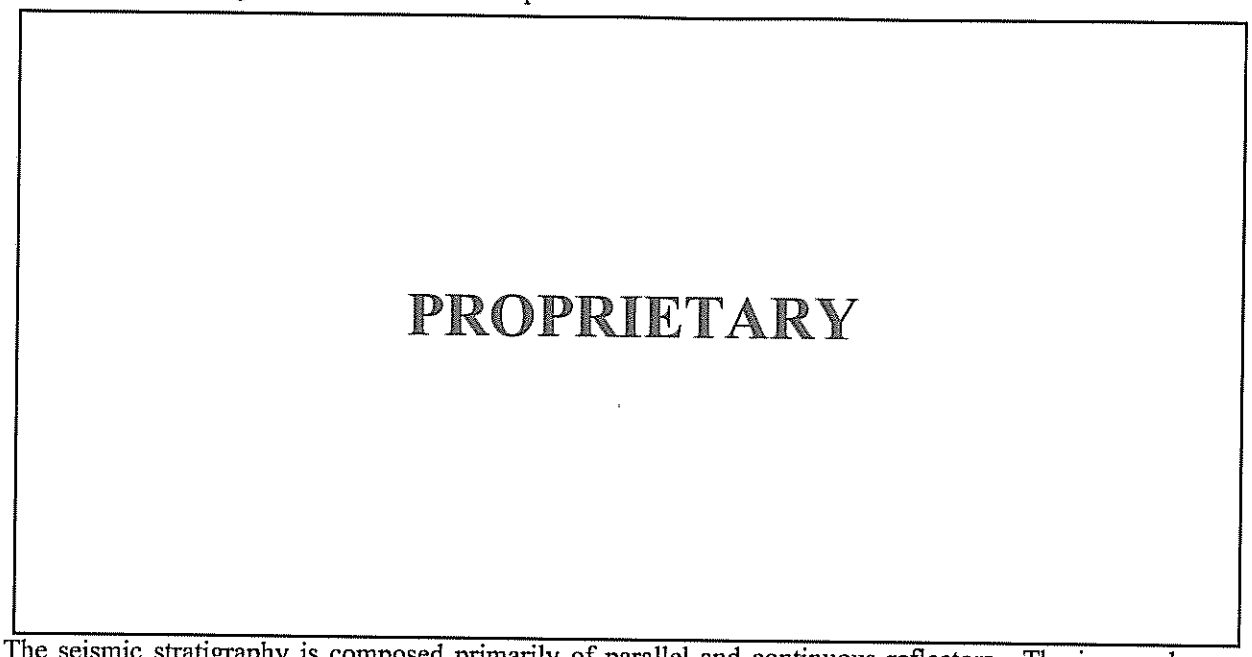


Figure 22. Physiographic sub-provinces within the Chinook Development area.

(UCR) Seafloor Furrows. Seafloor furrows are present in the northern portion of the area (WR 425 and 426) as shown in Figure 23 below and on Map 4B.



The seismic stratigraphy is composed primarily of parallel and continuous reflectors. The image above illustrates the incisive nature of the furrows into existing parallel stratigraphy. As observed at Cascade, there is some attenuation and focusing of the profiler energy in the tightly spaced, very steep furrows. The "Triplet" is mapped in the Chinook area, Map 5B shows depths bml to the base of the transitional late Pleistocene (low-stand) and current Holocene (high-stand) sediments.

The furrows are evident in the multi-beam data as linear features trending northeast to southwest (Map 4B). In general, individual furrows average about 100 ft wide and 30 ft deep and have relatively steeply dipping walls. In the northwestern corner of WR 425 the furrows are more tightly spaced, often with less than 25 ft between them. Further to the southeast (in the central portion of WR 425) the furrows become more spread out, up to 200 ft apart. These furrows also appear to branch and merge with each other. The exact nature of the seafloor current responsible for the varying appearance of the furrows in this area is not well understood at this time; however, it is possible that the dominant direction and/or intensity of the currents may vary over time (Maps 2B and 4B).

The side-scan data show a striped seafloor of alternating light and dark areas (Map 6B). Soils will be similar to those observed in the furrowed sub-province at Cascade, varying from normally consolidated clays in the areas between the furrows to stiffer, slightly over-consolidated clays, silts, and possible foraminiferal sands along the furrow floors.

The Chinook Tie-Back routes will cross the furrowed area as they traverse north-northeast to the Cascade FPSO (see Figure 22). The routes appear feasible given the observed geologic and geotechnical conditions. The topography of the furrows, and seafloor currents that cause them, should be considered with respect to the route engineering.

(UCR) Seafloor Anti-Dunes. The remaining portions of the Chinook area, which are free of furrows, contain seafloor anti-dunes (Figures 24 and 25 and Map 4B). Anti-dunes are defined as low, undulating bedforms whose crests are in phase with the seafloor currents, therefore they migrate by accretion in the upstream direction. The anti-dunes in the Chinook area are typically 2 to 5 ft in height and spaced about 500 to 700 ft apart. They are randomly distributed, but do seem to become less prominent on the seafloor in the southwestern portion of the area. The side-scan data in this region displays a mottled appearance (Map 4B), with lighter areas indicating where anti-dunes are located.

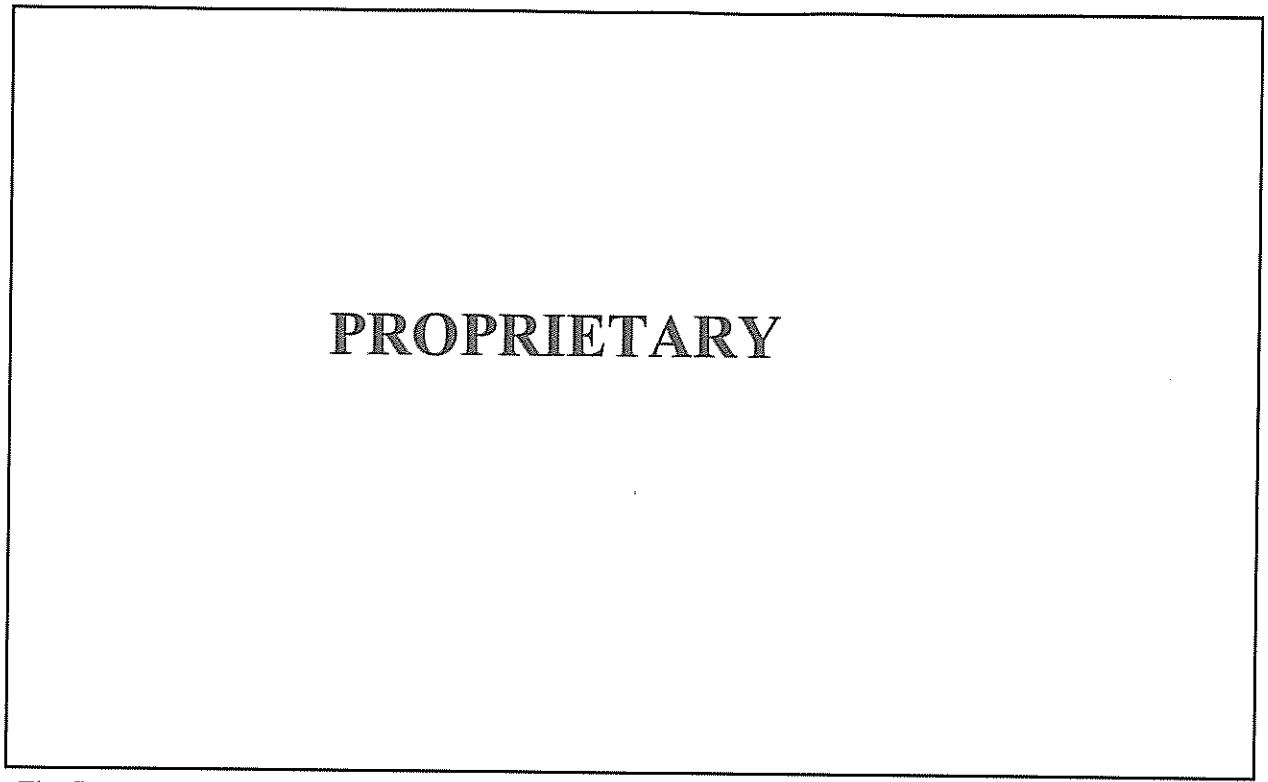
The subbottom data show parallel and continuous reflectors in the shallow stratigraphy beneath this region as shown in Figure 24 below.

PROPRIETARY

The folds are approximately 30 ft in height and roughly 5,000 ft between crests. These folds affect the seafloor and shallow stratigraphy evenly to the limit of the subbottom data. The cause of this deformation is not evident in the data. It is possible these features are related to compaction of large, regional mass-transport deposits deeper in the stratigraphic section.

The Chinook Drill center and southern end of the Chinook Tie-Back routes will be in this sub-province (see Figure 22). The geologic and geotechnical conditions are favorable for these facilities. The currents should be considered with respect to their engineering.

(UCR) Topographic Low. A topographic low with a maximum of 140 ft of seabed relief is located in the central portion of WR 426 (Maps 2B and 4B). This low is a continuation of the topographic low discussed in Section 3 of this report. Figure 26 on the next page is an annotated subbottom profiler of this sub-province.



The figure shows a series of low folds or anticlines in the shallow subsurface. As with Cascade, the feature may be the shallow expression of a deeper paleo-channel that focused both regional mass-transport deposits and landslides emanating from the Escarpment to the north and east of the Chinook area.

The near surface sedimentary section (above the triplet, Map 5B) thickens, by approximately 10 to 15 ft within the low, possibly as a result of erosion of stratigraphy on the higher, more exposed portions of the stratigraphic section. The side-scan data show little variation of surficial sediments, apart from the striping due to furrows in the north, within this feature. Furrows are present in the northwestern portion of the low; however, they terminate abruptly at the edge of the low to the southwest. This suggests that the current regime responsible for the furrow formation may not extend down to the seafloor within this portion of the topographic low. Anti-dunes are present within the low; however, their effect on the seafloor is less pronounced than it is to the south.

A short portion of the Chinook Tie-Back routes will cross the furrowed topographic low (see Figure 22). Engineering of the routes appear feasible in this area with respect to the observed geologic and geotechnical conditions. The seafloor currents should be considered with respect to the routes.

Geotechnical Data

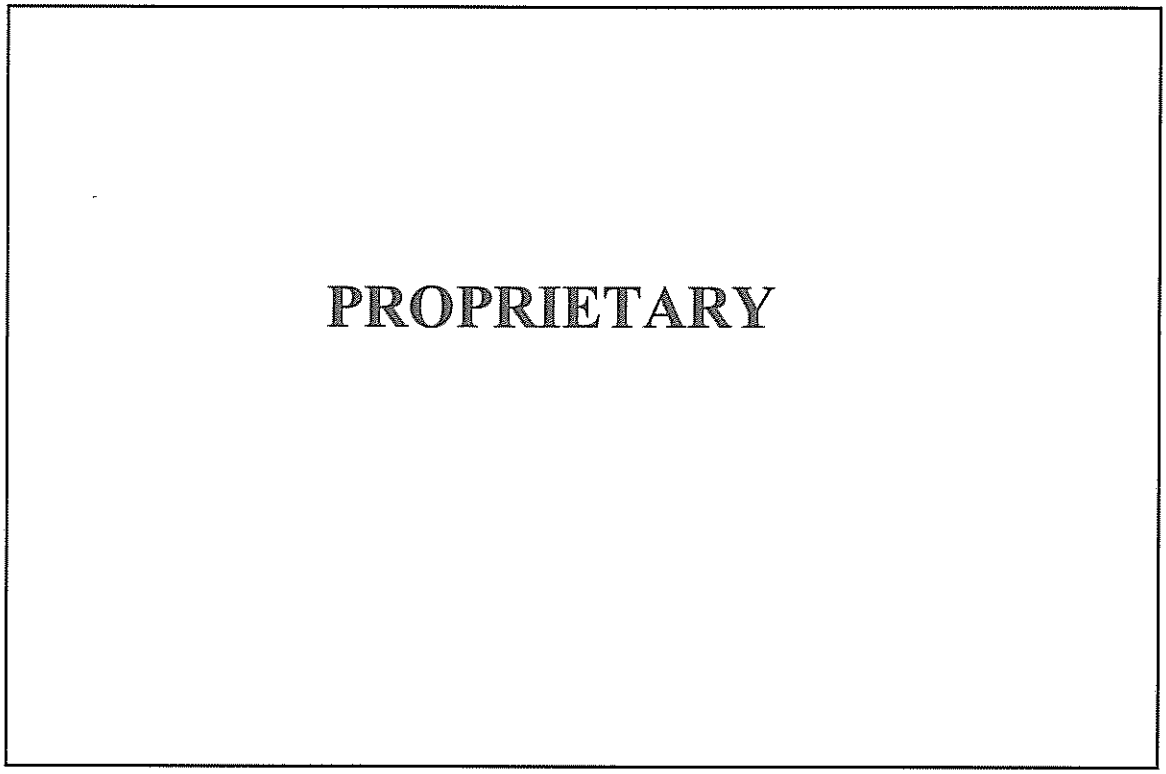
The Chinook area consists of a drill center that will tie-back to the Cascade FPSO via flowlines and umbilicals. The tie-back line traverses through the furrowed region. Three box cores were recovered from this area (Appendix B). The soil properties in the furrowed region are similar to those found in the furrowed region of the Cascade area (Section 3, Figure 13).

Two short cores, one jumbo piston core, and one box core were recovered from the future Chinook drill center location (Appendix B). All the geotechnical lab data is not available at this time. Based on the limited box core data, the moisture contents near surface seem to follow similar profile with depth as observed in the Cascade area, i.e. closer to 150% at surface and reducing to 65%-100% at 12 ft depth. The liquidity index also follows similar trends indicating gain in strength with depth. The Chinook site consists of normally consolidated clays similar to those observed in the Cascade "Fluked" region (Section 3, page 22).

The soil sensitivity along the tie-back route based on the limited data appears to be low. However, the sensitivity of soils at the drill site based on one data point appears to be low to medium. The strengths with depth based on all the data to date in this region are provided in the Figure 27 below.

Piston Core	Box Core
CHPC-1	CHBOX-1
CHPC-2	CHBOX-2
CHPC-3	CHBOX-3
CHPC-4	CHBOX-4
	CHBOX-5
	CHBOX-6
	CHBOX-7
	CHBOX-8

Table 10. List of cores for the Chinook area, UCR province.



The strength of surficial material in certain areas can be expected to be as high as 200 psf. This results from the amount of erosion and reworking of the soils taking place within this area. The fluked region of the topographic low in the Cascade area shows significant erosion, down to the "Triplet" (as defined earlier) in many places exposing older sediments with higher strengths at the seafloor. Whereas, the topographic low in Chinook as mentioned earlier shows a slight thickening of surficial sediments resulting in slightly lower strengths in this area.

Chemosynthetic Communities

Chemosynthetic Communities are not expected within the Chinook Development area. There is no evidence of hydrocarbon seepage to the seafloor in the geophysical data. The multibeam data reveal an eroded seafloor exhibiting furrows and anti-dunes. The side-scan data does not indicate areas of hard seabed or expulsion features. The subbottom profiler data show generally parallel and continuous stratigraphy.

SECTION 5: SEAFLOOR AND SHALLOW GEOLOGY CONDITIONS OF THE CHINOOK TIE-BACK PIPELINE CORRIDOR

Petrobras America Inc. (PAI) is evaluating development of the Chinook area in Walker Ridge Area (WR) in the Gulf of Mexico. PAI has proposed placing a drill center in Block 425 and tie-back flowlines extending from the drill center to the Cascade FPSO (Section 3). The area surveyed for the tie-back corridor includes WR Blocks249, 293, 337, 381 and 425 (Map 1C).

The planned pipeline corridor generally trends south to north from the Chinook drill center located in south-central WR 425 to the Cascade FPSO location in southeastern WR 249. Two pipelines are planned in the corridor. The proposed pipelines are planned as straight line runs departing the Chinook drill center on a north-northeast bearing and crossing WR blocks 381, 337, 293, and ending at the Cascade FPSO riser base PLETS located in WR 249.

Water Depths and Gradient

Water Depth in the route corridor ranges from about -8,170 ft near the Cascade FPSO location in WR 249 to about -8,820 ft south of the Chinook drill center in WR 425 (Maps 2C and 3C). Water depths increase relatively uniformly southward from the Cascade FPSO location to the Chinook drill center, shallowing slightly in northern WR 425.

Seabed gradients range from nearly flat to about 32° with an average along the west and east routs routes of 9° and 10° respectively. The furrowed region of the corridor contains irregular topography with the furrows exhibiting high slope angles along their walls. Seabed dip angle and orientation will vary rapidly over short distances. The following table lists the range in water depth and average seabed gradient for the two routes:

West Route		
Minimum Water Depth	-8,185 ft	Sta. 690+66.71
Maximum Water Depth	-8,794 ft	Sta. 480+00 to 540+00
Average Seafloor Gradient	9° (15.7%)	South
East Route		
Minimum Water Depth	-8,190 ft	Sta. 690+66.71
Maximum Water Depth	-8,794 ft	Sta. 480+00 to 540+00
Average Seafloor Gradient	10° (17.5%)	South

Table 11. Water depth and gradient along the Tie-Back routes.

Seafloor Currents

Seabed anti-dunes and furrows are present within the pipeline corridor and cannot be avoided. The erosional nature of these features indicates the presence of potentially strong bottom currents (possibly exceeding 2 knots) within the tie-back corridor. These currents may, at least in part, originate from strong eddies that spin off the Loop Current and "feel" bottom along the Escarpment.

Seafloor Morphology and Soils

The route corridor has been divided into three soil provinces based on seafloor morphology and core data. The provinces are designated as Seafloor Anti-dunes, Seafloor Furrows, and Seafloor Flukes. Soils data from each province are provided by cores collected along the routes length.

Seafloor Anti-dunes. Anti-dunes are defined as low, undulating bedforms whose crests are in phase with the seafloor currents, therefore they migrate by accretion in the upstream direction. The anti-dunes in the within the corridor are typically 2 to 5 ft in height and spaced about 500 to 700 ft apart (Maps 2C and 3C). The side-scan sonar data in this portion of the corridor show generally light gray from the Chinook drill

center to the start of the furrow field (Map 2C and 3C). This correlates with the core data (i.e. CHBOX-5, CHPC-1, and CHPC-4) which collected primarily very soft clay from the seabed to 17 ft bml. Although, CHPC-1 did collect 0.42 inches of sand at the seabed demonstrating that some variability of soils can be expected.

Seafloor Furrows. Seafloor furrows are present along much of the route corridor and cannot be avoided. The furrows are evident in the multi-beam data as linear features trending northeast to southwest. In general, individual furrows average about 100 ft wide and 30 ft deep and have relatively steeply dipping walls. The side-scan data show a striped seafloor of alternating light and dark areas (Maps 2C and 3C). Soils will vary from normally consolidated clays in the areas between the furrows to stiffer, slightly over-consolidated clays, sand, and shell fragments along the furrow floors. The seafloor currents and resulting furrows should be considered with respect to pipeline engineering.

Sediments

The surficial sediments along the proposed route will vary from silty and clayey sand to very soft clays, occasionally with shell fragments. Primarily soft clays are expected from the start of the routes to the furrows in the Chinook area. Silty sands, clayey sands, sandy clays, and clays mixed with shell fragments are expected along the route where furrows are present. North of the furrowed area to the end of the route in WR 293, the surficial sediments are composed of very soft clays over sandy clay grading to very soft clay westward.

Two short cores, one jumbo piston core, and one box core were recovered from the future Chinook drill center location (Appendix B). All the geotechnical lab data is not available at this time. Based on the limited box core data, the moisture contents near surface seem to follow similar profile with depth as observed in the Cascade area, i.e. closer to 150% at surface and reducing to 65%-100% at 12 ft depth. The liquidity index also follows similar trends indicating gain in strength with depth (Section 4, Figure 27). The strength of surficial material in certain areas can be expected to be as high as 200 psf. This results from the amount of erosion and reworking of the soils taking place within this area.

The near surface soils within this area are mainly very soft to soft high plastic clays becoming firm to stiff with depth (Appendix B). The strengths near surface are in the range of 15-50 PSF with maximum at some locations reaching up to 100 psf, a few inches below the surface (Section 3, Figure 16). Interestingly, the CBOX-2 indicates strengths greater than 150 psf. It is believed that this sample is possibly sandy. A thin drape of foraminiferal clayey-sand is commonly observed in furrowed areas. Ripple marks, indicative of a sandy seabed, have been observed in other furrowed regions below the Escarpment. The moisture content varies between 150% near surface decreasing to 100% around 5ft depth. The liquidity index near surface is in excess of two and drops to one at depth. The sensitivity data indicates low sensitivity over the entire site. The soils appear favorable for installation and operation of the flowlines.

Man-made Features and Conditions

There are no man-made features or conditions that are considered to be a constraint to pipeline installation and operation. The proposed routes will not cross any shipping safety fairways, ordnance or waste disposal sites, or military areas. No shipwrecks are reported within the survey corridor or along the proposed route. No other man-made features or conditions occur along the proposed route that would hinder or constrain pipe-lay activities or operation.

Geologic Conditions along the Proposed West Gas Flowline Route

The proposed West Gas Flowline begins at a PLET (pipeline end termination) structure north of the Chinook drill center (start-of-line, Sta.00+00) and continues in a straight line segment to a PLET near the south riser base at the Cascade FPSO location (end-of-line, Sta. 611+81.01), Map 2C. From Sta. 00+00 to Sta. 37+45 the route traverses seafloor anti-dunes in the Chinook development area. Seafloor furrows are

present from Sta. 37+45.96 to Sta. 538+29.16. North of Sta. 538+29.16 to the end of the route the seafloor contains flukes.

The following tables outline the coordinates for the beginning, termination point, and block crossings as well as water depth and seafloor gradient along the West Flowline route.

Proposed 9 5/8-Inch Gas Pipeline West Route Description					
Designation Points	**X Coordinate (ft)**	**Y Coordinate (ft)**	**Latitude (degrees North)**	**Longitude (degrees West)**	**Station Number**
Start of Pipeline	2,446,912.87'	9,633,069.91'	26° 31' 34.55"	90° 31' 59.20"	00+00.00
Block Crossing WR 425/381	2,448,319.95'	9,646,560.00'	26° 33' 47.81"	90° 31' 40.86"	135+63.28
Block Crossing WR 381/337	2,449,972.15'	9,662,400.00'	26° 36' 24.29"	90° 31' 19.29"	294+89.21
Block Crossing WR 337/293	2,451,624.34'	9,678,240.00'	26° 39' 00.77"	90° 30' 57.71"	454+15.14
End of Pipeline	2,453,259.93'	9,693,920.80'	26° 41' 35.67"	90° 30' 36.32"	611+81.01

Table 12. West Tie-Back block crossings.

Minimum Water Depth	**Maximum Water Depth**	**Average Water Depth**	**Maximum Seafloor Gradient**	**Average Seafloor Gradient**
-8,185 ft	-8,794 ft	-8,530 ft	32.7° / 57.1%	9° / 15.7%
STA. 690+66.71	Sta. 480+00 to 540+00		STA. 184+35	

Table 13. Water depth and gradient along the west Tie-Back route.

Man-made Features and Conditions

The proposed West Flowline will not cross any existing pipelines or wellsites. The locations of side-scan sonar targets relative to the proposed route are show on Maps 1C. The sonar targets are small contacts with little or no relief and are believed to be unknown man-made debris. The nearest sonar target is Target No. 24, located 316 ft east of the flowline route at Sta. 385+36.86 (Map 2C, Sheet 2). The pre-installation ROV survey should be able to identify this potential debris and ascertain whether removal is required.

Chemosynthetic Communities

Chemosynthetic Communities are not expected along the West Flowline route. There is no evidence of hydrocarbon seepage to the seafloor in the geophysical data. The occurrence of periodic strong bottom currents in this area have scoured and eroded the seafloor. The multibeam data reveal an eroded seafloor exhibiting furrows, anti-dunes, and flukes. The side-scan data does not indicate areas of hard seabed or expulsion features.

Geologic Conditions along the Proposed East Gas Flowline Route

The proposed East Gas Flowline begins at a PLET (pipeline end termination) structure north of the Chinook drill center (start-of-line, Sta.00+00) and continues in a straight line segment to a PLET near the south riser base at the Cascade FPSO location (end-of-line, Sta. 610+61.81). From Sta. 00+00 to Sta. 38+88.70 the route traverses seafloor anti-dunes in the Chinook development area. Seafloor furrows are present from Sta. 38+88.70 to Sta. to Sta. 544+88.34. North of Sta. 544+88.34 to the end of the route the seafloor contains flukes.

The following tables outlines the coordinates for the beginning, termination point, and block crossings as well as water depth and seafloor gradient along the East Flowline route.

Proposed 9 5/8-Inch Gas Pipeline East Route Description					
Designation Points	**X Coordinate (ft)**	**Y Coordinate (ft)**	**Latitude (degrees North)**	**Longitude (degrees West)**	**Station Number**
Start of Flowline	2,447,145.93'	9,633,044.60'	26° 31' 34.25"	90° 31' 56.64"	00+00.00
Block Crossing WR 425/381	2,448,586.97'	9,646,560.00'	26° 33' 47.76"	90° 31' 37.92"	135+92.01
Block Crossing WR 381/337	2,450,275.86'	9,662,400.00'	26° 36' 24.23"	90° 31' 15.95"	295+21.79
Block Crossing WR 337/293	2,451,964.76'	9,678,240.00'	26° 39' 00.70"	90° 30' 53.96"	454+51.57
End of Pipeline	2,453,619.77'	9,693,762.26'	26° 41' 34.03"	90° 30' 32.39"	610+61.81

Table 14. West Tie-Back block crossings.

