ASSESSMENT OF DRILLING & WORKOVER RIG STORM SEA FASTENINGS ON OFFSHORE FLOATING PLATFORMS DURING HURRICANE IVAN
PHASE 1: Data Collection Report

by

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Prepared for the Minerals Management Service

Under the MMS/OTRC Cooperative Research Agreement
1435-01-04-CA-35515
Task Order 39238
MMS Project Number 551

August 1, 2006

OTRC Library Number: 0806-SFDC

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Abbreviation:

Nm = Nautical Miles

ASSESSMENTOF DRILLING & WORKOVER RIG STORM SEA FASTENINGS ON OFFSHORE FLOATING PLATFORMS DURING HURRICANE IVAN - PHASE 1 (MMS 551)

Data Collection Report
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Project Description

Drilling and workover rigs on Floating Production Systems (FPSs) are fastened to the decks of offshore structures sea fastenings to prevent movement during hurricanes. Sea fastenings include bolts, weldments, braces, or other means. During Hurricane Ivan, a number of drilling or workover rigs shifted. These movements are being assessed along with the current design philosophy and criteria for storm sea fastenings, rig and storm sea fastening installation practices, and onboard storm operational practices to ready FPSs for a hurricane. Results will provide information that can be used to assess any needs to revise tie-down criteria or practices to avoid future damage.

Phase 1 is being sponsored by MMS. The objectives are to collect information on FPSs that had drilling rig movements during Ivan and complete preliminary analyses to understand the observed movements relative to existing codes and practices. A Phase 2 study is envisioned as a JIP that would complete additional and more detailed analyses of rig tie-down failures and successes, and evaluate tie-down options for preventing observed movements.

The data collection phase has been completed and is documented in this report.

Introduction

Figure 1 shows the FPSs exposed to Hurricane Ivan. Table 1 indicates the specific Floating Production Systems studied during Phase 1. Note that bolted clamps are the predominant sea fastening system for drilling rigs on the FPSs listed in Table 1.

- Rig or substructure movements had been reported for the following FPSs:
- Medusa (Murphy)
- Ram Powell (Shell)
- Horn Mountain (BP)
- Devils Tower (Dominion)

A questionnaire was developed to gather data and guide discussions with operators. Information was gathered on the rig movements through discussions with Murphy, Shell, and BP. We did not receive any information from Dominion.

Additionally, a field trip was made to visit Shell's Brutus TLP, Murphy's Front Runner spar, and BP's Holstein and Mad Dog spars on August 26, 2005. The platform visits took place on the day before Hurricane Katrina passed through this portion of the Gulf, so we were able to observe these rigs being prepared for hurricane evacuation.

Information Collected

The information gathered through these questionnaires, discussions with operators, and the field trip have been documented in Appendices A, B, and C as described below.

Murphy (Medusa and Frontrunner Spars) The Medusa derrick and substructure on Medusa were toppled during Hurricane Ivan. Murphy reported that the measured maximum wave height on Medusa was 72 ft (significant wave height of 41 ft) and the maximum wind speed was 84 mph. Their studies indicated that the skid base slid relative to the deck and the rig slid off its skid beams into the sea 1 to 2 hours earlier when the wave heights and winds were lower. Platform motions were well within design limits throughout the storm. Murphy and Nabors concluded that while the clamp was able to prevent the rig from being blown over, it was not able to prevent sliding. The clamps were redesigned to improve the clamping force transfer to the skid beam, and improved procedures were developed to ensure that the design torque was applied to the bolts. Additional clamps were also provided for redundancy. The redesigned clamps and torques procedures were also applied to Frontrunner.

Front Runner was not significantly affected by Hurricane Ivan. However, the visit to Front Runner provided an opportunity to view and understand the sea fastening system and operational procedures that were developed based on the learnings from Ivan. See Figures 2.

Information pertaining to the Medusa and Front Runner sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with Murphy and Nabors. Appendix A describes the information gathered from Murphy and Nabors and during the field trip.

Shell (Ram Powell and Brutus TLPs) The derrick and drill floor on the Ram Powell TLP was moved during hurricane Ivan, but it was not toppled and remained onboard. Ram Powell was located just east of Ivan's track, and the eye of the storm likely passed over Ram Powell. The maximum hindcast significant wave was 52 ft and the maximum wind was 102 mph (30 min