Minimum Water Depth	**Maximum Water Depth**	**Average Water Depth**	**Maximum Seafloor Gradient**	**Average Slope**
-8,190 ft	-8,794 ft	-8,531 ft	32.0° / 55.9%	9° / 15.7%
STA. 690+66.71	Sta. 480+00 to 540+00		STA. 510+00	

Table 15. Water depth and gradient along the east Tie-Back route.

Man-made Features and Conditions

The proposed East Flowline will not cross any existing pipelines or wellsites. The locations of side-scan sonar targets relative to the proposed route are show on Maps 1C. The sonar targets are small contacts with little or no relief. The nearest sonar target is Target No. 24, located 6.8 ft west of the flowline route at Sta. 385+37.94 (Map 3C, Sheet 2). The pre-installation ROV survey should be able to identify this potential debris and ascertain whether removal is required.

Chemosynthetic Communities

Chemosynthetic Communities are not expected along the East Flowline route. There is no evidence of hydrocarbon seepage to the seafloor in the geophysical data. The occurrence of periodic strong bottom currents in this area have scoured and eroded the seafloor. The multibeam data reveal an eroded seafloor exhibiting furrows, anti-dunes, and flukes. The side-scan data does not indicate areas of hard seabed or expulsion features.

SECTION 6: FINDINGS AND RECOMMENDATIONS

The Cascade and Chinook development has a planned FPSO facility to be emplaced in the southeast corner of WR 249, drill centers in WR 205, 249, and 425, a tie-back pipeline between the drill center in WR 425 and the FPSO, and various infield flowlines and umbilicals. The proposed Cascade, Chinook, and Chinook Tie-Back flowlines appear feasible for development.

GEMS conducted an integrated geologic and geotechnical study for the Cascade and Chinook Prospects. GEMS coordinated a geophysical survey conducted by C&C Technologies, Inc., using their AUV system to acquire multibeam swath bathymetry, sidescan sonar, and subbottom profiler data. An extensive geotechnical program has also been conducted. All data were used to assess the site conditions for the planned drilling and production activities.

Cascade Development Area

The Cascade area displays a variety of seafloor and geologic features resulting from past salt related structural deformation as well as past and present seafloor erosion. The most prominent feature is the Sigsbee Escarpment, which crosses the northwestern part of the area. The Escarpment itself has variable gradients and thickness of sedimentary cover overlying older very stiff to hard soils. Faulting in many places along the Escarpment results in a rough topography, has uplifted and exposed older strata, and contributed to numerous past failures.

In the area of the development itself, below the Escarpment on the Upper Continental Rise, seafloor currents have significantly eroded the seabed below the Escarpment resulting in extensive furrows and flukes on the seafloor. The furrows average about 100 ft wide and 30 ft deep and have relatively steeply dipping walls and are tightly spaced, averaging between 75 and 100 ft apart. The flukes are about 150 to 200 ft in length and can be up to 10 ft in height, but more typically average between 5 and 8 ft high.

The following findings are made based on examination of available data for the Cascade area:

1. The water depth in the Cascade area varies from 5,637 ft to 8,510 ft and seafloor gradients range from nearly 0° to approximately 70° along the steeper portions of the Sigsbee Escarpment.
2. The area consists of three geomorphologic provinces, the Lower Continental Slope, the Sigsbee Escarpment, and the Upper Continental Rise with the Escarpment crossing the northeastern portion of the area.
3. The Escarpment displays high slope angles and rugged topography.
4. Seafloor furrows and flukes are present over most of the proposed Cascade, Chinook, and Chinook Tie-Back proposed facilities areas.
5. Periodic strong seabed currents are responsible for the formation of the furrows and flukes.
6. Several gas expulsion mounds are observed on the Lower Continental Slope in the northeast portion of WR 160, but will be over a mile from any possible future architecture (Export Option 2) and far from the main development below the Escarpment.
7. The shallow stratigraphy over the area consists generally of parallel bedded, differentially eroded hemipelagic clays resulting in varying soil properties at the seabed. Sands and coarse lag deposits may exist in the bottom of the furrows and be distributed throughout the area
8. Slump deposits from the Escarpment form debris aprons that extend ~1.0 mile from the base of the Escarpment. The nearest proposed facility is 0.5 mile from the most distal apron.
9. There are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact field development. The potential for encountering chemosynthetic communities is remote.

10. .With the exception of the existing exploration wellsites, there are no other man-made structures reported in the Cascade area.

Chinook Development Area

The Chinook Development appears feasible based on the observed geologic and geotechnical data. The following findings are made based on examination of available data for the Chinook area:

1. Water depths in the Chinook Development area range from 8,607 ft 9,260 ft and seafloor gradients range from nearly 0° to about 50° along the walls of furrows.
2. The shallow stratigraphy over the area consists generally of parallel bedded, differentially eroded hemipelagic clays. Sands are present along the floors of the furrows.
3. The Chinook area displays active erosional seafloor features consisting of furrows and anti-dunes.
4. Periodic strong seabed currents are responsible for the formation of the furrows and anti-dunes.
5. The furrows are located in the northern portion of the area and the anti-dunes are present in the south and east.
6. The furrows are similar in size and spacing as those identified in the Cascade area.
7. The anti-dunes are typically 2 to 5 ft in height and spaced about 500 to 700 ft apart.
8. The proposed Drill Center lies in the anti-dune area.
9. The proposed Chinook Tie-Back routes begin at the Drill Center in the anti-dune area and will encounter the furrows as they traverse north-northeast to the Cascade FPSO.
10. There are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact field development. The potential for encountering chemosynthetic communities is remote.
11. With the exception of the existing exploration wellsites, there are no other man-made structures reported in the Cascade area.

Chinook Tie-Back Corridor

The Tie-Back corridor traverses the seafloor between the Chinook Drill Center and the proposed Cascade FPSO location. The seafloor within the corridor is furrowed over much of its length. Seafloor flukes exist at the northern end of the corridor, near the FPSO location, and anti-dunes are present at the Chinook Drill Center in the south.

The following findings are made based on examination of available data for the Chinook area:

1. There are two proposed gas tie-back pipelines routes and one production umbilical in a corridor.
2. Water depths in the corridor range from -8,820 ft to -8,170 ft and seabed gradients in the corridor range from nearly 0° to locally approaching 32°, with an average along the west and east routes of 9° and 10° respectively.
3. The shallow stratigraphy beneath the corridor consists generally of parallel bedded, differentially eroded hemipelagic clays. Sands are present along the floors of the furrows.
4. Periodic strong seabed currents are responsible for the formation of the furrows and anti-dunes.
5. Irregular seafloor consisting of anti-dunes, furrows, and flukes are present at various locations along the entire length of the corridor.
6. Sonar Contact No. 24 lies very near the proposed East Gas Pipeline Route at about Sta. 385+37.94. This target, which has no measurable height, is 4-ft wide, and 10-ft long, and may be modern debris. No other sonar contacts lie directly along the proposed pipeline or umbilical routes.

7. There are no geologic constraints such as active faulting, gas venting, or hard bottom conditions that would impact pipeline lay operations. The potential for encountering chemosynthetic communities is remote.

Summary of Geologic and Geotechnical Findings With Respect to Proposed Field Architecture

The table beginning on the next page provides a summary of the geologic processes and geotechnical conditions for each of the physiographic provinces defined in sections 3, 4, and 5 of this report and describes which proposed facilities will fall into these conditions.

Table 16. SUMMARY TABLE:

Physiographic Region		Geologic Conditions	Geotechnical Properties	Comments	Planned Infrastructure
LOWER CONTINENTAL SLOPE		1) The shallow stratigraphy, to approximately 260 ft below the mud-line consists of well layered to amorphous reflectors. 2) The base of this surficial unit is identified as the "Triplet". 3) Carbon-14 dating of the three distinct silt-rich layers indicate that the layers were deposited between ~18.9 – 20.2 ka (1ka=1000 yrs) slightly before the end of the last low stand, i.e., Pleistocene/Holocene boundary.	1) Soils in these areas are generally high plastic, clays with a low sensitivity. 2) The soils are fairly uniform over the areal extent and are normally to slightly over-consolidated. 3) The moisture content near surface is in excess of 100% and it reduces to approximately 70% at 20 ft depth. 4) Shear strength increases linearly with depth. The strength of the surficial sediments varies between 40 psf and 70 psf. At some locations strengths in surficial sediments have been measured up to 150 psf.	1) The Triplet is an important marker horizon in the area because it both marks the base of the transitional late Pleistocene (low-stand) and current Holocene (high-stand) sediments. Both of these are present above and below the Sigsbee Escarpment. 2) Faults are present, caused by the underlying salt movement, and have resulted in the uplift and erosion of the sediments above the triplet in various portions of the area. Below the Triplet the stratigraphy can be characterized by parallel continuous layers. 3) Occasionally, strengths in surficial sediments can be expected to be as high as 150 psf.	The potential Gas Export Option 2 route is the only planned infrastructure in this region. The geologic and geotechnical conditions are favorable for pipeline installation and operation.
SIGSBEE ECARPMENT	Upper Scarp	1) The upper scarp is rugged, faulted, and steeply dipping. 2) Faults are salt rooted, trend parallel to the Escarpment face, and are typically downthrown to the southwest. Throw across the faults is highly variable, but is as much as 20 ft. 3) Thin to absent drape, or outcropping strata characterize the upper and lower scarps.	1) The moisture content of near surface sediments is in excess of 100% but drops rapidly 50% within few inches. 2) The shear strengths vary based on sampling of the normally consolidated drape or the much stiffer, overconsolidated underlying strata.	1) The currents are exposing the stiffer layers due to erosion.	The potential Gas Export Option 2 route will traverse the Upper Scarp. Spans and flowline stability should be considered with respect to engineering. Future additional, site-specific studies may be pertinent with respect to topography, soils, stability, and chemosynthetic communities.

Physiographic Region		Geologic Conditions	Geotechnical Properties	Comments	Planned Infrastructure
	Bench	1) The bench is widest and smoothest in WR 205 and thins and becomes more rugged to the north and south. 2) A possible drop in current velocity allows for the deposition and ponding and preservation of sediments, of varying thicknesses, over the bench.	1) The strength of these sediments is lower than the ones observed in both the Upper and Lower scarps. This material is underlain by stiffer material, probably the continuation of the sequences observed in the Upper and Lower Scarps. 2) The shear strengths vary based on sampling of the normally consolidated drape or the much stiffer, overconsolidated underlying strata.	1) The Bench is the transition between the Upper Scarp and Lower Scarp.	The potential Gas Export Option 2 route will traverse the Bench. Spans and flowline stability should be considered with respect to engineering. Future additional, site-specific studies may be pertinent with respect to topography, soils, stability, and chemosynthetic communities.
	Lower Scarp	1) Numerous slumps and gullies incise the lower scarp with debris aprons extending up to approximately 1 mile out onto the Upper Continental Rise.	1) The liquidity index of surficial layer is slightly less than 0.5 2) The shear strengths vary based on sampling of the normally consolidated drape or the much stiffer, overconsolidated underlying strata. The strength of this underlying strata is observed to be stronger than that of the Upper Scarp and Bench.	1) Furrows are present on the Escarpment and indicate seabed currents are actively eroding and re-depositing the surficial sediments. 2) Seafloor expression of a thrust wedge is evident at the base of the Lower Scarp.	The potential Gas Export Option 2 route will traverse the Lower Scarp. Spans and flowline stability should be considered with respect to engineering. Future additional, site-specific studies may be pertinent with respect to topography, soils, stability, and chemosynthetic communities.

Physiographic Region		Geologic Conditions	Geotechnical Properties	Comments	Planned Infrastructure
UPPER CONTINENTAL RISE	Furrows & Flukes	1) This region is more extensive in the south, extending out from the Escarpment about 3.5 miles, while to the north the region thins, limited to the seafloor within about 2,000 ft of the Escarpment. 2) A combination of thrust fault related uplift, slump deposition derived from the Escarpment and current erosion result in a high degree of variability in shallow seafloor soils.	1) The near surface moisture content in this region is approximately 100% reducing to 60% at depth. 2) The soils are normally to slightly over consolidated. 3) The liquidity index has a value of 1.5 near surface and drops below one at twelve feet depth.	1) The area is between the Escarpment and "Fluke" region to the south. This forms the part of the "Upper Continental Rise". 2) The soils within this entire region are generally uniform with subtle differences in their geotechnical properties.	The SW Cascade drill center and infield flowlines and umbilicals associated with the SW drill center are located in this province. The geologic and geotechnical conditions are favorable for shallow foundations. The seafloor currents should be considered in this area. The topography of the furrows and flukes should be considered with respect to placement of the individual field architecture.
	Flukes	1) Flukes are about 150 to 200 ft in length and can be up to 10 ft in height, but more typically average between 5 and 8 ft high. 2) Seafloor currents are thought to be stronger in fluked regions.	1) High plastic normally to slightly over-consolidated clays at depth. 2) Moisture content in excess 0f 100% near surface decreasing close to 30% at 500 ft depth. 3) Soils near surface slightly stiffer than "Furrowed" area.	1) The side-scan sonar data show a mottled appearance indicating a high variability in surficial sediments. 2) Seafloor currents have eroded surficial layer and exposed stiffer material near surface in some areas. Strengths closer to 400 psf can be expected in those areas. 3) Based on the current data, the strength estimates determined using overall strength relationship with the exception of lower bound strength, are expected to be within $\pm$ 25% of the location specific data.	Infrastructure located within this province include: the riser bases for the FPSO, the north and southwest FPSO mooring clusters, infield flowlines and umbilicals, and the Chinook tie-back pipeline. The geologic and geotechnical conditions are favorable for shallow foundations. The seafloor currents should be considered in this area. The topography of the flukes should be considered with respect to placement of the individual field architecture..

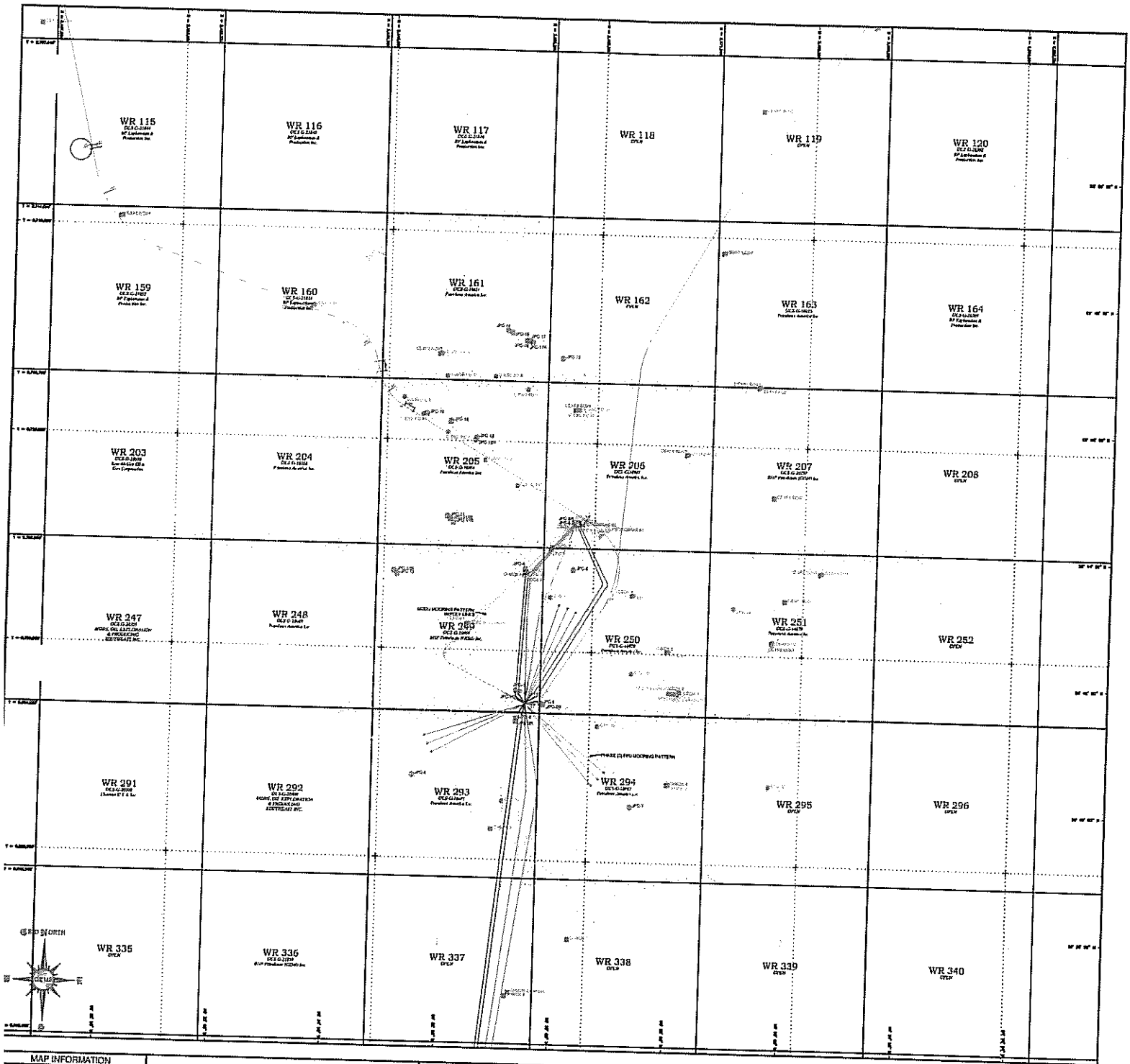
Physiographic Region		Geologic Conditions	Geotechnical Properties	Comments	Planned Infrastructure
UPPER CONTINENTAL RISE	Furrows	1) In general individual furrows average about 100 ft wide and 30 ft deep and have relatively steeply dipping walls. 2) The furrows are tightly spaced, averaging between 75 and 100 ft apart.	1) The soils are normally to slightly overconsolidated 2) The moisture content of 150% near surface decreasing to 100% around 5ft depth. 3) L.I. >2 near surface and decreasing to one at depth. 4) The sensitivity data indicates low sensitivity.	1) Along the furrow floors strengths near surface can be expected to be in excess of 100 psf. 2) Foraminifera sand may cover the furrow floors as well as be randomly distributed over the area. This sand is mobile, being eroded and reworked by periodic active seafloor currents.	The FPSO southeast mooring cluster is located within this province. The geologic and geotechnical conditions are favorable for shallow foundations. The topography of the furrows should be considered with respect to placement of the individual moorings. The seafloor currents should be considered in this area.
	Topographic Low	1) The low is possibly the remnant of a filled channel or results from landslides emanating from the Escarpment to the south and east of the Cascade area. 2) The flukes and furrows continue into the low; however, their effect on the seafloor is less pronounced.	1) The soils are normally to slightly overconsolidated.	1) Soils in this area are generally stronger than the soils observed in "Flukes" area. 2) The strength estimates determined using overall strength relationship with the exception of lower bound strength, are expected to be 20-30% lower than those determined using location specific data.	The southwest FPSO mooring cluster and the Chinook tie-back pipeline are located within the topographic low. The results of this study should be integrated with the in-process deep geotechnical investigation results to address foundation design for the FPSO moorings at Cascade. The topography of the furrows in this area at Chinook should be considered in the pipeline design. The seafloor currents should be considered in this area.
	Seafloor Anti-Dunes	1)The anti-dunes are typically 2 to 5 ft in height and spaced about 500 to 700 ft apart. 2)The anti-dunes are randomly distributed, but become less prominent to the southwest.	1) Normally consolidated clays similar to the "fluked" province. 2) The moisture content of 150% near surface decreasing to 65%-100% at 12ft depth. 3) The sensitivity data indicates low sensitivity.		The Chinook drill center and the tie-back pipeline are located in this province. The geologic and geotechnical conditions are favorable for shallow foundations. The seafloor currents should be considered in this area.

Recommendations

The observations of the geologic and geotechnical conditions in the Cascade, Chinook, and Chinook Tie-Back Corridor appear feasible for development. We provide the following recommendations based on the observed conditions and our previous experience on deepwater projects below the Sigsbee Escarpment:

1. Consider the local seabed topography in the furrows, flukes, and furrow/flukes soil provinces at Cascade with respect to the placement of individual pieces of seafloor and shallow-founded field architecture such as FPSO moorings, PLETS, PLEMS, manifolds, pumps, and riser bases.
2. Consider the topography in the furrows, flukes, and furrow/flukes soil provinces at Cascade with respect to the design of infield, tie-back, and gas export flowlines.
3. Consider the periodically strong currents that have caused the erosion over this broad region with respect to scour and overall facilities engineering.
4. Conduct current monitoring studies to full establish the range of velocities of these currents near the seabed.
5. If Export Option 2 is selected, consider more site-specific, detailed studies with respect to the local topography, soil conditions, slope stability, and potential presence of chemosynthetic communities on the Sigsbee Escarpment crossing.
6. Conduct a future slope stability assessment for the Sigsbee Escarpment to assess the slope conditions with respect to the location of the proposed facilities at Cascade.
7. Consider the topography through the furrowed regions with respect to detailed design of the Chinook Tie-Back flowlines upon completion of the planned higher-resolution bathymetric survey along the Chinook Tie-Back corridor.
8. Integrate the results of the Jumbo Piston Core and Rotary Soil Borings and PCPT geotechnical investigations with the existing geophysical and shallow geotechnical data to assist in engineering design of the various seabed and shallow foundations.

If the facilities layouts for the various developments are modified, this report can be used as a basis to assess the geologic and very shallow geotechnical site conditions with respect to the new layout(s).



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

NOTE:
INFRASTRUCTURE INCLUDED ON THIS MAP IS BASED ON INFORMATION OBTAINED FROM THE MMS DATABASE (MMS, 2007). TIES UPDATED APRIL, 2007.

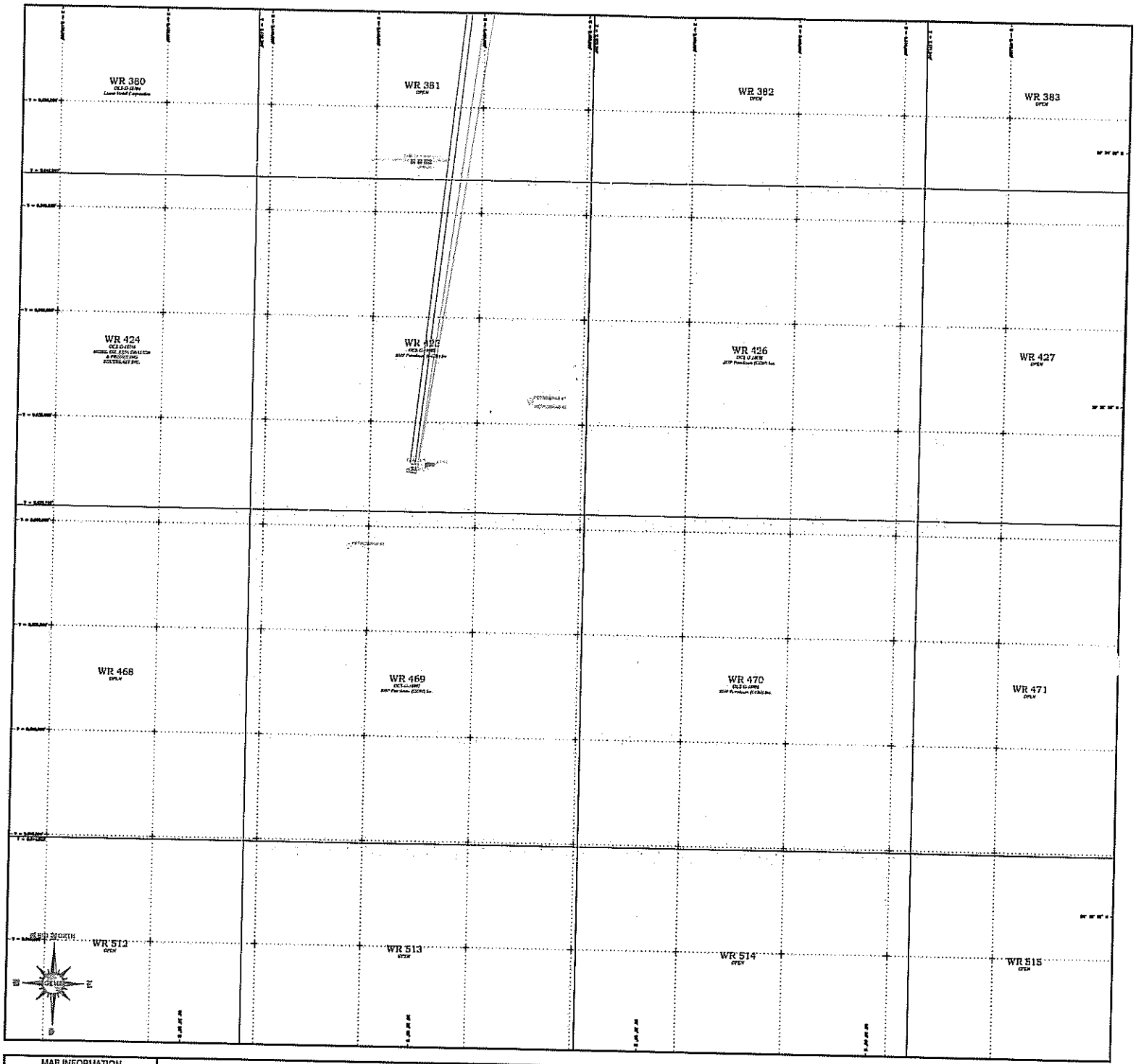
PETROBRAS AMERICA INC.

BASE MAP
CASCADE
DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 1R

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

NOTE:

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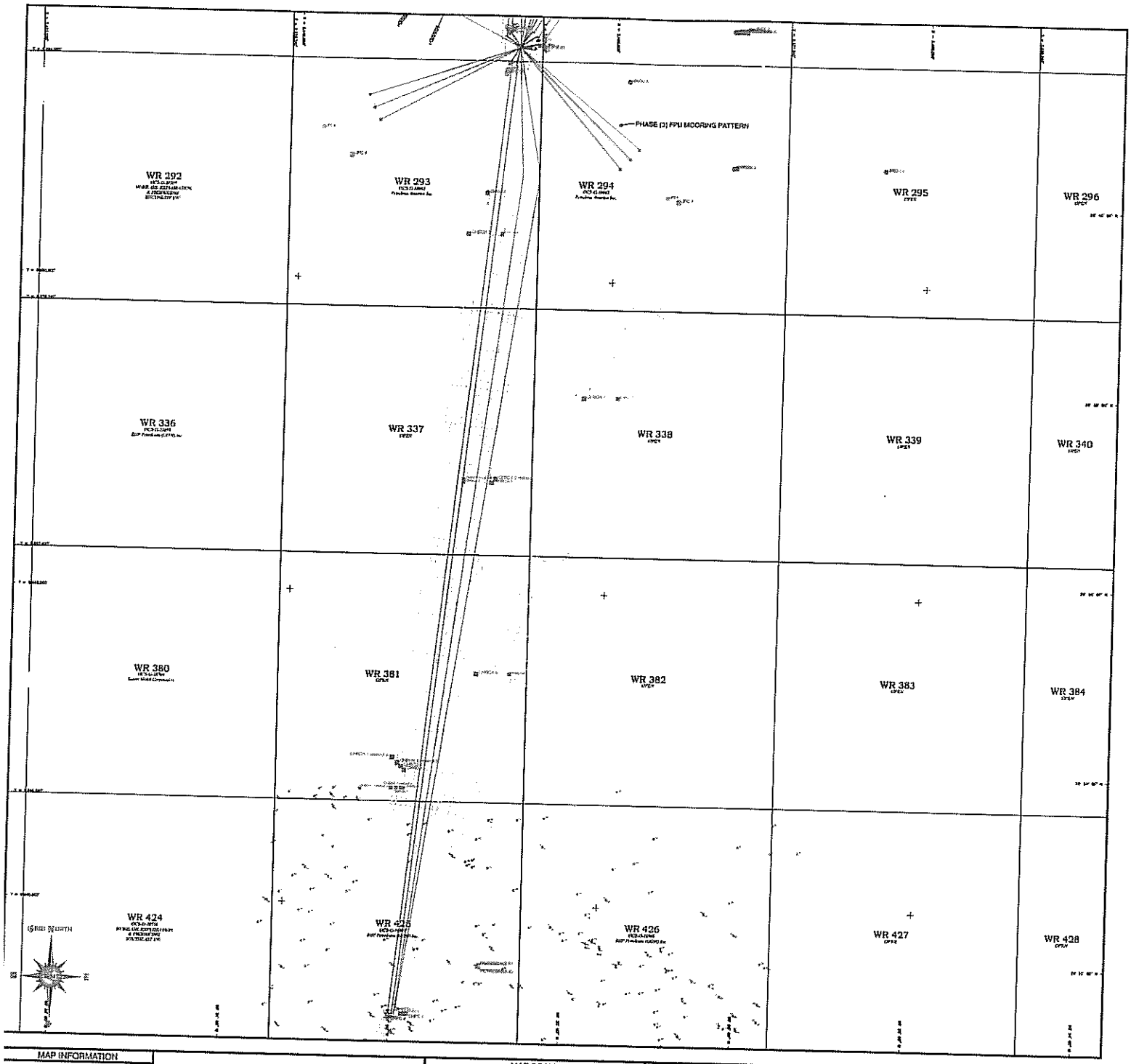
BASE MAP
CHINOOK
DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 1b

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

NOTE:

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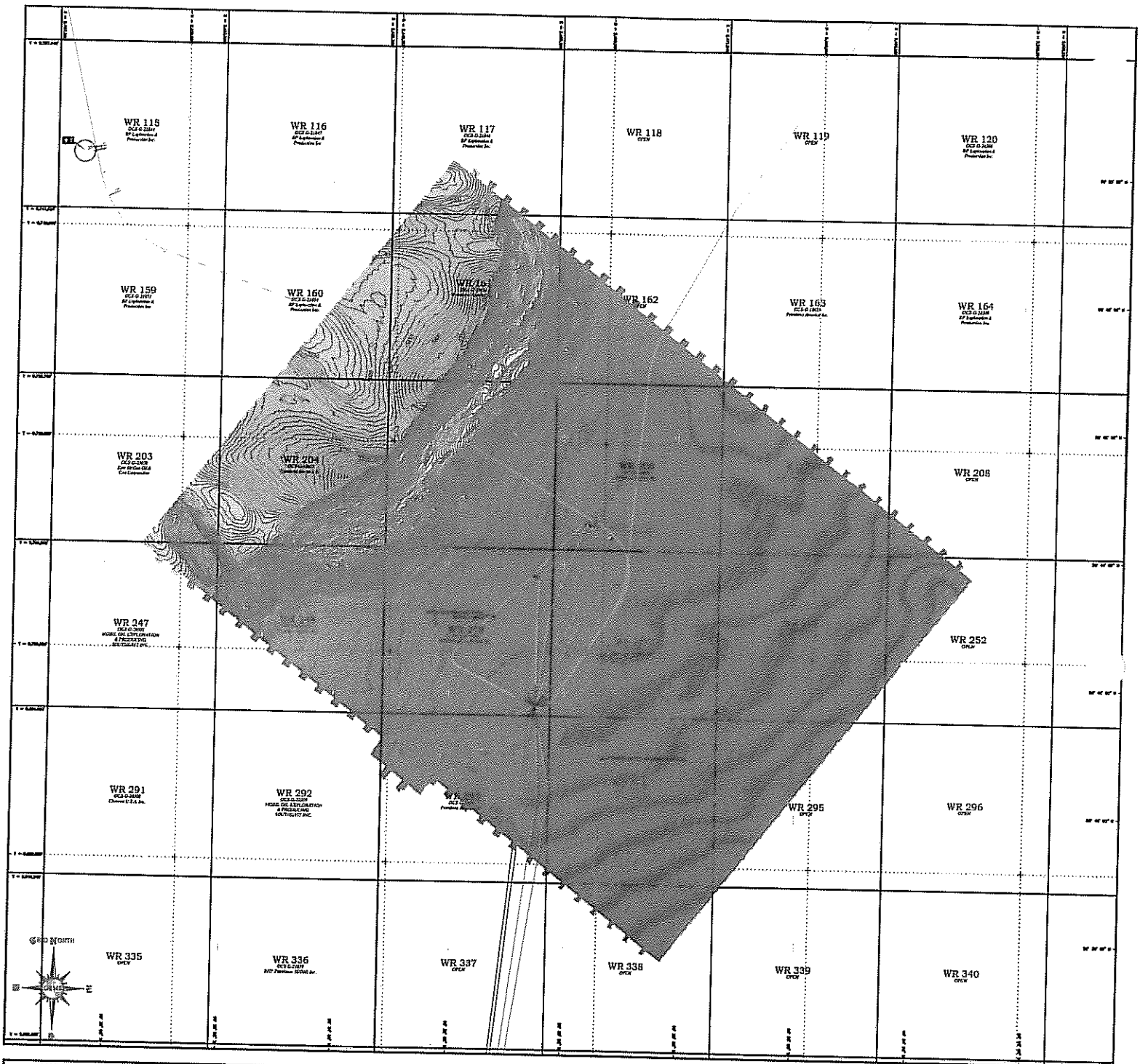
REGIONAL STUDY MAP CHINOOK TIE-BACK

BLOCKS 292-296, 336-340, 380-383, AND 424-428
WALKER RIDGE AREA
GULF OF MEXICO

DRAFT

MAP NO. 1c

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

GRID & CONTOUR INFORMATION

NOTE:

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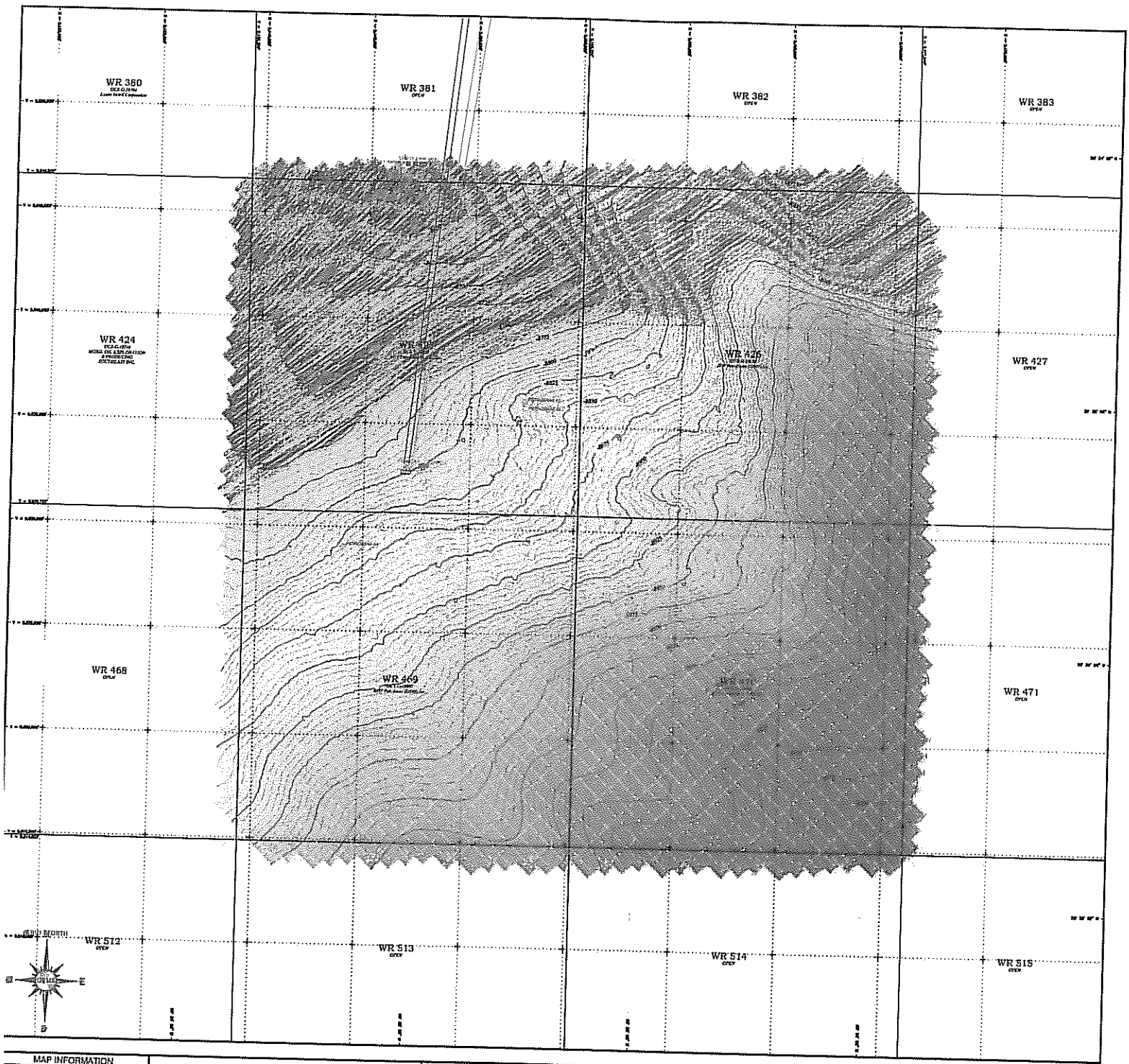
BATHYMETRY MAP CASCADE DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 2a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

SCALE 1 : 15,000
SCALE 1" = 1250'

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

GRID & CONTOUR INFORMATION

NOTE:
INFRASTRUCTURE INCLUDED ON THIS MAP IS BASED ON INFORMATION OBTAINED FROM THE MMS DATABASE (MMS, 2007). FILE UPDATED APRIL, 2008.

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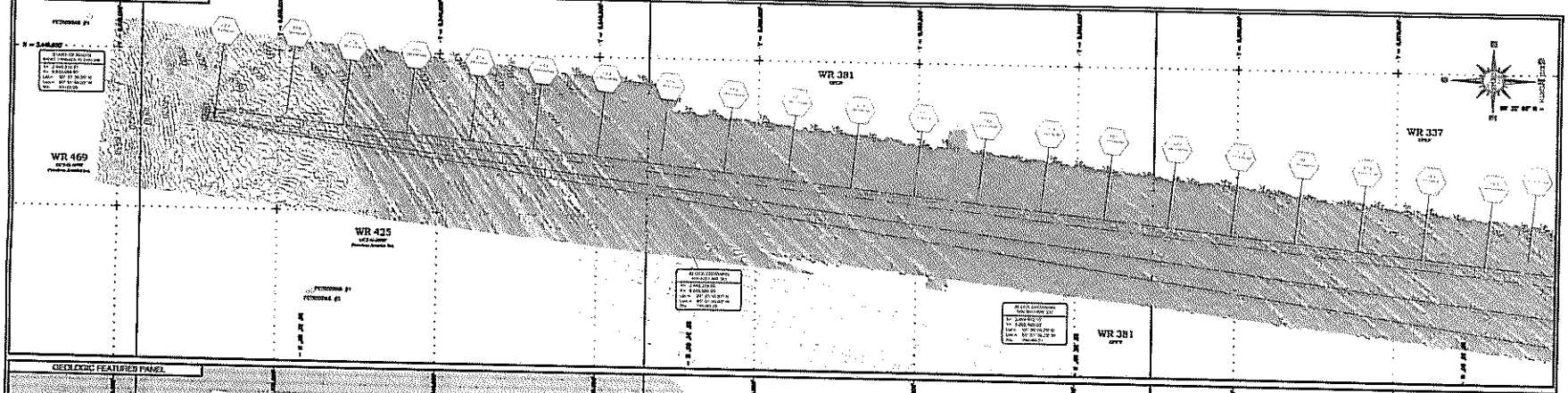
BATHYMETRY MAP
CHINOOK DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

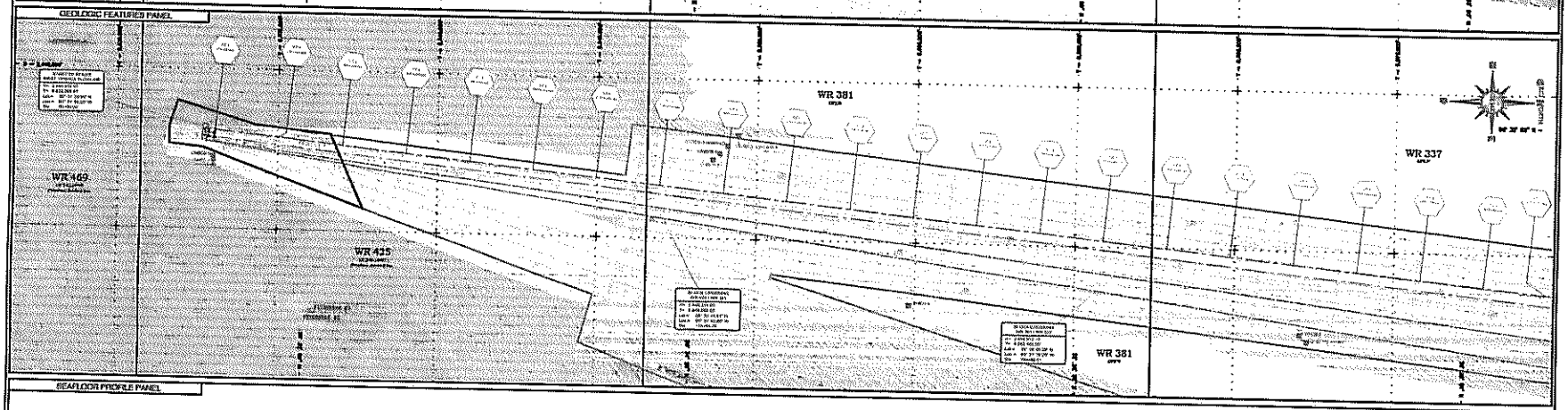
MAP NO. 2b

GEOSCIENCE EARTH & MARINE SERVICES, INC.

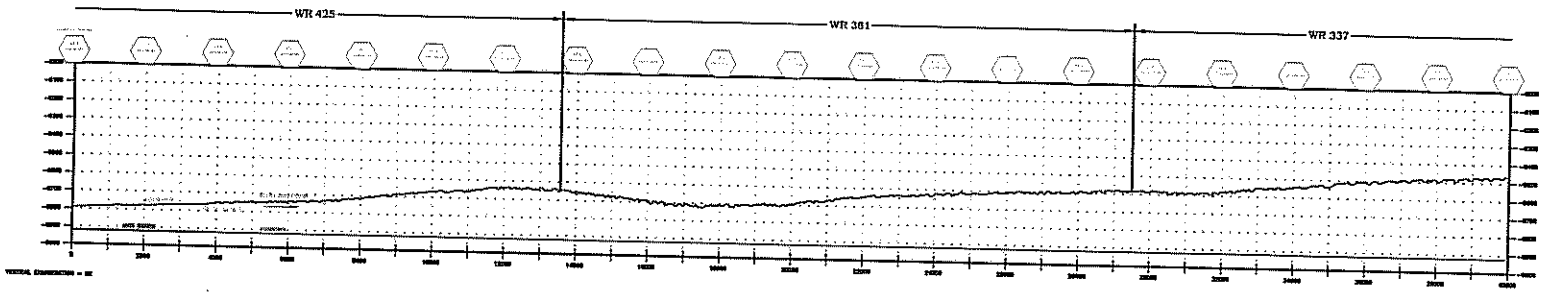
BATHYMETRY PANEL



GEOLOGIC FEATURES PANEL



SEAFLOOR PROFILE PANEL



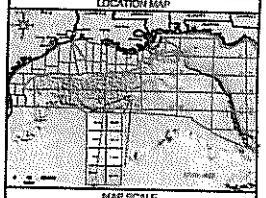
MAP INFORMATION

GRID & CONTOUR INFORMATION

MAPPING INFORMATION

GEODETIC INFORMATION

LOCATION MAP



MAP SCALE

PETROBRAS

PETROBRAS AMERICA, INC.

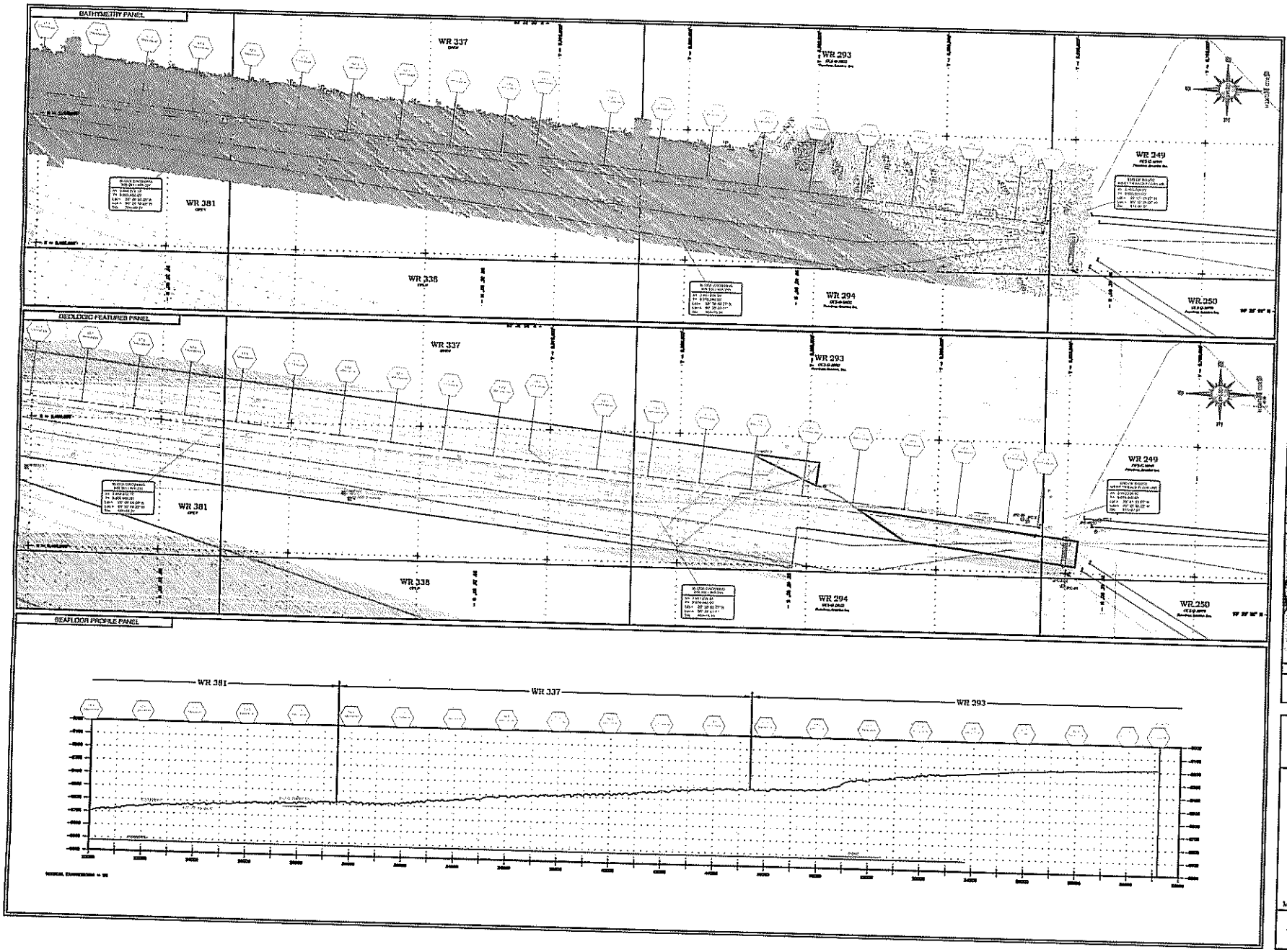
WEST FLOWLINE ALIGNMENT SHEET

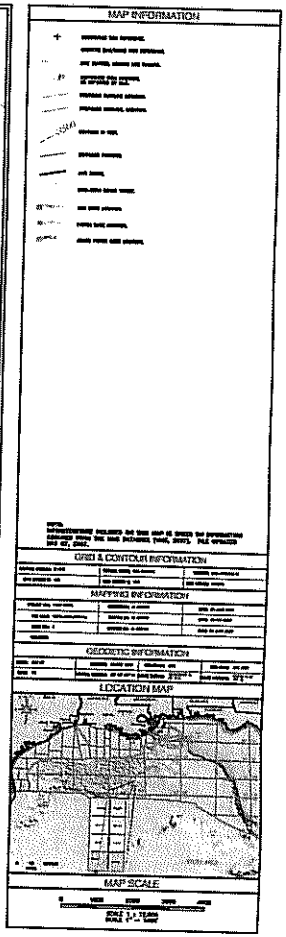
WALKER RIDGE AREA
BLOCK 425 TO
WALKER RIDGE AREA
BLOCK 293
GULF OF MEXICO

MAP NO. 2C

SHEET 1 OF 2

GEOSCIENCE EARTH & MARINE SERVICES, INC.





PETROBRAS

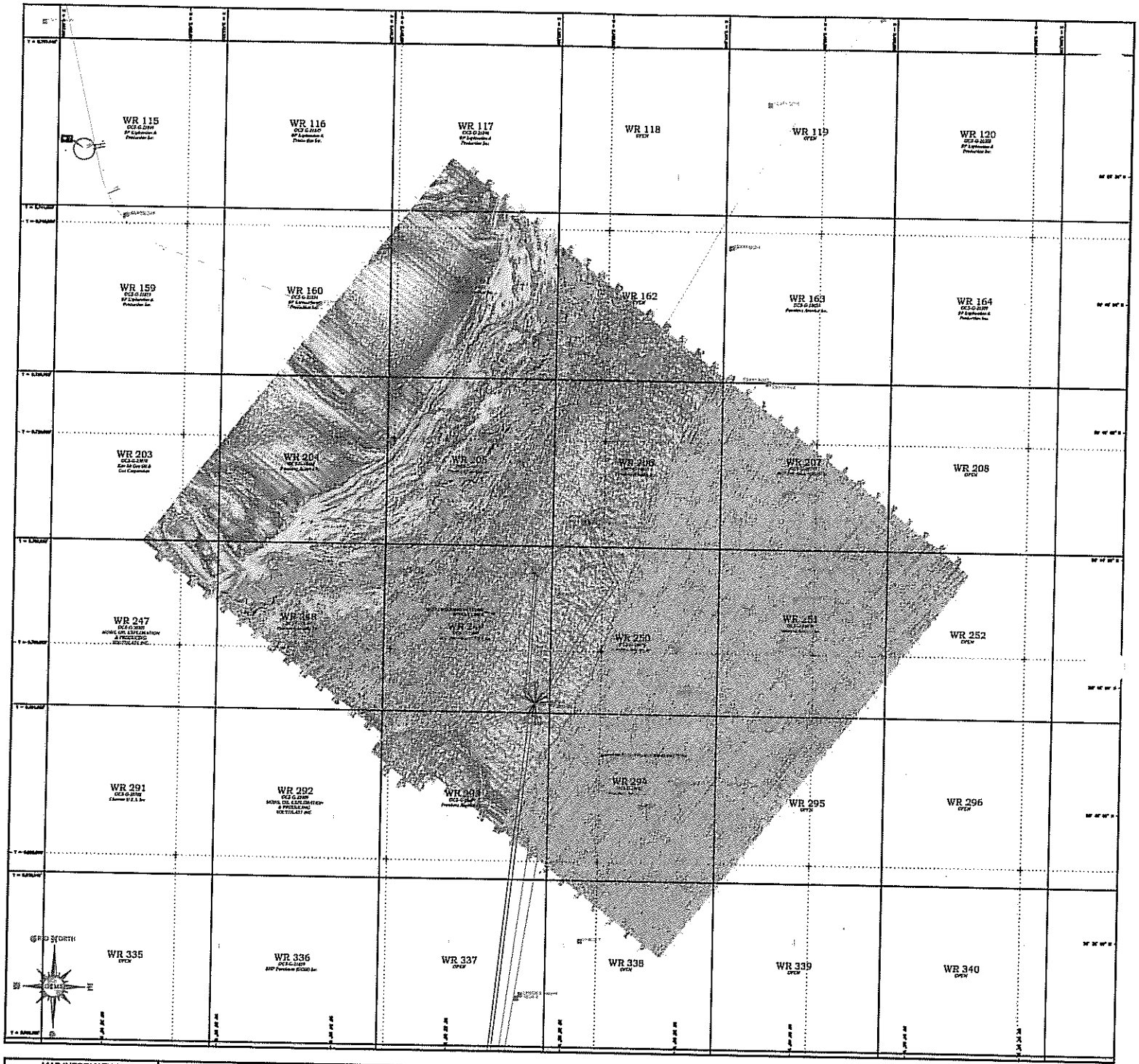
PETROBRAS AMERICA, INC.

WEST FLOWLINE ALIGNMENT SHEET

WALKER RIDGE AREA
BLOCK 425 TO
WALKER RIDGE AREA
BLOCK 293
GULF OF MEXICO

MAP NO. 2C SHEET 2 OF 2

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

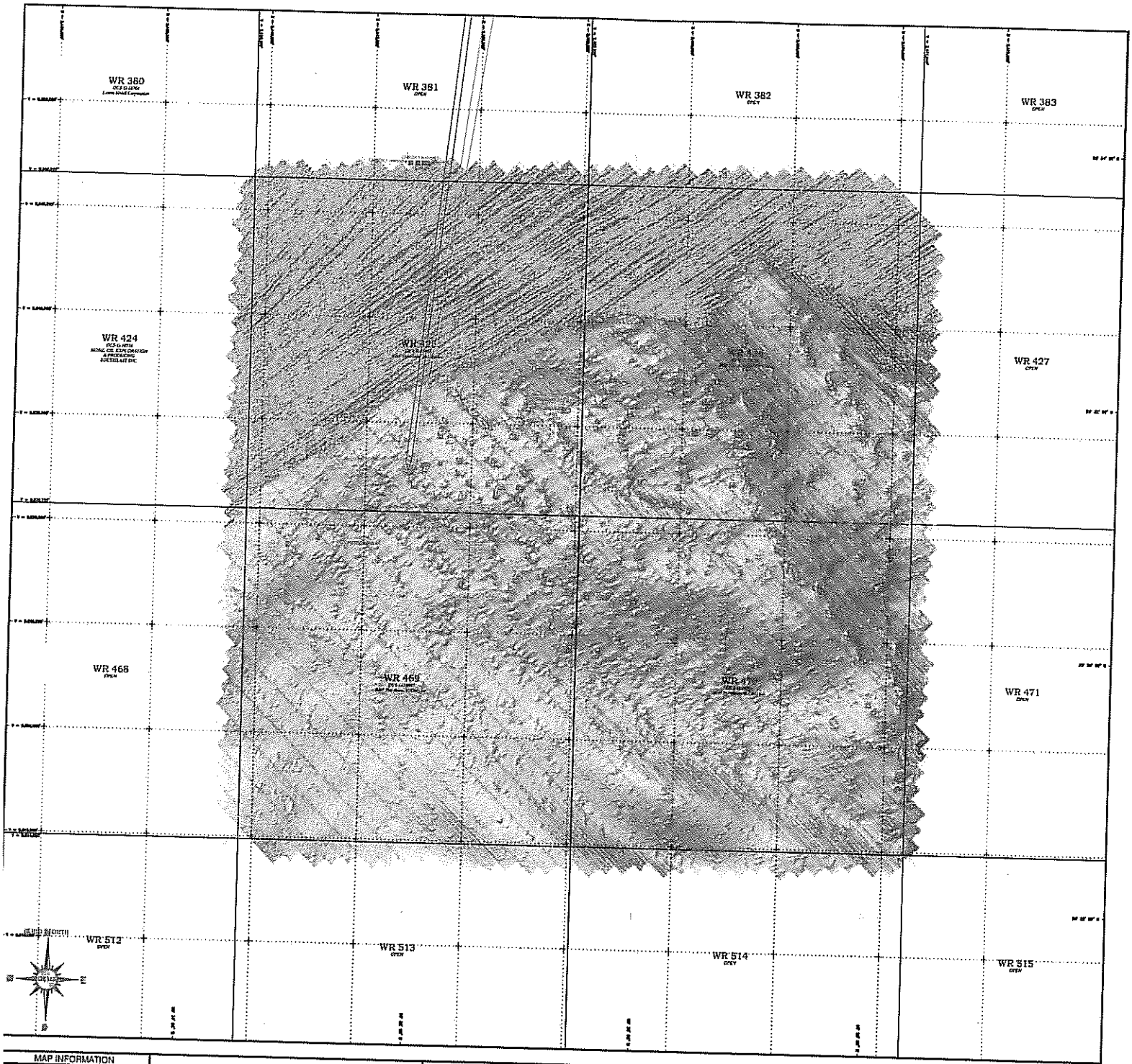
PETROBRAS AMERICA INC.

SEAFLOOR GRADIENT MAP CASCADE DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 3a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

PETROBRAS AMERICA INC.

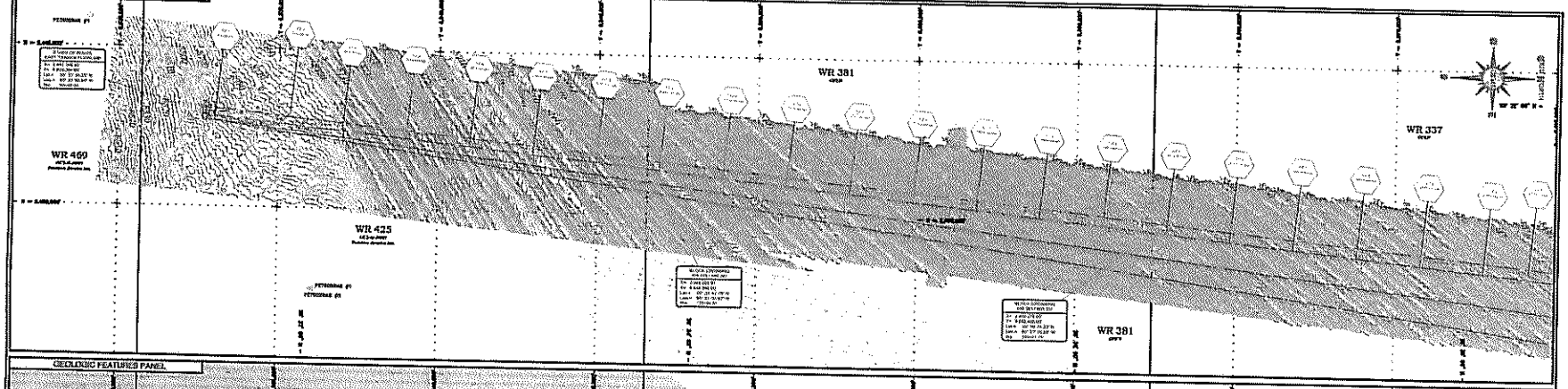
SEAFLOOR GRADIENT MAP
CHINOOK
DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

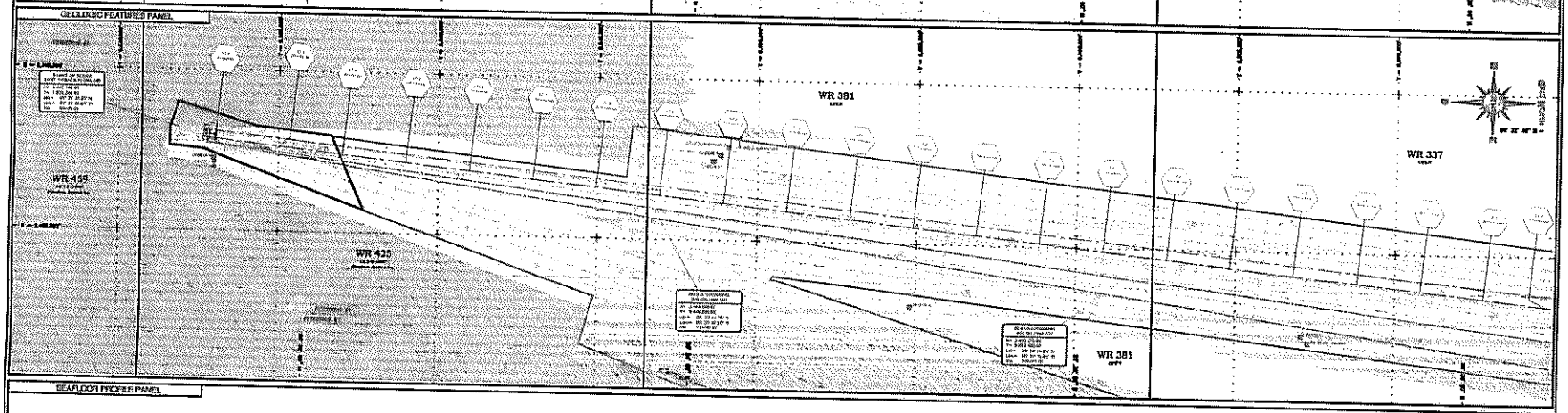
MAP NO. 3b

GEOSCIENCE EARTH & MARINE SERVICES, INC.

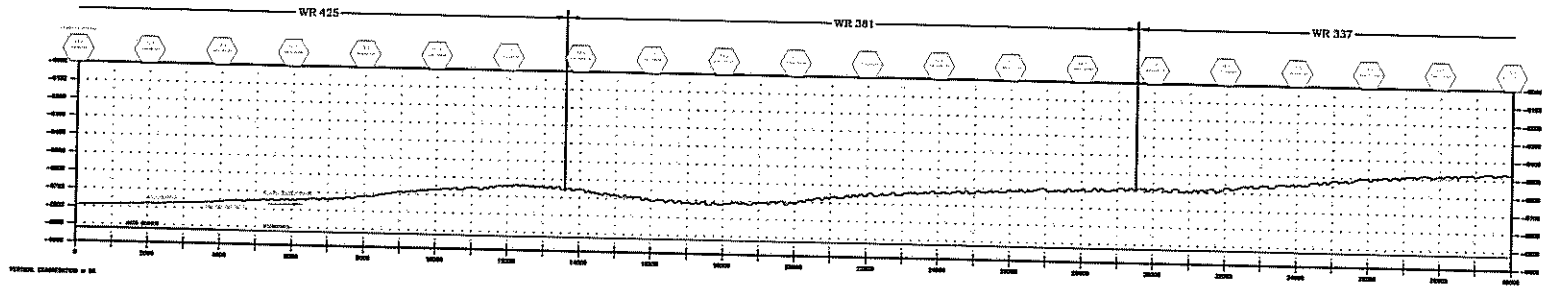
BATHYMETRY PANEL



GEOLOGIC FEATURES PANEL



SEAFLOOR PROFILE PANEL



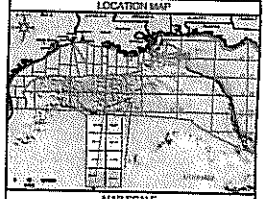
MAP INFORMATION

GRID & CONTOUR INFORMATION

MAPPING INFORMATION

GEODETIC INFORMATION

LOCATION MAP



MAP SCALE

PETROBRAS

PETROBRAS AMERICA, INC.

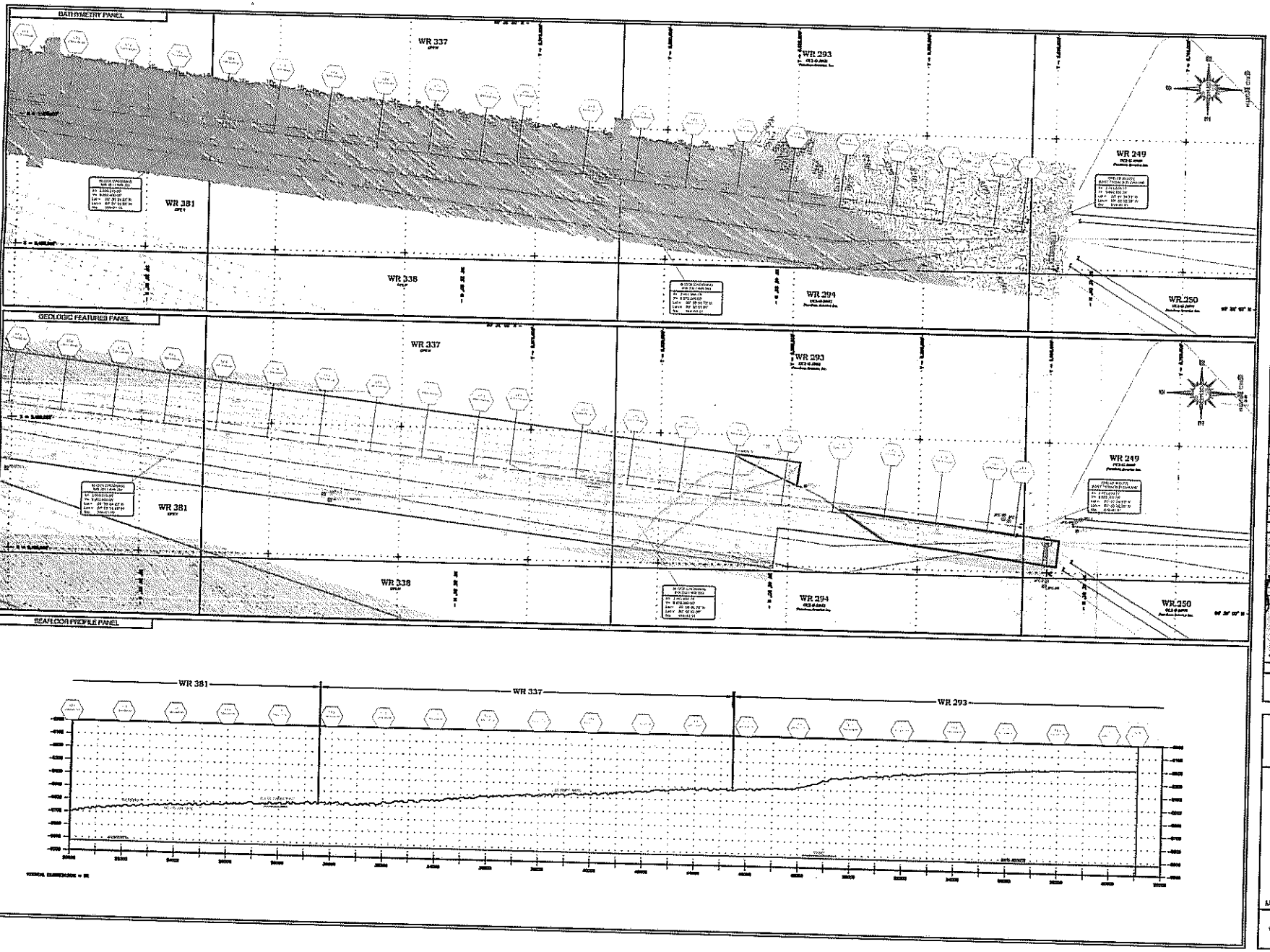
WEST FLOWLINE ALIGNMENT SHEET

WALKER RIDGE AREA
BLOCK 425 TO
WALKER RIDGE AREA
BLOCK 293
GULF OF MEXICO

MAP NO. 3C

SHEET 1 OF 2

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

GRID & CONTOUR INFORMATION

MAPPING INFORMATION

GEODETIC INFORMATION

LOCATION MAP

MAP SCALE

PETROBRAS

PETROBRAS AMERICA, INC.

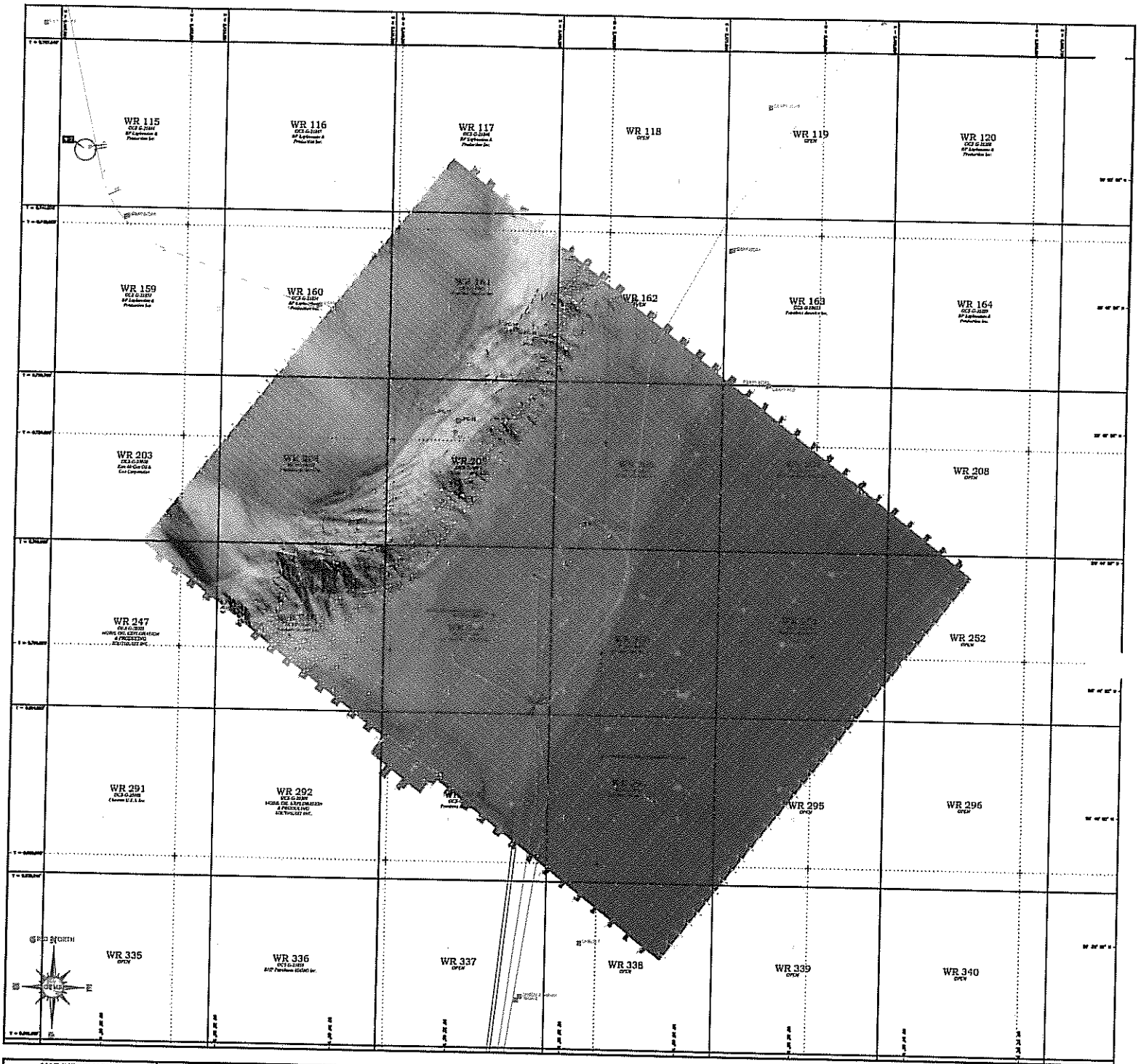
WEST FLOWLINE ALIGNMENT SHEET

WALKER RIDGE AREA
BLOCK 425 TO
WALKER RIDGE AREA
BLOCK 293
GULF OF MEXICO

MAP NO. 3C

SHEET 2 OF 2

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

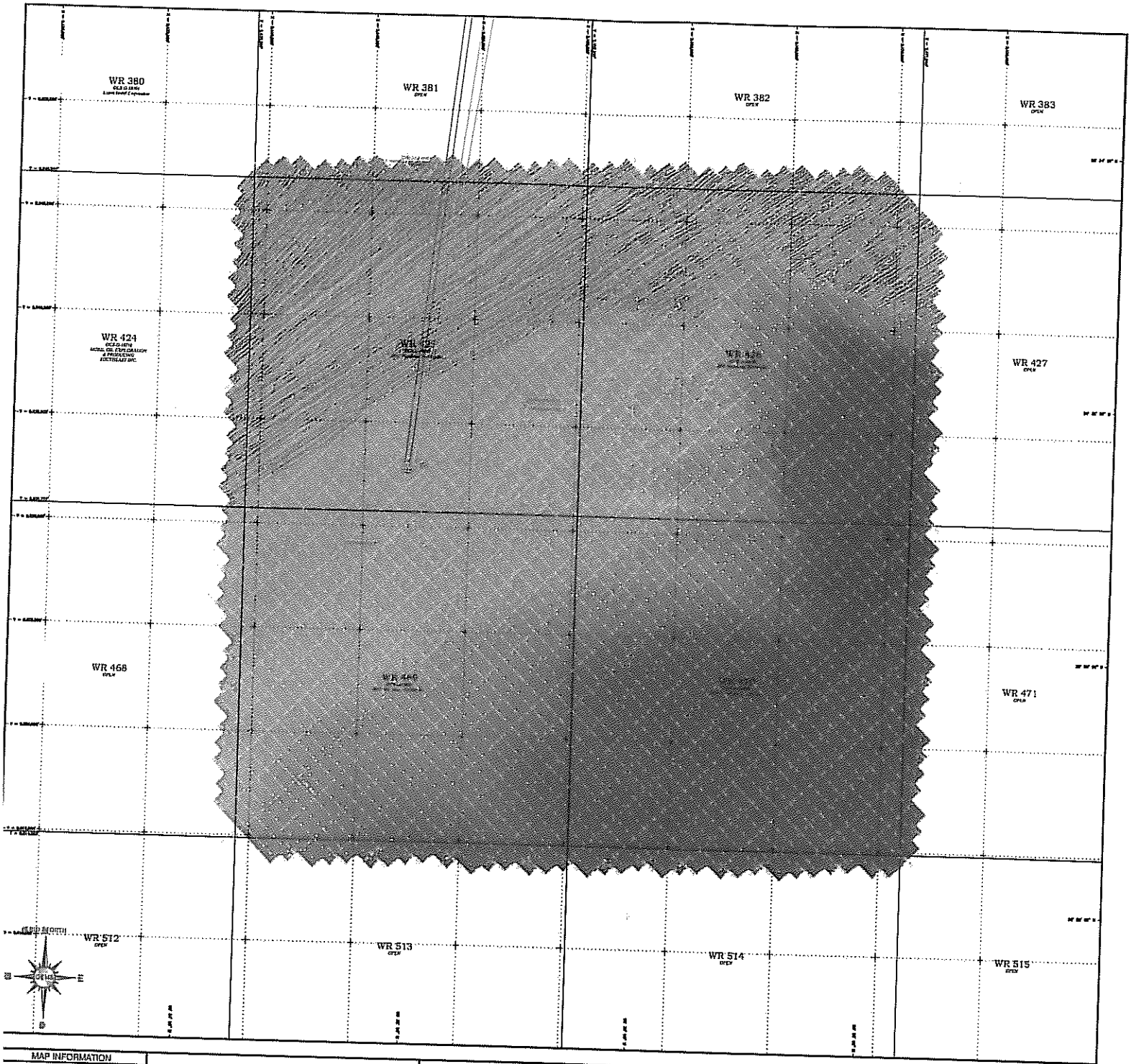
PETROBRAS AMERICA INC.

SEAFLOOR RENDERING CASCADE DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 4a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

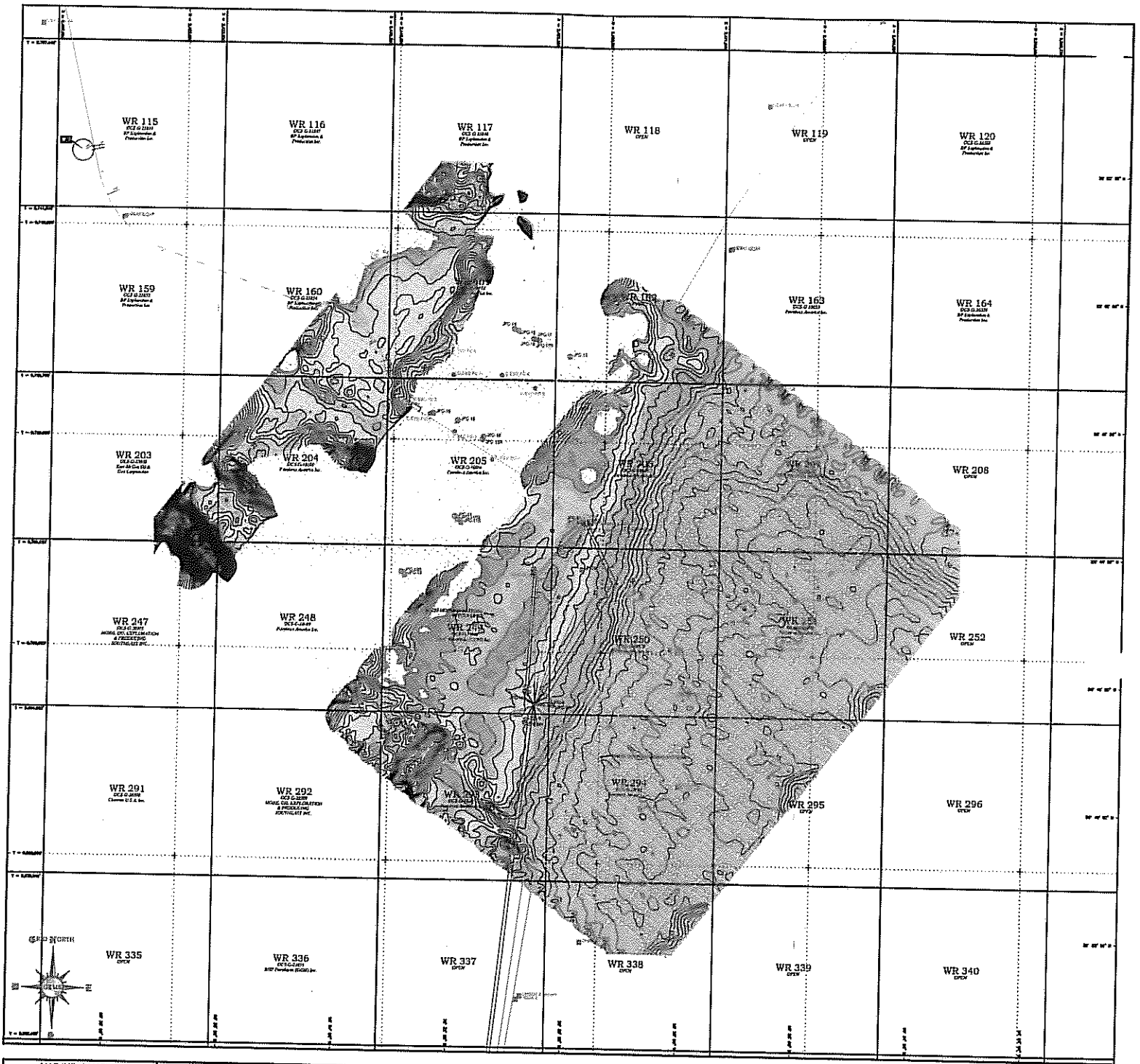
PETROBRAS AMERICA INC.

SEAFLOOR RENDERING
CHINOOK
DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 4b

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

GRID & CONTOUR INFORMATION

NOTE:

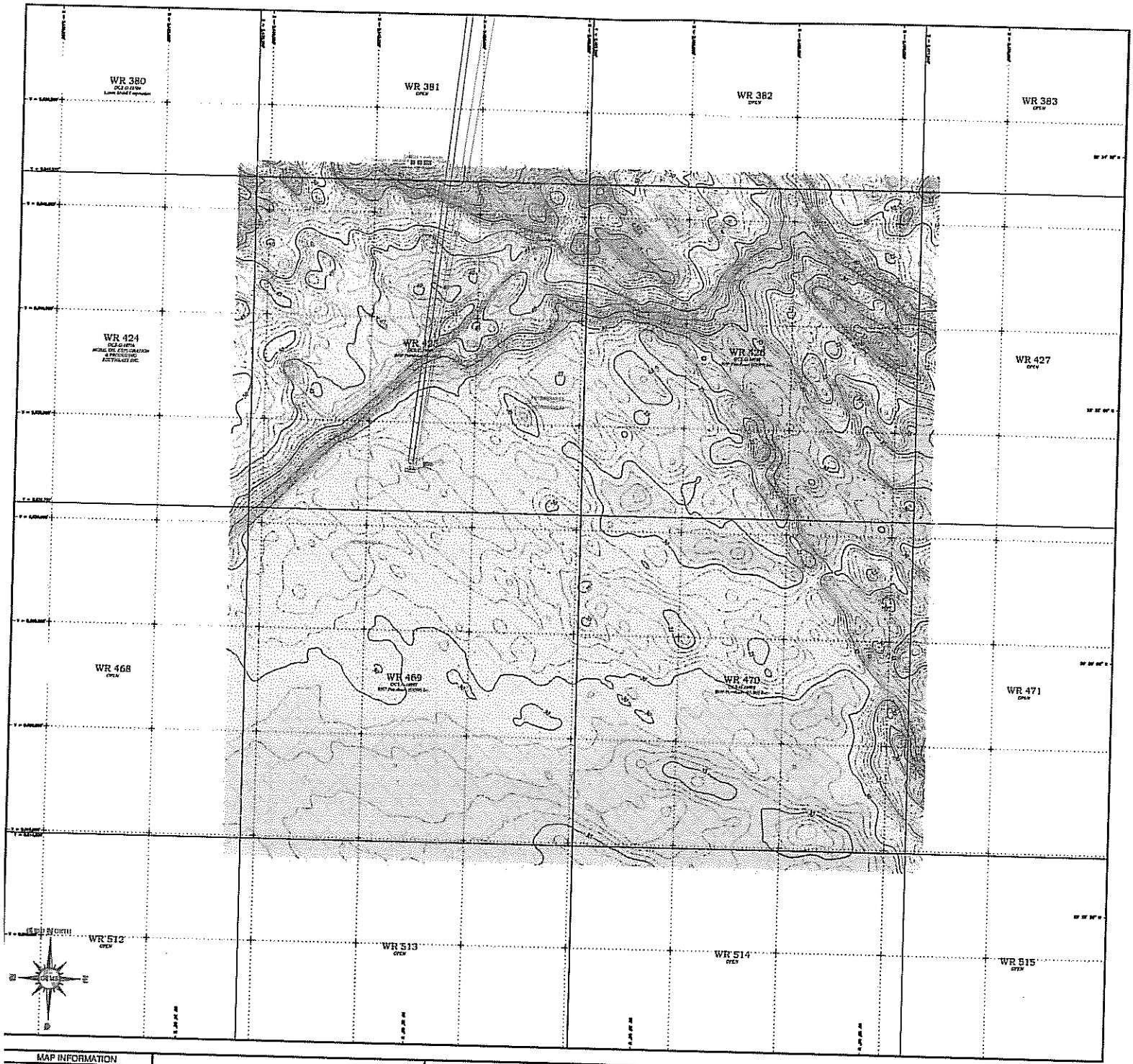
PETROBRAS AMERICA INC.

ISOPACH MAP SEAFLOOR TO "TRIPLET"

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 5a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

GRID & CONTOUR INFORMATION

NOTE:

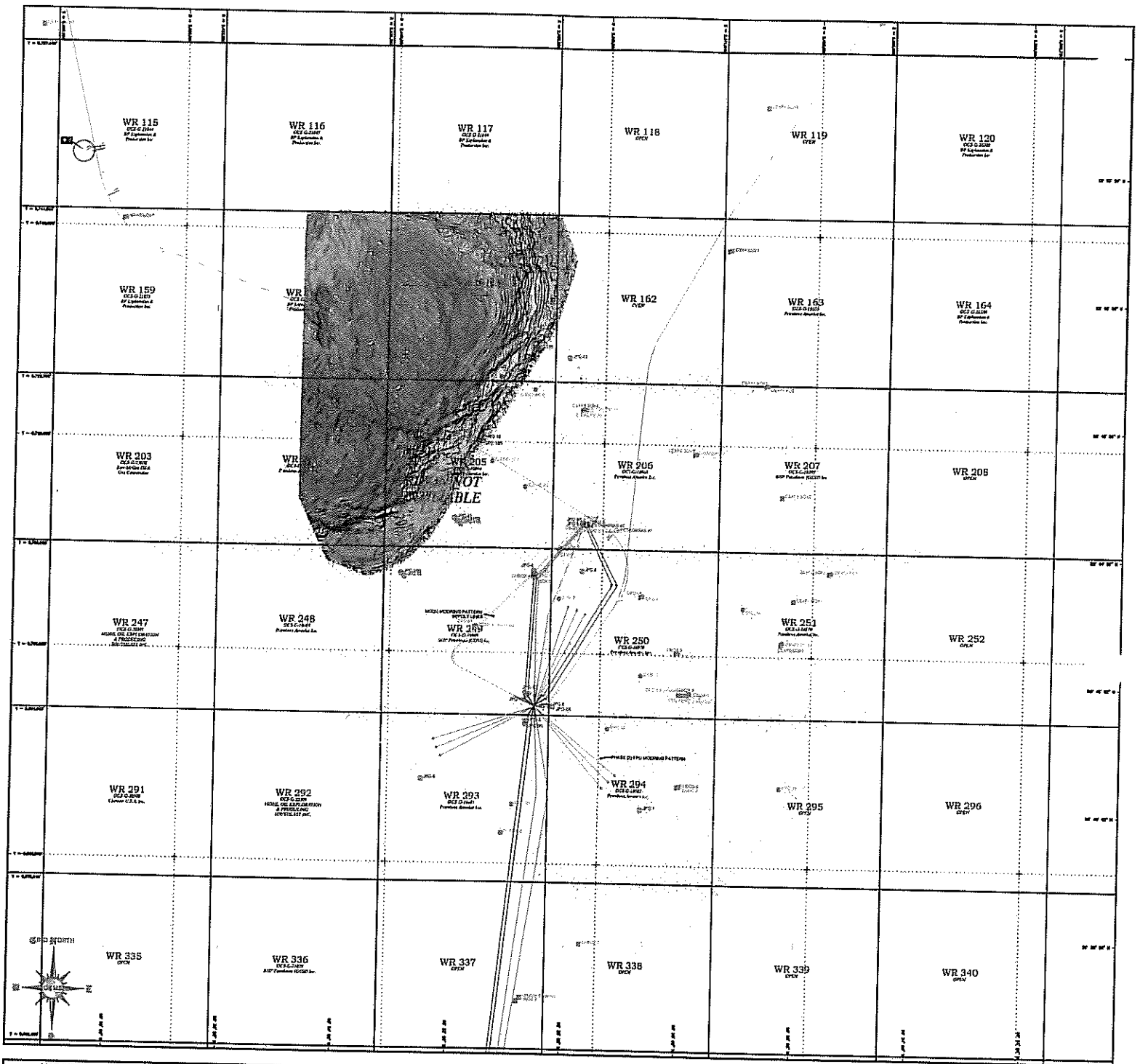
PETROBRAS AMERICA INC.

ISOPACH MAP SEAFLOOR TO "TRIPLET"

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 5b

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

GRID & CONTOUR INFORMATION

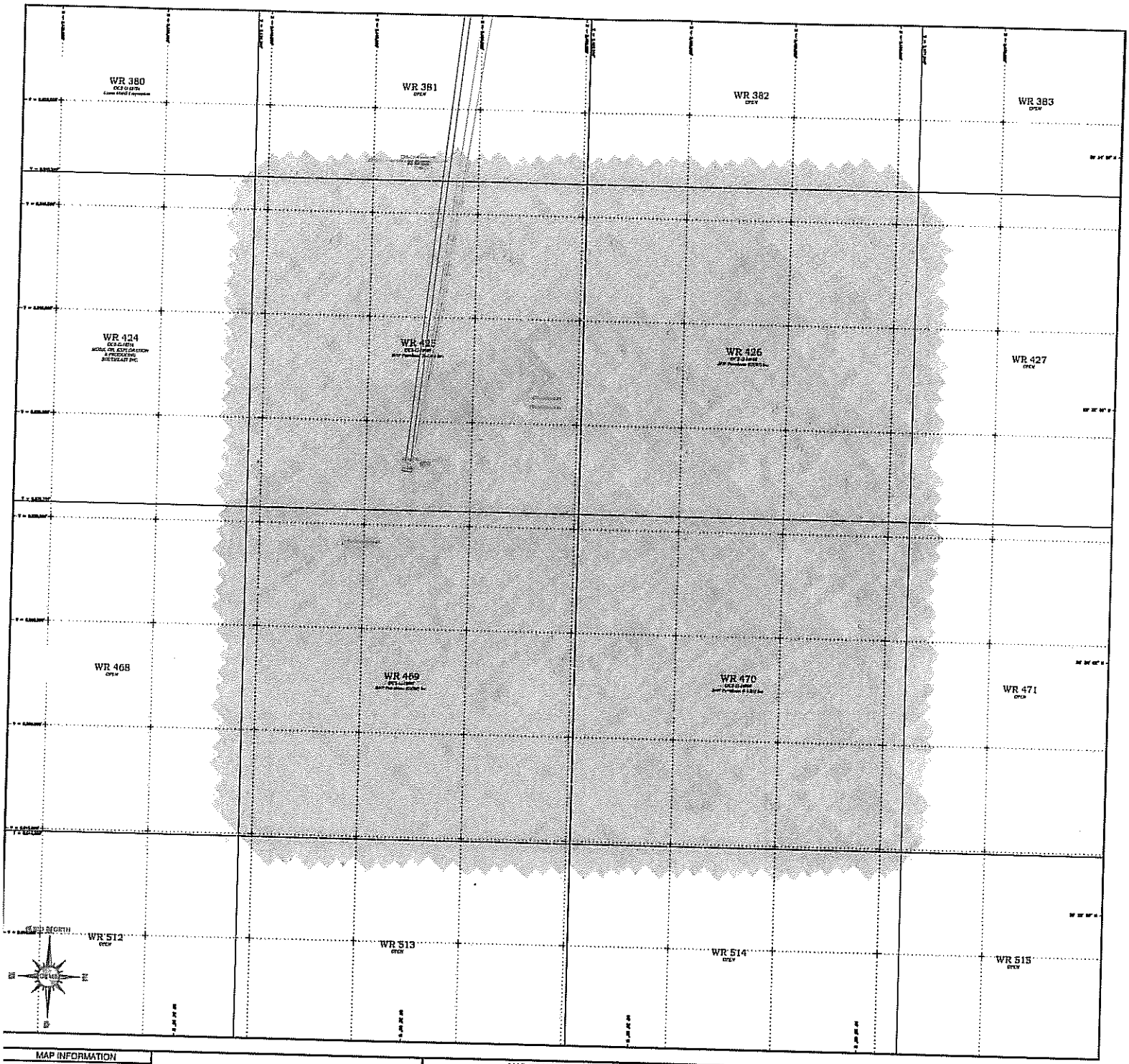
NOTE:
BP INFRASTRUCTURE INCLUDED ON THIS MAP IS BASED ON INFORMATION OBTAINED FROM THE MMS DATABASE MMS, 2007). WAS UPDATED APRIL, 2007.

PETROBRAS AMERICA INC.

STRUCTURE MAP
SEA SURFACE TO
TOP OF SALT
BLOCKS 160-162, 204-207, 248-252,
293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 6a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

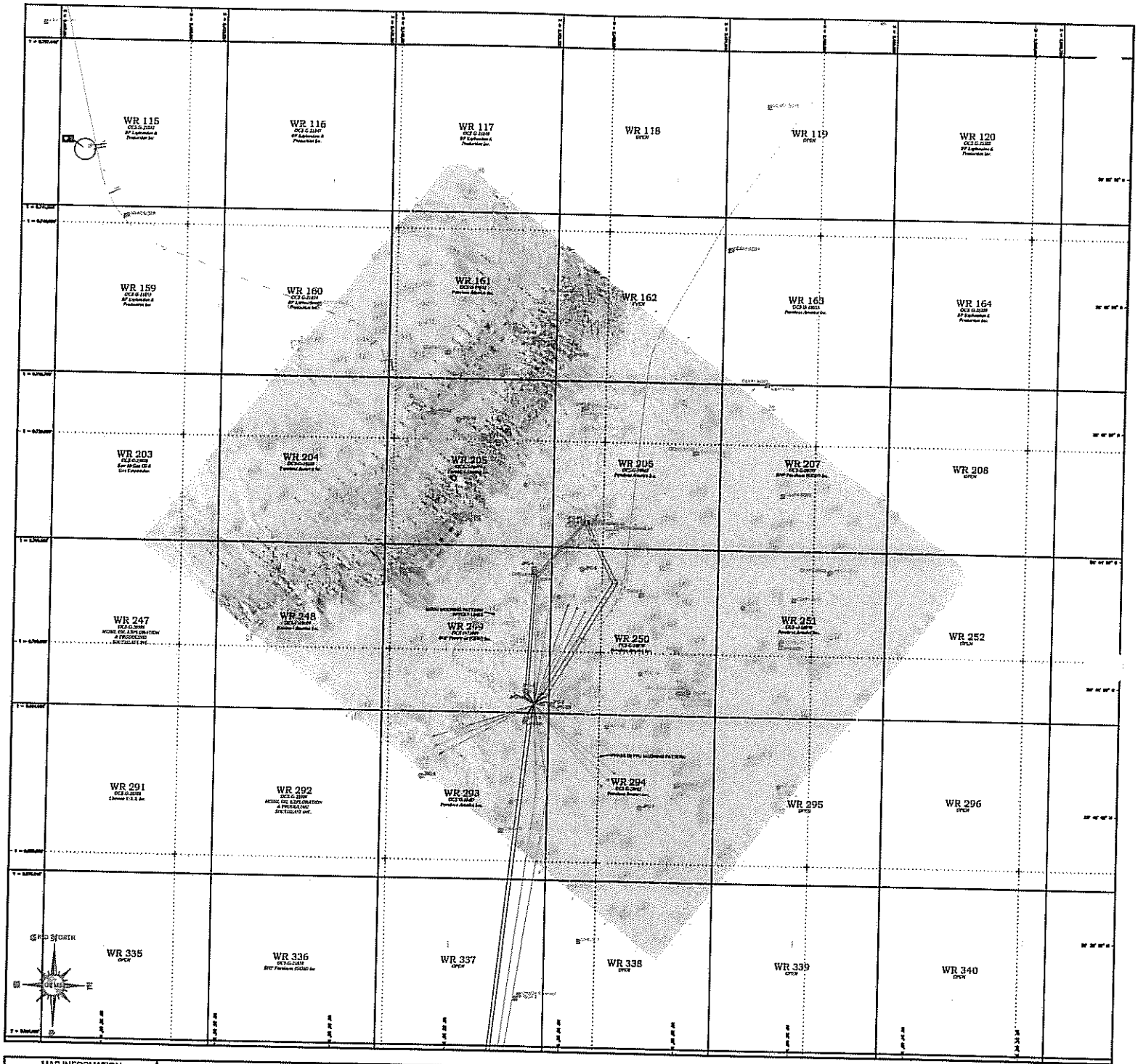
PETROBRAS AMERICA INC.

SIDE-SCAN MOSAIC MAP CHINOOK DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 6b

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

NOTE:
INFRASTRUCTURE INCLUDED ON THIS MAP IS BASED ON INFORMATION OBTAINED FROM THE BMS DATABASE MAY, 2007. FILE UPDATED APRIL, 2007.

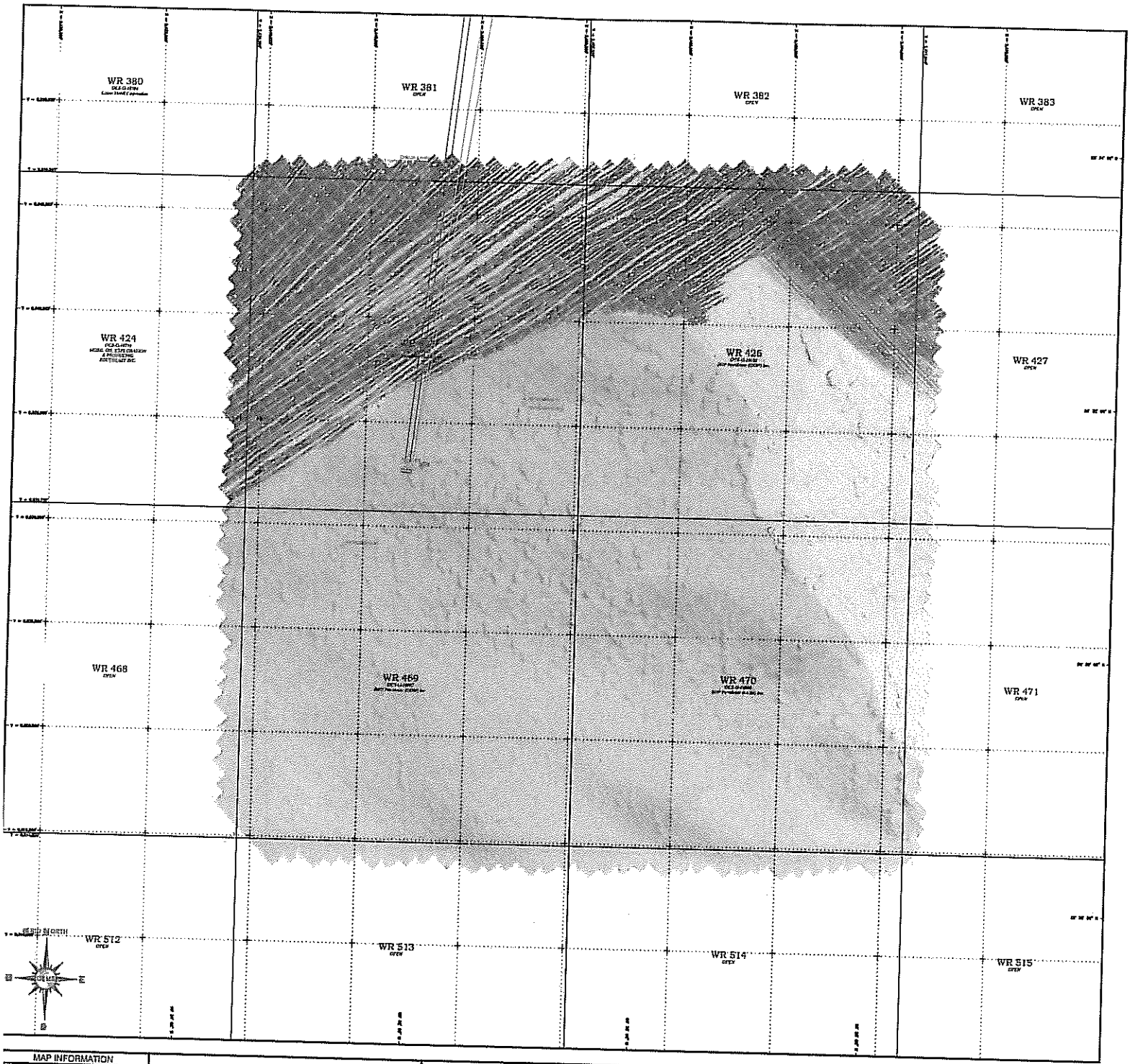
PETROBRAS AMERICA INC.

SIDE-SCAN MOSAIC
CASCADE
DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 7a

GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP

GEODETIC INFORMATION

MAPPING INFORMATION

NOTE:

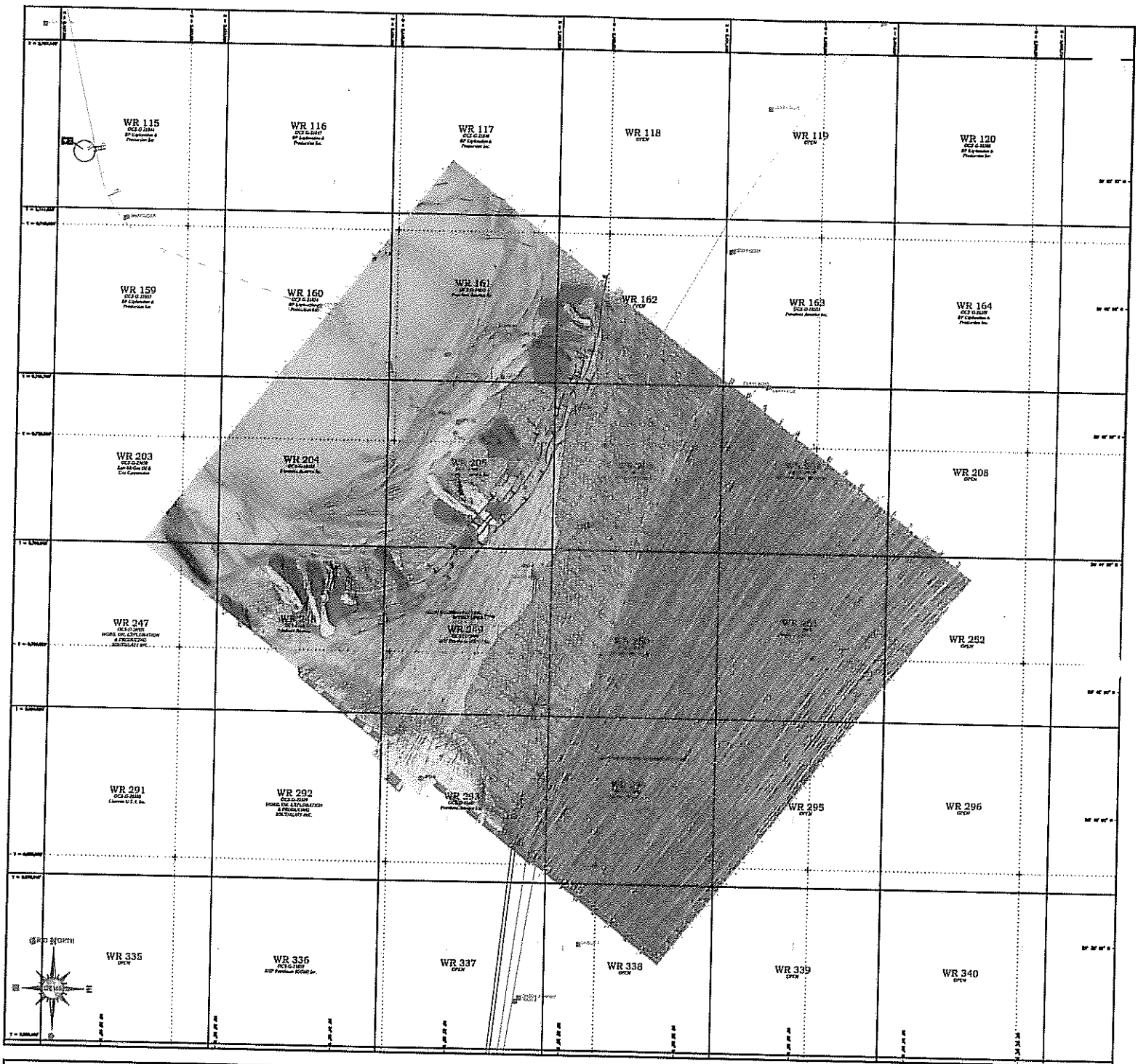
PETROBRAS AMERICA INC.

FEATURES MAP
CHINOOK
DEVELOPMENT AREA

BLOCKS 425, 426, 469, and 470
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 7b

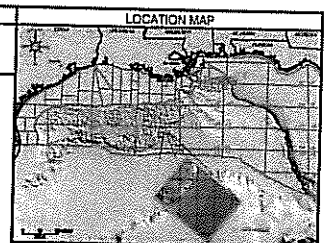
GEOSCIENCE EARTH & MARINE SERVICES, INC.



MAP INFORMATION

MAP SCALE

LOCATION MAP



GEODETIC INFORMATION

MAPPING INFORMATION

PETROBRAS AMERICA INC.

FEATURES MAP
CASCADE
DEVELOPMENT AREA

BLOCKS 160-162, 204-207, 248-252, 293-295, AND 338
WALKER RIDGE AREA
GULF OF MEXICO

MAP NO. 8a

GEOSCIENCE EARTH & MARINE SERVICES, INC.

Petrobras America, Inc.
Development Operations Coordination Document
Cascade / Chinook Development Project

APPENDIX 3 (Proprietary)

Supporting Data for H_2S Absent Classification

APPENDIX 4

Air Emissions Worksheets

DOCD AIR QUALITY SCREENING CHECKLIST

OMB Control No. 1010-0049
OMB Approval Expires: August 31, 2006

COMPANY	Petrobras America
AREA	Walker Ridge
BLOCK	249
LEASE	OCS-G 16969
PLATFORM	FPSO
WELL	
COMPANY CONTACT	Mike Bigler
TELEPHONE NO.	(713) 808-2495
REMARKS	

LEASE TERM PIPELINE CONSTRUCTION INFORMATION:

YEAR	NUMBER OF PIPELINES	TOTAL NUMBER OF CONSTRUCTION DAYS
2008		
2009	2	30
2010		0
2011		0
2012		0
2013		0
2014		0

AIR EMISSION C UTATION FACTORS

Fuel Usage Conversion Factors	Natural Gas Turbines		Natural Gas Engines		Diesel Recip. Engine		REF.	DATE
	SCF/hp-hr	9.524	SCF/hp-hr	7.143	GAL/hp-hr	0.0483	AP42 3.2-1	4/76 & 8/84

Equipment/Emission Factors	units	PM	SOx	NOx	VOC	CO	REF.	DATE
NG Turbines	gms/hp-hr		0.00247	1.3	0.01	0.83	AP42 3.2-1& 3.1-1	10/96
NG 2-cycle lean	gms/hp-hr		0.00185	10.9	0.43	1.5	AP42 3.2-1	10/96
NG 4-cycle lean	gms/hp-hr		0.00185	11.8	0.72	1.6	AP42 3.2-1	10/96
NG 4-cycle rich	gms/hp-hr		0.00185	10	0.14	8.6	AP42 3.2-1	10/96
Diesel Recip. < 600 hp.	gms/hp-hr	1	1.468	14	1.12	3.03	AP42 3.3-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr	0.32	1.468	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Recip. > 600 hp.	gms/hp-hr			8.1			MARPOL 73/78*	3/07
Crude Fired Recip. < 600 hp.	gms/hp-hr	1	9.909	14	1.12	3.03	AP42 3.3-1	10/96
Crude Fired Recip. > 600 hp.	gms/hp-hr	0.32	9.909	11	0.33	2.4	AP42 3.4-1	10/96
Diesel Boiler	lbs/bbl	0.084	2.42	0.84	0.008	0.21	AP42 1.3-12,14	9/98
HFO Boiler	lbs/bbl	0.42	16.335	2.31	0.012	0.21	AP42 1.3-12,14	9/98
NG Heaters/Boilers/Burners	lbs/mmscf	7.6	0.593	100	5.5	84	P42 1.4-1, 14-2, & 14	7/98
NG Flares	lbs/mmscf		0.593	71.4	60.3	388.5	AP42 11.5-1	9/91
Liquid Flaring	lbs/bbl	0.42	6.83	2	0.01	0.21	AP42 1.3-1 & 1.3-3	9/98
Tank Vapors	lbs/bbl				0.03		E&P Forum	1/93
Fugitives	lbs/hr/comp.				0.0005		API Study	12/93
Glycol Dehydrator Vent	lbs/mmscf				6.6		La. DEQ	1991
Gas Venting	lbs/scf				0.0034			
Helicopter - Sikorsky H-60 Class	lbs/hr	3.13	0.30	5.28	0.41	3.10	AESO Memo	6/99

Sulfur Content Source	Value	Units
Fuel Gas	3.33	ppm
Diesel Fuel	0.4	% weight
HFO / Crude Oil	2.7	% weight
Produced Gas(Flares)	3.33	ppm
Produced Oil (Liquid Flaring)	1	% weight

1.) "Ocean Endeavor" MODU emissions based on Caterpillar Offshore SCR Power Module manufacturer's guarantee meeting regulation 13 of ANNEX VI of MARPOL 73/78 - 45 x (engine rpm)$^{-0.2}$ g/kWh.

2.) "Petrorig 1" MODU emissions based on Caterpillar Offshore SCR Power Module manufacturer's guarantee meeting regulation 13 of ANNEX VI of MARPOL 73/78 - 45 x (engine rpm)$^{-0.2}$ g/kWh.

AIR EMISSION CALCULATIONS - 2008

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16969	FPSO	0		Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel (Drill Rig #1 Moored)	15050	726.9	17446	24	210	10.61	48.66	268.51	10.94	79.56	26.73	122.63	676.65	27.57	200.49
	VESSELS>600hp diesel (Crew Boat/Fast Supply)	6300	304.3	7303.0	24	90	4.44	20.37	152.64	4.58	33.30	5	22	165	5	36
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4000	193.2	4636.8	24	60	2.82	12.93	96.92	2.91	21.15	2.03	9.31	69.78	2.09	15.22
	VESSELS>600hp diesel (Offshore Service Vessel #2)	4000	193.2	4636.8	24	60	2.82	12.93	96.92	2.91	21.15	2.03	9.31	69.78	2.09	15.22
	VESSELS>600hp diesel (AHTV #1 @ 16,000 hp)	16000	772.8	18547	24	9	11.28	51.74	387.67	11.63	84.58	1.22	5.59	41.87	1.26	9.13
	VESSELS>600hp diesel (AHTV #2 @ 16,000 hp)	16000	772.8	18547	24	9	11.28	51.74	387.67	11.63	84.58	1.22	5.59	41.87	1.26	9.13
PIPELINE	PIPELINE LAY BARGE diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
INSTALLATION -	SUPPORT VESSEL diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
Includes gas export	VESSELS>600hp diesel (crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
and infield lines	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
FACILITY	MATERIAL TUG diesel	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
INSTALLATION	VESSELS>600hp diesel(const.)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel(supply)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PRODUCTION	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.>600hp diesel (Shuttle Tanker) Offloading	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.>600hp diesel (Shuttle Tanker) Transit	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - RECIP.>600hp diesel (EG)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	VESSELS>600hp diesel (crew)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.000	0.000	0.00	0.000	0.000
	SUPPORT VESSEL diesel (4000 hp)	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - BURNER diesel (Steam Boilers)	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - IGG System burner	0			0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	FPSO - TURBINE nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	FPSO - TANK (Vapors @ Production Rate)	0			0	0	0									
	Shuttle tanker Offload - 50% IG				0	0				0.00					0.00	
	FLARE- (upset considered insignificant)		0			0				0.00					0.00	
	PROCESS VENT		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	FUGITIVES-			0.0		0				0.00					0.00	
	GLYCOL STILL VENT-		0		0	0				0.00					0.00	
	Sikorsky H-60 Helicoptor (1 for drilling)				12	210	3.13	0.60	10.56	0.82	6.19	3.95	0.75	13.31	0.00000 1.03	7.80
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE (2 wells)		50000		24	14		0.03	3.57	3.02	19.43		0	1	1	3
	2008 YEAR TOTAL						46.38	199.00	1404.45	48.43	349.93	41.97	175.19	1078.71	40.75	296.24

EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES
	166.0

5527.80	5527.80	5527.80	5527.80	102695.40	

Notes:
None

AIR EMISSIONS CALCULATIONS - 2009

COMPANY	AREA	BLOCK	LEASE	PLATFORM		CONTACT	PHONE	REMARKS
America	Walker Ridge	249	OCS-G 16950	FPSO	0	Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
DRILLING	PRIME MOVER>600hp diesel (Drill Rig #1 Moored)	15050	726.92	17446	24	155	10.61	48.66	268.51	10.04	79.56	19.73	90.51	499.43	20.35	147.98
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	64	4.44	20.37	152.64	4.58	33.30	3	16	117	4	26
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4000	193.20	4637	24	44	2.82	12.93	96.92	2.91	21.15	1	7	51	2	11
	VESSELS>600hp diesel (Offshore Service Vessel #2)	4000	193.2	4637	24	44	2.82	12.93	96.92	2.91	21.15	1.49	6.83	51.17	1.54	11.16
	VESSELS>600hp diesel (AHT #1 @ 16,000 hp)	16000	772.8	18547	24	9	11.28	51.74	387.67	11.63	84.58	1.22	5.59	41.87	1.26	9.13
	VESSELS>600hp diesel (AHT #2 @ 16,000 hp)	16000	772.8	18547	24	9	11.28	51.74	387.67	11.63	84.58	1.22	5.59	41.87	1.26	9.13
	PRIME MOVER>600hp diesel (Drill Rig #2 DP)	34088	1646.45	39515	24	210	24.03	110.22	808.18	24.78	180.20	60.55	277.76	1532.61	62.44	454.11
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	90	4.44	20.37	152.64	4.58	33.30	5	22	165	5	36
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4000	193.20	4637	24	60	2.82	12.93	96.92	2.91	21.15	2	9	70	2	15
	VESSELS>600hp diesel (Offshore Service Vessel #2)	4000	193.2	4637	24	60	2.82	12.93	96.92	2.91	21.15	2.03	9.31	69.76	2.09	15.22
	VESSELS>600hp diesel (AHT #1 @ 16,000 hp)	16000	772.8	18547	24	3	11.28	51.74	387.67	11.63	84.58	0.41	1.86	13.96	0.42	3.04
	VESSELS>600hp diesel (AHT #2 @ 16,000 hp)	16000	772.8	18547	24	3	11.28	51.74	387.67	11.63	84.58	0.41	1.86	13.96	0.42	3.04
PIPELINE	PIPELINE LAY BARGE diesel Cascade Flowlines and Gas Export	21,255	1026.6	24639	24	60	14.98	68.73	514.99	15.45	112.36	11	49	371	11	81
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4000	193.2	4637	24	17	2.82	12.93	96.92	2.91	21.15	1	3	20	1	4
	VESSELS>600hp diesel (Offshore Service Vessel #2 - ROV)	4000	193.2	4637	24	60	2.82	12.93	96.92	2.91	21.15	2	9	70	2	15
	PIPELAY BARGE diesel Chinook Flowlines (PIP)	27,625	1334.3	32023	24	30	10.47	60.32	669.33	20.08	140.04	7	32	241	7	53
	VESSELS>600hp diesel (Offshore Service Vessel #3)	4000	193.2	4637	24	9	2.82	12.93	96.92	2.91	21.15	0	1	10	0	2
	VESSELS>600hp diesel (Tugboat with Barge)	5000	241.5	5796	24	9	3.52	16.17	121.15	3.63	26.43	0.38	1.75	13.06	0.39	2.85
	VESSELS>600hp diesel (Offshore Service Vessel #4)	4000	193.2	4637	24	1	2.82	12.93	96.92	2.91	21.15	1	5	35	1	8
SUBSEA INSTALLATION	VESSELS>600hp diesel FSHRs (Risers)	13,732	663.3	15918	24	40	9.68	44.40	332.71	9.98	72.59	5	21	160	5	35
	VESSELS>600hp diesel (AHT)	7,200	347.8	8346	24	15	5.07	23.28	174.45	5.23	38.06	1	4	31	1	7
	VESSELS>600hp diesel (Construction Vessel)	5,750	277.7	6665	24	20	4.05	18.59	139.32	4.18	30.40	0.67	4.46	33.44	1.00	7.30
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	21	2.82	12.93	96.92	2.91	21.15	1	3	24	1	5
	VESSELS>600hp diesel (Subsea Equipmment Heavy Lifts)	13,732	663.3	15918	24	30	9.68	44.40	332.71	9.98	72.59	3.48	15.98	119.78	3.59	26.13
	VESSELS>600hp diesel (Offshore Service Vessel #2)	4,000	193.2	4637	24	9	2.82	12.93	96.92	2.91	21.15	0	1	10	0	2
	VESSELS>600hp diesel (Umbilicals, Jumpers, and FL)	13,732	663.3	15918	24	30	9.68	44.40	332.71	9.98	72.59	3.48	15.98	119.78	3.59	26.13
	VESSELS>600hp diesel (Construction Vessel)	5,750	277.7	6665	24	10	4.05	18.59	139.32	4.18	30.40	0.49	2.23	16.72	0.50	3.65
	VESSELS>600hp diesel (Offshore Service Vessel #3)	4,000	193.2	4637	24	40	2.82	12.93	96.92	2.91	21.15	1.35	6.21	46.52	1.40	10.15
FACILITIES INSTALLATION	VESSELS>600hp diesel - FPSO Mooring (AHT #1)	23,480	1134.1	27218	24	30	16.55	75.92	568.90	17.07	124.12	5.96	27.33	204.80	6.14	44.68
	VESSELS>600hp diesel - FPSO Mooring (AHT #2)	23,480	1134.1	27218	24	30	16.55	75.92	568.90	17.07	124.12	5.96	27.33	204.80	6.14	44.68
	FPSO Hookup (no support vessel required)					1										
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	60		0.12	60.73	0.47	36.78		0.06	43.73	0.34	27.02
	FPSO - RECIP.>600hp diesel (Emergency Generator)	870	32.381	776.68	24	2	0.47	2.17	10.23	0.49	3.54	0.011	0.052	0.390	0.012	0.085
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	60	1.68	73.10	10.34	0.05	0.04	1.35	52.63	7.44	0.04	0.68
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	60	3.78	5.55	52.92	4.23	11.45	2.72	4.00	38.10	3.05	8.25
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	5	2.52	3.70	35.28	2.82	7.64	0.15	0.22	2.12	0.17	0.46
	FPSO - IGG System burner	32			24	2	0.57	22.05	3.12	0.02	0.28	0.01	0.53	0.07	0.000	0.01
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3284	157.7	3783.8	24	4	2.30	10.55	79.08	2.37	17.25	0.11	0.51	3.80	0.11	0.83
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	2	8.05	36.04	276.70	8.30	60.39	0.19	0.89	6.64	0.20	1.45
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	26	4.44	20.37	152.64	4.58	33.30	1	6	48	1	10
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	17	2.82	12.93	96.92	2.91	21.15	0.58	2.64	19.77	0.59	4.31
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	60	5.64	25.87	193.83	5.81	42.29	4.06	18.62	139.56	4.19	30.45
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2-cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4-cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4-cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	FPSO - TANK (Vapors @ Production Rate)				24	60				22.50					6.10	
	Shuttle tanker Loading - 50% IG				24	2				206.25					4.95	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		60				5.71					4.11	
	GLYCOL STILL VENT-		0.1471444		24	60				9.71E-07					6.99E-07	
	Sikorsky H-60 Helicopter (Drilling)				12	365	3.13	0.60	10.56	0.82	6.19	0.86	1.31	23.13	1.80	13.56
	Sikorsky H-60 Helicopter (Installation Activities)				12	180	3.13	0.60	10.56	0.82	6.19	3.38	0.64	11.41	0.89	6.69
DRILLING WELL TEST	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	GAS FLARE (one well)		50000		24	7		0.03	3.57	3.02	19.43		0	0	0	2
2009	YEAR TOTAL						271.67	1283.14	8695.78	511.38	2015.82	169.96	772.67	4743.34	184.03	1225.27
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											5527.80	5527.80	5527.80	5527.80	102695.40
	166.0															

Notes

1.) Allseas "Solitaire" information has been utilized for Chinook PIP work scope. Allseas has communicated to PAI that the "Solitaire" operates at 40% of the maximum HP load during normal pipelaying operations based on historical fuel consumption.

2.) Technip "Deep Blue" information has been utilized for FSHR Installation, Subsea Heavy Lifts, and Umbilicals / Flying Leads Installation. Technip has communicated to PAI that the "Deep Blue" operates at 40% of the maximum HP load during normal installation operations based on historical fuel consumption.

3.) Subsea 7 "Toisa Perseus" information has been utilized. Subsea 7 has communicated to PAI that the "Toisa Perseus" operates at 40% of the maximum HP load during normal installation operations based on historical fuel consumption.

4.) Other construction, drilling, marine support vessels are shown at 100% of operating load.

5.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #6 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

6.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every 2 weeks.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	7	10.35	47.49	355.88	10.68	77.65	0.87	3.99	29.89	0.90	6.52
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	4	4.60	21.11	158.17	4.75	34.51	0.22	1.01	7.59	0.23	1.66
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	43	1.73	7.92	59.31	1.78	12.94	0.89	4.08	30.61	0.92	6.68

AIR EMISSIONS CALCULATIONS - 2010

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16989	FPSO	0		Mike Bigler	(713) 808-2405	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
PRODUCTION	FPSO - RECIP,>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73	0.47	38.78		0.51	266.01	2.05	169.84
	FPSO - RECIP,>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23	0.49	3.54	0.085	0.390	2.922	0.088	0.636
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34	0.05	0.94	8.23	320.16	45.27	0.23	4.12
	FPSO - RECIP,<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92	4.23	11.45	16.56	24.30	231.77	18.54	50.16
	FPSO - RECIP,<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28	2.82	7.64	0.91	1.33	12.70	1.02	2.75
	FPSO - IGG System burner	32			24	26	0.57	22.05	3.12	0.02	0.28	0.18	6.88	0.97	0.005	0.09
	Shuttle Vessel - RECIP,>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	26	2.30	10.55	79.08	2.37	17.25	0.72	3.29	24.67	0.74	5.38
	Shuttle Vessel - RECIP,>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	10	8.05	36.94	276.79	8.30	60.39	0.97	4.43	33.22	1.00	7.25
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64	4.58	33.30	8	38	286	9	62
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.82	12.93	96.92	2.91	21.15	3.52	16.14	120.95	3.63	26.39
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83	5.81	42.29	24.70	113.30	848.99	25.47	185.23
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP,2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP,4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP,4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	MISC.	BPD	SCF/HR	COUNT												
	FPSO - TANK (Vapors @ Production Rate)				24	365				41.25					90.34	
	Shuttle tanker Loading - 50% IG				24	26				206.25					64.35	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		365				5.71					25.01	
	GLYCOL STILL VENT-		0.14714444		24	365				9.71E-07					4.25E-06	
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56	0.82	6.19	6.86	1.31	23.13	1.80	13.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	2010 YEAR TOTAL						35.60	213.93	988.45	286.09	243.21	71.03	530.18	1896.36	242.83	527.75
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											5527.80	5527.80	5527.80	5527.80	102695.40
	166.0															

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every 2 weeks.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP,>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	42	10.35	47.49	355.88	10.68	77.65	5.22	23.94	179.36	5.38	39.13
Shuttle Vessel - RECIP,>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	26	4.60	21.11	158.17	4.75	34.51	1.44	6.59	49.35	1.48	10.77
Shuttle Vessel - RECIP,>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	260	1.73	7.92	59.31	1.78	12.94	5.38	24.70	185.06	5.55	40.38

AIR EMISSIONS CALCULATIONS - 2011

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16869	FPSO	0		Mike Bigler	(713) 808-2495	0
OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR		
	Diesel Engines	HP	GAL/HR	GAL/D					
	Nat. Gas Engines	HP	SCF/HR	SCF/D					
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73
	FPSO - RECIP.>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28
	FPSO - IGG System burner	32			24	52	0.57	22.05	3.12
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	52	2.30	10.55	79.08
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	20	8.05	36.94	276.79
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.62	12.93	96.92
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00
	BURNER nat gas	0	0	0	0	0		0.00	0.00
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00
	FPSO - TANK (Vapors @ Production Rate)				24	365			
	Shuttle tanker Loading - 50% IG				24	52			
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00
	PROCESS VENT		0		0	0			
	FUGITIVES-			11420.0		365			
	GLYCOL STILL VENT-		0.14714444		24	365			
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00
WELL TEST	GAS FLARE		0		0	0		0.00	0.00
	2011 YEAR TOTAL						35.60	213.93	988.45
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES								
	166.0								

ESTIMATED TONS						
PM	SOx	NOx	VOC	CO		
0	0	0	0	0		
0.085	0.51	266.01	2.05	169.84		
8.23	0.390	2.922	0.088	0.638		
16.56	320.16	45.27	0.23	4.12		
0.91	24.30	231.77	18.54	50.16		
0.35	1.33	12.70	1.02	2.75		
1.44	13.76	1.95	0.010	0.18		
1.93	6.59	49.35	1.48	10.77		
8	8.87	66.43	1.99	14.49		
3.52	38	286	9	62		
24.70	16.14	120.95	3.63	26.39		
0.00	113.30	848.99	25.47	185.23		
	0.00	0.00	0.00	0.00		
	0	0	0	0		
	0	0	0	0		
	0	0	0	0		
	0	0	0	0		
0	0	0	0	0		
			60.00			
			206.25			
	0	0	0.00	0		
			0.00			
			5.71			
			9.71E-07			
6.86	1.31	23.13	0.82	6.19		
0	0	0	0.00	0.00		
	0	0	0	0		
	0	0	0	0		
72.89	544.78	1955.23	349.98	540.47		
5527.80	5527.80	5527.80	5527.80	102695.40		

ESTIMATED TONS				
131.40				
128.70				
0	0	0	0	
0.00				
25.01				
4.25E-06				
1.80	13.56			
0	0	0	0	0
0	0	0	0	0

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every week.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	85	10.35	47.49	355.88	10.68	77.65	10.56	48.44	362.99	10.89	79.20
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	52	4.60	21.11	158.17	4.75	34.51	2.87	13.17	98.70	2.96	21.53
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	156	1.73	7.92	59.31	1.78	12.94	3.23	14.82	111.03	3.33	24.23

AIR EMISSIONS CALCULATIONS - 2012

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16969	FPSO	0		Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73	0.47	38.78		0.51	266.01	2.05	169.84
	FPSO - RECIP.>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23	0.49	3.54	0.085	0.390	2.922	0.088	0.638
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34	0.05	0.94	8.23	320.16	45.27	0.23	4.12
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92	4.23	11.45	16.56	24.30	231.77	18.54	50.16
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28	2.82	7.64	0.91	1.33	12.70	1.02	2.75
	FPSO - IGG System burner	32			24	52	0.57	22.05	3.12	0.02	0.28	0.35	13.76	1.95	0.010	0.18
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	52	2.30	10.55	79.08	2.37	17.25	1.44	6.59	49.35	1.48	10.77
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	20	8.05	36.94	276.79	8.30	60.39	1.93	8.87	66.43	1.99	14.49
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64	4.58	33.30	8	38	286	9	62
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.82	12.93	96.92	2.91	21.15	3.52	16.14	120.95	3.63	26.39
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83	5.81	42.29	24.70	113.30	848.99	25.47	185.23
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	MISC.	BPD	SCF/HR	COUNT												
	FPSO - TANK (Vapors @ Production Rate)				24	365				90.00					197.10	
	Shuttle tanker Loading - 50% IG				24	52				206.25					128.70	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		365				5.71					25.01	
	GLYCOL STILL VENT-		0.14714444		24	365				9.71E-07					4.25E-06	
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56	0.82	6.19	6.86	1.31	23.13	1.80	13.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	2012 YEAR TOTAL						35.60	213.93	988.45	334.84	243.21	72.89	544.78	1955.23	415.68	540.47
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											5527.80	5527.80	5527.80	5527.80	102695.40
	166.0															

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every week.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	85	10.35	47.49	355.88	10.68	77.65	10.56	48.44	362.99	10.89	79.20
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	52	4.60	21.11	158.17	4.75	34.51	2.87	13.17	98.70	2.96	21.53
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	156	1.73	7.92	59.31	1.78	12.94	3.23	14.82	111.03	3.33	24.23

AIR EMISSIONS C_CULATIONS - 2013

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16669	FPSO	0		Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73	0.47	38.78		0.51	266.01	2.05	169.84
	FPSO - RECIP.>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23	0.49	3.54	0.085	0.390	2.922	0.088	0.638
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34	0.05	0.94	8.23	320.16	45.27	0.23	4.12
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92	4.23	11.45	16.56	24.30	231.77	18.54	50.16
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28	2.82	7.64	0.91	1.33	12.70	1.02	2.75
	FPSO - IGG System burner	32			24	52	0.57	22.05	3.12	0.02	0.28	0.35	13.76	1.95	0.010	0.18
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	52	2.30	10.55	79.08	2.37	17.25	1.44	6.59	49.35	1.48	10.77
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	20	8.05	36.94	276.79	8.30	60.39	1.93	8.87	66.43	1.99	14.49
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64	4.58	33.30	8	38	286	9	62
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.82	12.93	96.92	2.91	21.15	3.52	16.14	120.95	3.63	26.39
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83	5.81	42.29	24.70	113.30	848.99	25.47	185.23
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	FPSO - TANK (Vapors @ Production Rate)				24	365				100.00					219.00	
	Shuttle tanker Loading - 50% IG				24	52				206.25					128.70	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		365				5.71					25.01	
	GLYCOL STILL VENT-		0.14714444		24	365				9.71E-07					4.25E-06	
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56	0.82	6.19	6.86	1.31	23.13	1.80	13.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
							35.60	213.93	988.45	344.84	243.21	72.89	544.78	1955.23	437.58	540.47
	2013 YEAR TOTAL											5527.80	5527.80	5527.80	5527.80	102695.40
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES															
	166.0															

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every week.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	85	10.35	47.49	355.88	10.68	77.65	10.56	48.44	362.99	10.89	79.20
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	52	4.60	21.11	158.17	4.75	34.51	2.87	13.17	98.70	2.96	21.53
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	156	1.73	7.92	59.31	1.78	12.94	3.23	14.82	111.03	3.33	24.23

AIR EMISSIONS CALCULATIONS - 2014

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16569	FPSO	0		Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73	0.47	38.78		0.51	266.01	2.05	169.84
	FPSO - RECIP.>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23	0.49	3.54	0.085	0.390	2.922	0.088	0.638
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34	0.05	0.94	8.23	320.16	45.27	0.23	4.12
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92	4.23	11.45	16.56	24.30	231.77	18.54	50.16
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28	2.82	7.64	0.91	1.33	12.70	1.02	2.75
	FPSO - IGG System burner	32			24	52	0.57	22.05	3.12	0.02	0.28	0.35	13.76	1.95	0.010	0.18
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	52	2.30	10.55	79.08	2.37	17.25	1.44	6.59	49.35	1.48	10.77
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	20	8.05	36.94	276.79	8.30	60.39	1.93	8.87	66.43	1.99	14.49
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64	4.58	33.30	8	38	286	9	62
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.82	12.93	96.92	2.91	21.15	3.52	16.14	120.95	3.63	26.39
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83	5.81	42.29	24.70	113.30	848.99	25.47	185.23
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	FPSO - TANK (Vapors @ Production Rate)				24	365				100.00					219.00	
	Shuttle tanker Loading - 50% IG				24	52				206.25					128.70	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		365				5.71					25.01	
	GLYCOL STILL VENT-		0.14714444		24	365				9.71E-07					4.25E-06	
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56	0.82	6.19	6.86	1.31	23.13	1.80	13.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	2014 YEAR TOTAL						35.60	213.93	988.45	344.84	243.21	72.89	544.78	1955.23	437.58	540.47
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											5527.80	5527.80	5527.80	5527.80	102695.40
	166.0															

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every week.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	65	10.35	47.49	355.88	10.68	77.65	10.56	48.44	362.99	10.89	79.20
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	52	4.60	21.11	158.17	4.75	34.51	2.87	13.17	98.70	2.96	21.53
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	156	1.73	7.92	59.31	1.78	12.94	3.23	14.82	111.03	3.33	24.23

AIR EMISSIONS C..LCULATIONS - 2015

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL		CONTACT	PHONE	REMARKS
Petrobras America	Walker Ridge	249	OCS-G 16960	FPSO	0		Mike Bigler	(713) 808-2495	0

OPERATIONS	EQUIPMENT	RATING	MAX. FUEL	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS				
	Diesel Engines	HP	GAL/HR	GAL/D												
	Nat. Gas Engines	HP	SCF/HR	SCF/D												
	Burners	MMBTU/HR	SCF/HR	SCF/D	HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
PRODUCTION	FPSO - RECIP.>600hp (3 Wartsila Total hp) standby	0	0	0	0	0	0	0	0	0	0		0	0	0	0
	FPSO - TURBINES Natural Gas	21,210	202,004	4,848,097	24	365		0.12	60.73	0.47	38.78		0.51	266.01	2.05	169.84
	FPSO - RECIP.>600hp diesel (Emergency Generator)	670	32.361	776.66	24	15	0.47	2.17	16.23	0.49	3.54	0.085	0.390	2.922	0.088	0.638
	FPSO - BURNER diesel (Steam Boilers)	107.4			24	365	1.88	73.10	10.34	0.05	0.94	8.23	320.16	45.27	0.23	4.12
	FPSO - RECIP.<600hp diesel (3 Deck Cranes)	1716	82.9	1989.19	24	365	3.78	5.55	52.92	4.23	11.45	16.56	24.30	231.77	18.54	50.16
	FPSO - RECIP.<600hp diesel (2 Fire Pumps)	1144	55.3	1326.12	24	30	2.52	3.70	35.28	2.82	7.64	0.91	1.33	12.70	1.02	2.75
	FPSO - IGG System burner	32			24	52	0.57	22.05	3.12	0.02	0.28	0.35	13.76	1.95	0.010	0.18
	Shuttle Vessel - RECIP.>600hp diesel (Loading from FPSO)	3264	157.7	3783.6	24	52	2.30	10.55	79.08	2.37	17.25	1.44	6.59	49.35	1.48	10.77
	Shuttle Vessel - RECIP.>600hp diesel (Transit within 25 miles)	11424	551.8	13242.7	24	20	8.05	36.94	276.79	8.30	60.39	1.93	8.87	66.43	1.99	14.49
	VESSELS>600hp diesel (Crew Boat/Fast Supply #1)	6300	304.29	7303	24	156	4.44	20.37	152.64	4.58	33.30	8	38	286	9	62
	VESSELS>600hp diesel (Offshore Service Vessel #1)	4,000	193.2	4637	24	104	2.82	12.93	96.92	2.91	21.15	3.52	16.14	120.95	3.63	26.39
	VESSELS>600hp diesel (Offshore Service Vessel #2)	8,000	386.4	9274	24	365	5.64	25.87	193.83	5.81	42.29	24.70	113.30	848.99	25.47	185.23
	FPSO - AUXILIARY EQUIP<600hp diesel (Air Comp.)	0	0	0.00	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	RECIP.2 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle lean nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	RECIP.4 cycle rich nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	BURNER nat gas	0	0	0	0	0		0.00	0.00	0.00	0.00		0	0	0	0
	MISC.	BPD	SCF/HR	COUNT			0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
	FPSO - TANK (Vapors @ Production Rate)				24	365				100.00					219.00	
	Shuttle tanker Loading - 50% tG				24	52				206.25					128.70	
	FLARE- (upset considered insignificant)		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	PROCESS VENT		0		0	0				0.00					0.00	
	FUGITIVES-			11420.0		365				5.71					25.01	
	GLYCOL STILL VENT-		0.14714444		24	365				9.71E-07					4.25E-06	
	Sikorsky H-60 Helicoptor (Production Operations)				12	365	3.13	0.60	10.56	0.82	6.19	6.86	1.31	23.13	1.80	13.56
DRILLING	OIL BURN	0			0	0	0.00	0.00	0.00	0.00	0.00	0	0	0	0	0
WELL TEST	GAS FLARE		0		0	0		0.00	0.00	0.00	0.00		0	0	0	0
	2015 YEAR TOTAL						35.60	213.93	988.45	344.84	243.21	72.89	544.78	1955.23	437.58	540.47
EXEMPTION CALCULATION	DISTANCE FROM LAND IN MILES											5527.80	5527.80	5527.80	5527.80	102695.40
	166.0															

Notes:

1.) The air emissions worksheet only captures Shuttle Vessel air emissions while the Shuttle Vessel is within 25 miles of the FPSO. This has been done to be consistent with current regulatory framework. See Note #2 and the table below for additional information on Shuttle Vessel air emissions outside of the 25 mile radius from the FPSO.

2.) Crowley "750" has been utilized for the Shuttle Vessel. Crowley has communicated to PAI that the "750" operates at the following HP loads based on historical fuel consumption; loading from FPSO (20%), transit within 25 miles of FPSO (70%), transit outside of 25 miles of FPSO (90%), offloading to terminal (40%), and idle but on contract (15%). Note that HP at 100% is 16,320. Based on 1 Shuttle Vessel offloading every week.

	HP	GAL/HR	ACT. FUEL	RUN TIME		MAXIMUM POUNDS PER HOUR					ESTIMATED TONS PER YEAR				
				HR/D	DAYS	PM	SOx	NOx	VOC	CO	PM	SOx	NOx	VOC	CO
Shuttle Vessel - RECIP.>600hp diesel (Transit outside 25 miles)	14688	709.4	17026.3	24	65	10.35	47.49	355.88	10.68	77.65	10.56	48.44	362.99	10.89	79.20
Shuttle Vessel - RECIP.>600hp diesel (Offloading to terminal)	6528	315.3	7567.3	24	52	4.60	21.11	158.17	4.75	34.51	2.87	13.17	98.70	2.96	21.53
Shuttle Vessel - RECIP.>600hp diesel (Idle but on contract)	2448	118.2	2837.7	24	156	1.73	7.92	59.31	1.78	12.94	3.23	14.82	111.03	3.33	24.23

AIR EMISSION CALCULATIONS

OMB Control No. 1010-0049
OMB Approval Expires: August 31, 2006

COMPANY	AREA	BLOCK	LEASE	PLATFORM	WELL
Petrobras America	Walker Ridge	249	OCS-G 16969	FPSO	0

Year	Emitted Substance				
	PM	SOx	NOx	VOC	CO
2008	41.97	175.19	1078.71	40.75	296.24
2009	169.96	772.67	4743.34	184.03	1225.27
2010	71.03	530.18	1896.36	242.83	527.75
2011	72.89	544.78	1955.23	349.98	540.47
2012	72.89	544.78	1955.23	415.68	540.47
2013	72.89	544.78	1955.23	437.58	540.47
2014	72.89	544.78	1955.23	437.58	540.47
2015	72.89	544.78	1955.23	437.58	540.47
Allowable	5527.80	5527.80	5527.80	5527.80	102695.40

APPENDIX 5

WCD Equipment Response Times

WCD Scenario for > 10 Miles From Shore – <u>BASED ON LOSS OF A WELL BLOWOUT</u> (166 miles from shore)
Walker Ridge Blocks 205, 206, 249, 250, 425, 426, 469, 470
12,284 bbls of crude
API Gravity 23°

Equipment Response Times to: WR 205, 206, 249, 250, 425, 426, 469, 470

EQUIPMENT					Owner/Location	Initial Staging	Hours To Staging Area	Total Time to Procure (1)	Time to Load Out (2)	Travel Time (Staging/ Spill) (3)	Time to Deploy (4)	Total Estimated Response Time
	TYPE	Derated Capacity (BBLS)	Storage (BBLS)	No. of Units								
A	DC 4 Spray Aircraft DC 3 Spray Aircraft Spotter Plane Spotter Personnel Dispersant	-- --	-- --	1 1 1 2	ASI/HOUMA ASI/HOUMA ASI/HOUMA ASI/HOUMA CGA/HOUMA	HOUMA HOUMA HOUMA HOUMA HOUMA	0 0 0 1 0	1	1	1.5	0	3.5
B	HOSS Barge Operators Tugs	43,000	4,130	1 12 3	CGA/HOUMA STARS Vessel of Opportunity	HOUMA HOUMA HOUMA	4 2 4	4	1	28	1	34
C	FRU/Expandi Operators Utility Boat Crew Boat	10,200	600	3 18 3 3	CGA/HOUMA STARS* Vessel of Opportunity Vessel of Opportunity	FOURCHON FOURCHON FOURCHON FOURCHON	1 2 2 2	2	1	14.25	1	18.25
D	FRU/Expandi Operators Utility Boat Crew Boat	3,770	200	1 6 1 1	CGA/VENICE STARS* Vessel of Opportunity Vessel of Opportunity	VENICE VENICE VENICE VENICE	1 2 2 2	2	1	13	1	17
E	FRU/Expandi Operators Utility Boat Crew Boat	3,770	200	1 6 1 1	CGA/LAKE CHARLES STARS* Vessel of Opportunity Vessel of Opportunity	CAMERON CAMERON CAMERON CAMERON	1 2 2 2	2	1	19	1	23
F	**INITIAL SUPPORT** Spotter Helo Surveillance Helo Hand Held Radios Open Ocean Barge Tugs	-- -- -- -- --	-- -- -- 23,000 --	1 1 25 1 2	PHI/HOUMA PHI/HOUMA STARS* CENAC/HOUMA Vessel of Opportunity	SPILL SITE SPILL SITE HOUMA HOUMA HOUMA	1 1 1.5 2 2	1 1 1.5 4 4	-- -- -- 1 1	1.75 1.75 1.75 28 28	-- -- -- 1 1	2.75 2.75 3.25 34 34
	TOTAL	60,740	28,130									

Petrobras America, Inc.
Development Operations Coordination Document
Cascade / Chinook Development Project

APPENDIX 6

Oil Spill Risk Analysis (OSRA) Report

OCS Report
MMS 2007-0XX

Oil-Spill Risk Analysis: Contingency Planning Statistics for Gulf of Mexico OCS Activities

By:

Zhen-Gang Ji
Walter R. Johnson
Charles F. Marshall
Eileen M. Lear (Editor)

U.S. Department of the Interior
Minerals Management Service
Environmental Division

February 2007

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Introduction

The Federal Government offers U.S. Outer Continental Shelf (OCS) lands in the Gulf of Mexico (GOM) for oil and gas leasing. Because oil spills may occur from activities associated with offshore oil exploration, production, and transportation resulting from these lease sales, the Minerals Management Service (MMS) has conducted a formal oil-spill risk analysis (OSRA) to provide spill statistics that can be used in contingency planning for these areas. This report summarizes the results of that analysis, the objective of which was to estimate the risk of oil-spill contact to coastal resources in the GOM from oil spills accidentally occurring from the OCS activities (LaBelle, 2001).

The occurrence of oil spills is fundamentally a matter of probability. There is no certainty regarding the amount of oil that would be produced, or the size or likelihood of a spill that would occur, during the estimated life of a given lease sale. Neither can the winds and ocean currents that transport oil spills be known for certain. A probabilistic event such as an oil-spill occurrence or oil-spill contact to an environmentally sensitive area cannot be predicted, only an estimate of its likelihood (its probability) can be quantified.

This report provides the contingency planning statistics for the OCS activities in the GOM. The probabilities of oil spill occurrence and the combined probabilities of contact in the GOM are already presented in previous reports. (Ji et al. 2002a, 2002b). This report is available from the MMS's Internet site (*http://www.mms.gov*).

Framework of the Analysis

Domain/Study Areas

The domain (shown in fig.1) defines the geographic boundaries that encompass the environmental resources at risk from a hypothetical oil spill from OCS operations in the lease areas. Although few hypothetical oil spills were likely to extend beyond the borders of the domain within 30 days after release (the maximum elapsed time considered), we have tracked and tabulated spills that would travel beyond the open-ocean boundaries. These spills could contact land or other environmental resources outside the domain.

The study area (shown in fig. 1) is the Walker Ridge Planning Area that encompasses the a portion offshore waters within the Gulf of Mexico. The subarea of Walker Ridge that contains the Cascade and Chinook projects is approximately 140 to 160 nautical miles offshore and is close to the limits of the Exclusive Economic Zone–the maritime region extending 200 nautical miles from the baseline of the territorial sea, in which the United States has exclusive rights and jurisdiction over living and nonliving natural resources.

The study area was created as a hypothetical spill site, which are used to represent oil-spill risks from platforms (fig. 1).

Hypothetical Spill Locations

The OSRA Model initiated hypothetical oil spills uniformly in space and time from within the study area, as shown in figure 1. At 1/10° intervals in the north-south direction (about 11 km) and 1/10° intervals in the east-west direction (about 10 km), the model launched an oil spill every 1.0 day. At this resolution, there were 15 total launch points in space, and a total of 5,760 oil-spill trajectories were launched from each spatial grid point over a periods of 9 years and 7 years, as described below. The spatial resolution of the spill simulations was well within the spatial resolution of the input data, and the interval of time between releases was sufficiently short to sample weather-scale changes in the input winds (Price et al., 2003).

The sensitivity tests on the OSRA Model (Price et al., 2002) indicated that, statistically, the above-mentioned spatial resolution (1/10° by 1/10°) and time resolution (1.0 day) are sufficient to represent the spatial and time variations of the particle trajectories in the area.

Environmental Resources

The environmental resources considered in this analysis include the counties and parishes along the coast of the Gulf of Mexico. Figures 2 and 3 depict locations of these counties and parishes. The MMS used data derived from the Coastal Offshore Resource Information System (CORIS) and other databases. The CORIS data were developed and supported by State and Federal Agencies and the oil industry operating along the Gulf coast.

All onshore, coastal environmental resource locations were represented by one or more partitions of the coastline, herein called land. The study area coastline was partitioned into 162 equidistant land segments of approximately 10-mile (16-km) length. The partitions were formed by creating straight lines between two points projected onto the coast; therefore, the actual miles of shoreline represented by each land segment may be greater than 10 miles, depending upon the complexity of the coastal area.

The counties and parishes examined in this OSRA are shown below.

Counties/Parishes (set 1)--shown on Figure 2

C1-Cameron, TX
C3-Kenedy, TX
C5-Nueces, TX
C7-Calhoun, TX
C9-Brazoria, TX
C11-Chambers, TX
C13-Cameron, LA
C15-Iberia, LA
C17-Terrebonne, LA
C19-Jefferson, LA
C21-St. Bernard, LA
C23-Jackson, MS
C25-Baldwin, AL
C27-Santa Rosa, FL
C29-Walton, FL
C31-Gulf, FL
C33-Wakulla, FL
C35-Taylor, FL
C37-Levy, FL
C39-Hernando, FL
C41-Pinellas, FL
C43-Manatee, FL
C45-Charlotte, FL
C47-Collier, FL

Counties/Parishes (set 2)--shown on Figure 3

C2-Willacy, TX
C4-Kleberg, TX
C6-Aransas, TX
C8-Matagorda, TX
C10-Galveston, TX
C12-Jefferson, TX
C14-Vermilion, LA
C16-St. Mary, LA
C18-Lafourche, LA
C20-Plaquemines, LA
C22-Hancock & Harrison, MS
C24-Mobile, AL
C26-Escambia, FL
C28-Okaloosa, FL
C30-Bay, FL
C32-Franklin, FL
C34-Jefferson, FL
C36-Dixie, FL
C38-Citrus, FL
C40-Pasco, FL
C42-Hillsborough, FL
C44-Sarasota, FL
C46-Lee, FL
C48-Monroe, FL

Oil-Spill Risk Analysis

In this report, the OSRA was conducted to calculate the trajectories of oil spills from hypothetical spill locations to various environmental resources.

Risk analyses may be characterized as "hazard-based" or "risk-based." A hazard-based analysis examines possible events regardless of their low (or high) likelihood. For example, a potential impact would not lose significance because the risk has been reduced due to an increase in the level of control, such as engineering standards. A risk-based analysis, on the other hand, does take into account the likelihood of the event occurring or the measures that can be taken to mitigate against its potential impacts. This OSRA is designed for use as a hazard-based assessment. Therefore, the likelihood of oil spills occurring on the OCS was not considered in the analysis.

Oil-Spill Trajectory Simulations

The OSRA Model, originally developed by Smith et al. (1982) and enhanced by MMS over the years (LaBelle and Anderson, 1985; Ji et al., 2003, Ji et al. 2004), simulates oil-spill transport using realistic data fields of winds and ocean currents in the GOM. An oil spill on the ocean surface moves around by the complex surface ocean currents exerting a shear force on the spilled oil from below. In addition, the prevailing wind exerts an additional shear force on the spill from above, and the combination of the two forces causes the transportation of the oil spill away from its initial spill location. In the OSRA Model, the velocity of a hypothetical oil spill is the linear superposition of the surface ocean current and the wind drift caused by the winds. The model calculates the movement of hypothetical spills by successively integrating time sequences of two spatially gridded input fields: the surface ocean currents and the sea-level winds, both of which were generated by other computer models using many observations of relevant physical parameters. In this fashion, the OSRA Model generates time sequences of hypothetical oil-spill locations–essentially, oil-spill trajectories.

At each successive time step, the OSRA Model compares the location of the hypothetical spills against the geographic boundaries of shoreline and designated offshore environmental

resources. The model counts the occurrences of oil-spill contact to these areas during the time periods that the habitat is known to be used by the resource. Finally, the frequencies of oil-spill contact are computed for designated oil-spill travel times (e.g., 3, 10, or 30 days) by dividing the total number of oil-spill contacts by the total number of hypothetical spills initiated in the model from a given hypothetical spill location. The frequencies of oil-spill contact are the model-estimated probabilities of oil-spill contact. The OSRA Model output provides the estimated probabilities of contact to all identified offshore environmental resources and segments of shoreline from locations chosen to represent hypothetical oil spills from oil production and transportation facilities, at several selected oil-spill travel times.

There are factors not explicitly considered by the OSRA Model that can affect the transport of spilled oil as well as the dimensions, volume, and nature of the oil spills contacting environmental resources or the shoreline. These include possible cleanup operations, chemical composition or biological weathering of oil spills, or the spreading and splitting of oil spills. The OSRA analysts have chosen to take a more environmentally conservative approach by presuming persistence of spilled oil over the selected duration of time of the trajectories.

In the trajectory simulation portion of the OSRA Model, many hypothetical oil-spill trajectories are produced by numerically integrating a temporally and spatially varying ocean current field and superposing on that an empirical wind-induced drift of the hypothetical oil spills (Samuels et al., 1982). Collectively, the trajectories represent a statistical ensemble of simulated oil-spill displacements produced by a field of winds derived from observations and numerically derived ocean currents. The winds and currents are assumed to be statistically similar to those that will occur in the Gulf during future offshore activities. In other words, the oil-spill risk analysts assume that the frequency of strong wind events in the wind field is the same as what will occur during future offshore activities. By inference, the frequencies of contact by the simulated oil spills are the same as what could occur from actual oil spills during future offshore activities.

The other portion of the OSRA Model tabulates the contacts by the simulated oil spills. The model contains the geographical boundaries of a variety of identified environmental features. At every integration time step, the OSRA Model tracks the locations of the simulated spills and counts the number of oil-spill contacts to segments of shoreline (counties). A contact to shore will stop the trajectory of an oil spill; no re-washing is assumed in this model. After specified periods of time, the OSRA Model will divide the total number of contacts to the coastline segments by the total number of simulated oil spills from a given geographic location. These ratios are the estimated probabilities of oil-spill contact from offshore activities at that geographic location, assuming spill occurrence.

Conducting an oil-spill risk analysis needs detailed information on ocean currents and wind fields (Ji, 2004). The ocean currents used are numerically computed from an ocean circulation model of the GOM driven by analyzed meteorological forces (the near-surface winds and the total heat fluxes) and observed river inflow into the GOM (Herring et al., 1999; Oey et al., 2004; Oey, 2005). The models used are versions of the Princeton Ocean Model (POM), an enhanced version of the earlier constructed Mellor-Blumberg Model. It is a three-

dimensional, time-dependent, primitive equation model using orthogonal curvilinear coordinates in the horizontal and a topographically conformal coordinate in the vertical. The use of these coordinates allows for a realistic coastline and bottom topography, including a sloping shelf, to be represented in the model simulation. The model incorporates the Mellor-Yamada turbulence closure model to provide a parameterization of the vertical mixing process through the water column.

The prognostic variables of the model are velocity, temperature, salinity, turbulence kinetic energy, and turbulence macroscale. The momentum equations are nonlinear and incorporate a variable Coriolis parameter. Prognostic equations governing the thermodynamic quantities (temperature and salinity) account for water mass variations brought about by highly time-dependent coastal upwelling processes. The processes responsible for eddy production, movement, and eventual dissipation are also included in the model physics. Other computed variables include density, vertical eddy viscosity, and vertical eddy diffusivity.

Two separate model runs were used to calculate the trajectories for this statistical report. The first was a 9-year simulation was performed by Dynalysis of Princeton (Herring, et al., 1999). The POM was driven by winds and heat fluxes over the 9-year period, 1986 through 1994, which were analyzed by the European Center for Medium-Range Weather Forecasts (ECMWF). The second ocean model calculation was performed by Princeton University (Oey, 2003; Oey, et al., 2004). This simulation covered the 7 year period 1993 through 1999, and the results were saved at 1-hour intervals. This run included the assimilation of sea surface altimeter observations, to improve the ocean model results. The surface currents were then computed for input into the OSRA Model along with the concurrent wind field. The OSRA Model used the same wind field to calculate the empirical wind drift of the simulated spills. The statistics for the contacts by the trajectories forced by the two model runs were combined for the average probabilities.

The ocean model simulations were extensively skill-assessed with many observations from the GOM (Herring et al., 1999; Oey, et al., 2004, Oey, 2005). These extensive sets of observations affords a rigorous test of the model's ability to reproduce ocean transport as well as prominent features of the Gulf such as the Loop Current and strong mesoscale eddies, which are easily observed from satellite-borne instrumentation. With these observations and other current measurements from moored current meters, a good determination of the model's veracity was made. Both the POM models did an excellent job in reproducing the characteristics of the GOM surface currents both on and off the continental shelf. The surface current field manifests all the dominant structures in time and space as the observed currents and is, therefore, applicable in the statistical estimation of future spill risk that the OSRA Model makes.

Trajectories of hypothetical spills were initiated every 1.0 day from each of the 15 launch points in space–3,240 trajectories per launch point over the 9-year simulation period and 2520 over the 7-year simulation period. The chosen number of trajectories per site (5,760) was small enough to be computationally practical and large enough to reduce the random sampling error to an insignificant level. Also, the weather-scale changes in the winds are at least minimally sampled with simulated spills started every 1.0 day.

The OSRA Model integrates the spill velocities (a linear superposition of surface ocean currents and empirical wind drift) by integrating in time to produce the spill trajectories. The time step selected was 1 hour to fully utilize the spatial resolution of the ocean current field and to achieve a stable set of trajectories. The velocity field was bilinearly interpolated from the 3-hourly or 1-hourly grid to get velocities at 1-hour intervals. Smaller time steps did not produce significant differences in the simulated trajectories after 30 model days, so the 1-hour time step was chosen for this analysis. Ji et al. (2004) summarized the latest improvement on the OSRA Model and the model sensitivity tests.

Conditional Probabilities of Contact

The probability that an oil spill will contact a specific environmental resource within a given time of travel from a certain location or spill point is termed a *conditional probability*, the condition being that a spill is assumed to have occurred. Each trajectory was allowed to continue for as long as 30 days. However, if the hypothetical spill contacted shoreline sooner than 30 days after the start of the spill, the spill trajectory was terminated, and the contact was recorded.

The trajectories simulated by the model represent only hypothetical pathways of oil slicks; they do not involve any direct consideration of cleanup, dispersion, or weathering processes that could alter the quantity or properties of oil that might eventually contact the environmental resource locations. However, an implicit analysis of weathering and decay can be considered by choosing a travel time for the simulated oil spills when they contact environmental resource locations that represent the likely persistence of the oil slick on the water surface. The MMS performed an analysis of the likely weathering and cleanup of a typical offshore oil spill of 1,000 bbl or greater occurring under the proposed action scenarios (USDOI, MMS, 2002). The analysis of the slick's fate showed that a typical GOM oil slick of 1,000 bbl or greater, exposed to typical winds and currents, would not persist on the water surface beyond 10 days. Therefore, OSRA Model trajectories were analyzed for 3, 10, and 30 days. Spill contacts occurring within these time periods are reported in the probability tables (tables 1 through 3). The probability of spill contact was also analyzed on a seasonal basis, and these probabilities are reported in tables 1 through 6. The counties and parishes with all probabilities of less than 0.5 percent are not shown in these tables.

Discussion

As one might expect, the environmental resource locations closest to the spill sites had the greatest risk of contact. As the model run duration increases, more of the identified environmental resources and shoreline segments could have meaningful probabilities of contact ($\geq$0.5%). The longer transit times (up to 30 days) allowed by the model enable more hypothetical spills to reach the environmental resources and the shoreline from more distant spill locations. With increased travel time, the complex patterns of wind and ocean currents produce eddy-like motions of the oil spills and multiple opportunities for a spill to make contact with any given environmental resource or shoreline segment. The hypothetical spill area for this analysis is between 140 and 160 nm from the coast, which resulted in no probabilities of contact to county land segments of greater than 0.5% for 3 to 10 days and an annual average maximum of 2%. Due to the climatology of the wind, the spring season had the higher average probabilities of contact to county segments (the highest being 8%), and the fall season had the lowest (none greater than 0.5%). The hypothetical launch area was approximately 40 to 55 nm from the international boundary segments, thus these segments have annual average contact probabilities of up to16% within 10 days. The international boundary segments do not terminate the trajectories, so that one trajectory could contact more than one segment, based on changing wind and current histories.

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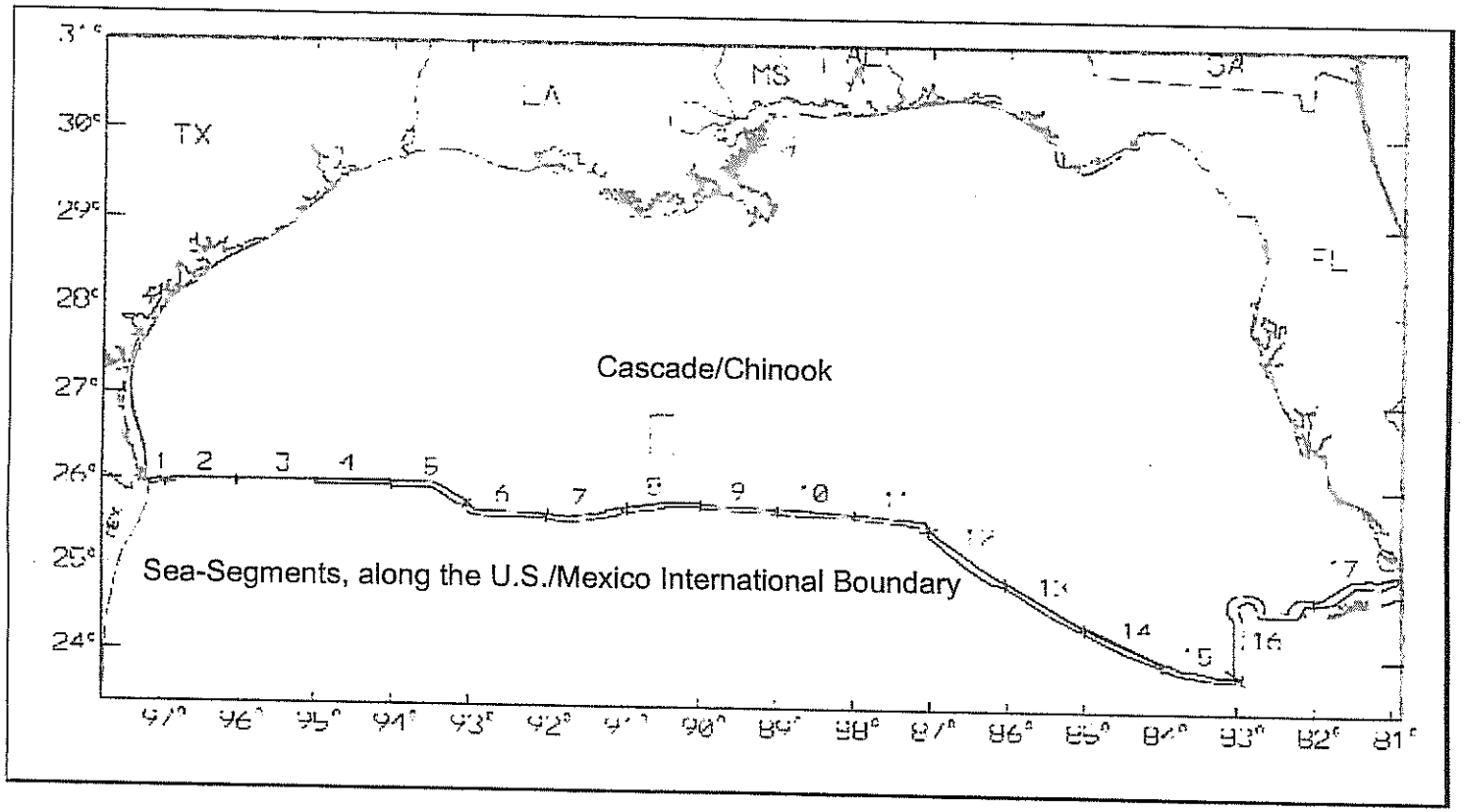

Figure 1. Location of the launch area in the Walker Ridge Planning Area

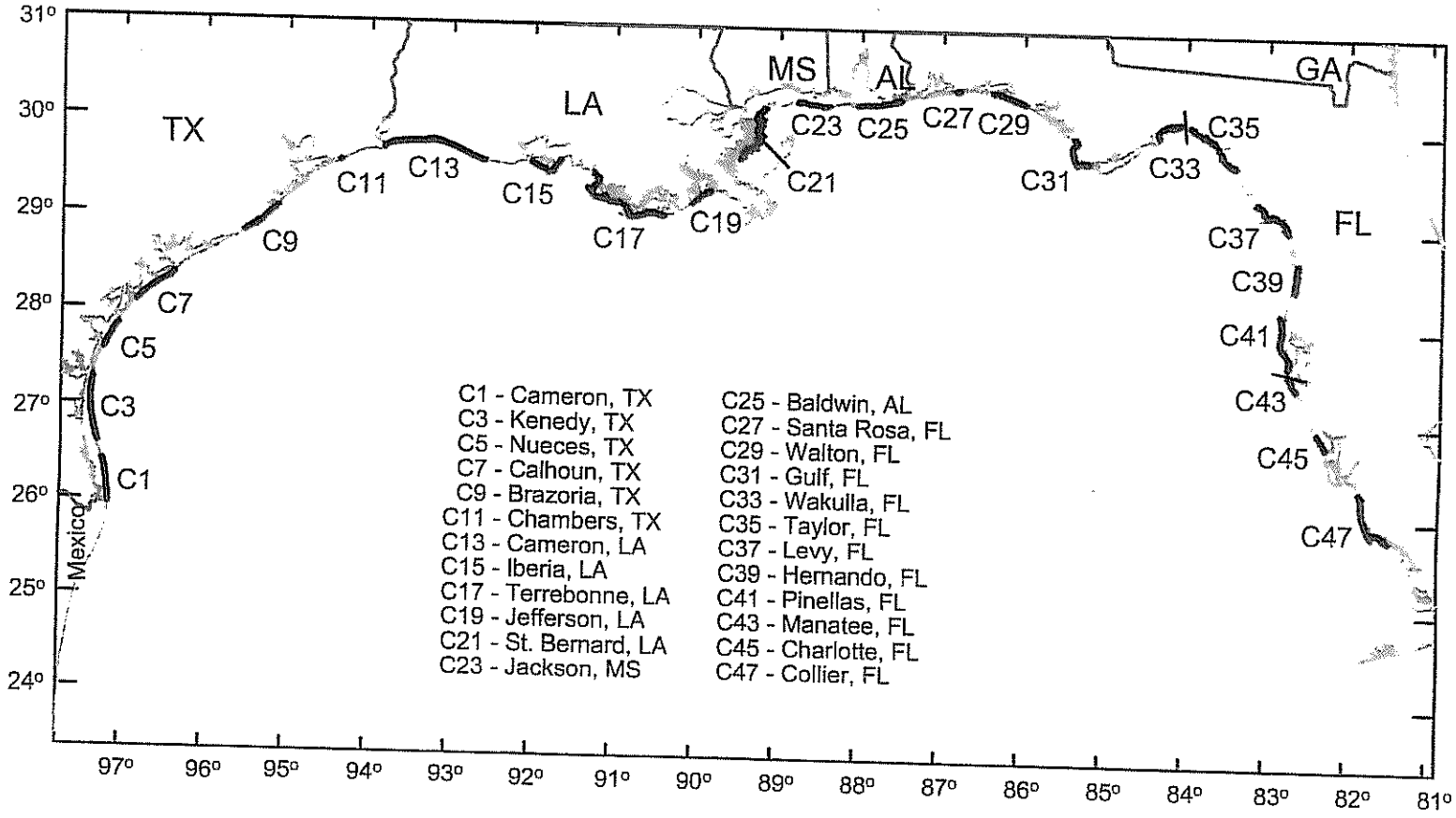

Figure 2. Locations of Gulf of Mexico counties (set 1). (Shading is not to scale.)

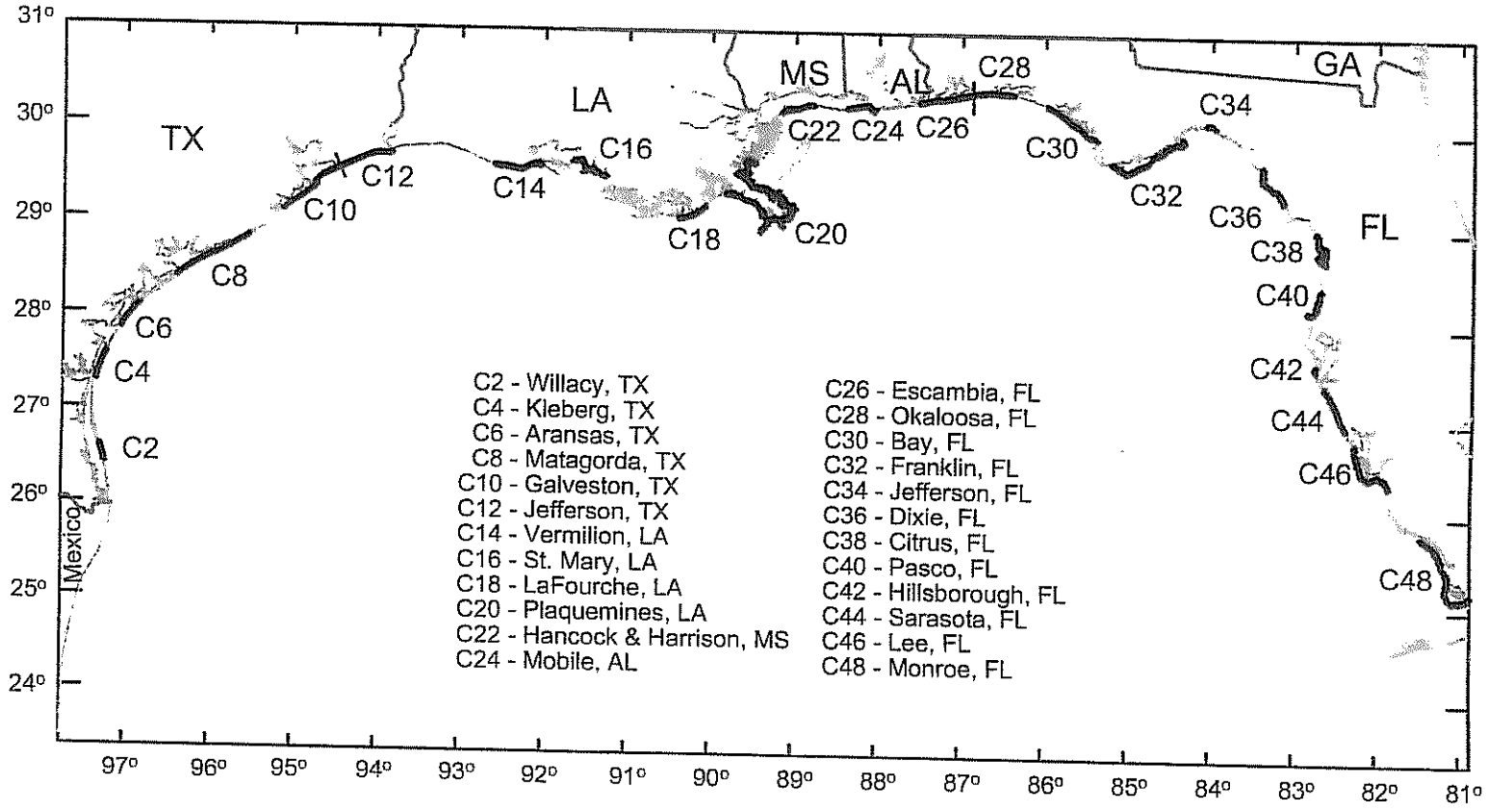

Figure 3. Locations of Gulf of Mexico counties (set 2). (Shading is not to scale.)

Table 1
Probabilities (expressed as percent chance) that an oil spill starting at a particular location for annual and each season will contact a certain land segment within 30 days, Walker Ridge Cascade/Chinook

County	Annual	Winter	Spring	Summer	Fall
C7 Calhoun TX	n	n	1	n	n
C8 Matagorda TX	1	2	2	n	n
C9 Brazoria TX	1	1	2	n	n
C10 Galveston TX	2	2	6	1	n
C12 Jefferson TX	1	n	3	n	n
C13 Cameron LA	2	1	8	n	n
C14 Vermillion LA	1	n	4	n	n
C15 Iberia LA	n	n	2	n	n
C17 Terrebonne LA	1	n	5	n	n
C18 LaFourche LA	1	n	2	n	n
C19 Jefferson LA	n	n	1	n	n
C20 Plaquemines LA	1	n	5	1	n

Notes:
** = Greater than 99.5 percent; n = less than 0.5 percent.
Rows with all values less than 0.5 percent are not shown.

Table 2
Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location will contact a certain environmental resource within 3, 10 and 30 days, Sea Segments from Walker Ridge launch area.

	Number of Days		
Environmental Resource	3	10	30
SEA SEG 1 (to - 97 DEG)	n	n	n
SEA SEG 2 (97 - 96 DEG)	n	n	n
SEA SEG 3 (96 - 95 DEG)	n	n	2
SEA SEG 4 (95 - 94 DEG)	n	n	4
SEA SEG 5 (94 - 93 DEG)	n	1	9
SEA SEG 6 (93 - 92 DEG)	n	4	17
SEA SEG 7 (92 - 91 DEG)	2	13	26
SEA SEG 8 (91 - 90 DEG)	6	16	23
SEA SEG 9 (90 - 89 DEG)	1	7	12
SEA SEG 10 (89 - 88 DEG)	n	2	5
SEA SEG 11 (88 - 87 DEG)	n	n	1
SEA SEG 12 (87 - 86 DEG)	n	n	1
SEA SEG 13 (86 - 85 DEG)	n	n	1
SEA SEG 14 (85 - 84 DEG)	n	n	n
SEA SEG 15 (84 - 83 DEG)	n	n	n
SEA SEG 16 (83 - 82 DEG)	n	n	n
SEA SEG 17 (82 - 81 DEG)	n	n	n

Note: ** = Greater than 99.5 percent; n = Less than 0.5 percent.

Table 3

Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the winter season will contact a certain environmental resource within 3, 10, and 30 days, Sea Segments from Walker Ridge launch area.

	Number of Days		
Environmental Resource	3	10	30
SEA SEG 1 (to - 97 DEG)	N	n	n
SEA SEG 2 (97 - 96 DEG)	N	n	n
SEA SEG 3 (96 - 95 DEG)	N	n	4
SEA SEG 4 (95 - 94 DEG)	N	n	5
SEA SEG 5 (94 - 93 DEG)	N	1	10
SEA SEG 6 (93 - 92 DEG)	N	2	18
SEA SEG 7 (92 - 91 DEG)	2	14	31
SEA SEG 8 (91 - 90 DEG)	10	23	29
SEA SEG 9 (90 - 89 DEG)	N	2	6
SEA SEG 10 (89 - 88 DEG)	N	n	2
SEA SEG 11 (88 - 87 DEG)	N	n	1
SEA SEG 12 (87 - 86 DEG)	N	n	n
SEA SEG 13 (86 - 85 DEG)	N	n	n
SEA SEG 14 (85 - 84 DEG)	N	n	n
SEA SEG 15 (84 - 83 DEG)	N	n	n
SEA SEG 16 (83 - 82 DEG)	N	n	n
SEA SEG 17 (82 - 81 DEG)	N	n	n

Note: ** = Greater than 99.5 percent; n = Less than 0.5 percent.

Table 4
Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the spring season will contact a certain environmental resource within 3, 10 and 30 days, Sea Segments from Walker Ridge launch area.

	Number of Days		
Environmental Resource	3	10	30
SEA SEG 1 (to - 97 DEG)	n	n	n
SEA SEG 2 (97 - 96 DEG)	n	n	n
SEA SEG 3 (96 - 95 DEG)	n	n	n
SEA SEG 4 (95 - 94 DEG)	n	n	1
SEA SEG 5 (94 - 93 DEG)	n	n	4
SEA SEG 6 (93 - 92 DEG)	n	1	4
SEA SEG 7 (92 - 91 DEG)	n	4	11
SEA SEG 8 (91 - 90 DEG)	n	2	6
SEA SEG 9 (90 - 89 DEG)	n	1	5
SEA SEG 10 (89 - 88 DEG)	n	2	3
SEA SEG 11 (88 - 87 DEG)	n	n	n
SEA SEG 12 (87 - 86 DEG)	n	n	1
SEA SEG 13 (86 - 85 DEG)	n	n	2
SEA SEG 14 (85 - 84 DEG)	n	n	n
SEA SEG 15 (84 - 83 DEG)	n	n	n
SEA SEG 16 (83 - 82 DEG)	n	n	n
SEA SEG 17 (82 - 81 DEG)	n	n	n

Note: ** = Greater than 99.5 percent; n = Less than 0.5 percent.

Table 5

Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the summer season will contact a certain environmental resource within 3, 10, and 30 days, Sea Segments from Walker Ridge launch area.

	Number of Days		
Environmental Resource	3	10	30
SEA SEG 1 (to - 97 DEG)	n	n	n
SEA SEG 2 (97 - 96 DEG)	n	n	n
SEA SEG 3 (96 - 95 DEG)	n	n	2
SEA SEG 4 (95 - 94 DEG)	n	n	5
SEA SEG 5 (94 - 93 DEG)	n	1	10
SEA SEG 6 (93 - 92 DEG)	n	7	21
SEA SEG 7 (92 - 91 DEG)	4	14	24
SEA SEG 8 (91 - 90 DEG)	2	5	12
SEA SEG 9 (90 - 89 DEG)	1	4	7
SEA SEG 10 (89 - 88 DEG)	n	n	1
SEA SEG 11 (88 - 87 DEG)	n	n	n
SEA SEG 12 (87 - 86 DEG)	n	n	1
SEA SEG 13 (86 - 85 DEG)	n	n	1
SEA SEG 14 (85 - 84 DEG)	n	n	1
SEA SEG 15 (84 - 83 DEG)	n	n	1
SEA SEG 16 (83 - 82 DEG)	n	n	n
SEA SEG 17 (82 - 81 DEG)	n	n	n

Note: ** = Greater than 99.5 percent; n = Less than 0.5 percent.

Table 6

Conditional probabilities (expressed as percent chance) that an oil spill starting at a particular location in the autumn season will contact a certain environmental resource within 3, 10 and 30 days, Sea Segments from Walker Ridge launch area.

	Number of Days		
Environmental Resource	3	10	30
SEA SEG 1 (to - 97 DEG)	n	n	n
SEA SEG 2 (97 - 96 DEG)	n	n	1
SEA SEG 3 (96 - 95 DEG)	n	n	1
SEA SEG 4 (95 - 94 DEG)	n	n	4
SEA SEG 5 (94 - 93 DEG)	n	1	11
SEA SEG 6 (93 - 92 DEG)	n	8	23
SEA SEG 7 (92 - 91 DEG)	1	19	38
SEA SEG 8 (91 - 90 DEG)	14	32	44
SEA SEG 9 (90 - 89 DEG)	3	21	31
SEA SEG 10 (89 - 88 DEG)	n	5	13
SEA SEG 11 (88 - 87 DEG)	n	n	2
SEA SEG 12 (87 - 86 DEG)	n	n	1
SEA SEG 13 (86 - 85 DEG)	n	n	n
SEA SEG 14 (85 - 84 DEG)	n	n	n
SEA SEG 15 (84 - 83 DEG)	n	n	n
SEA SEG 16 (83 - 82 DEG)	n	n	n
SEA SEG 17 (82 - 81 DEG)	n	n	n

Note: ** = Greater than 99.5 percent; n = Less than 0.5 percent.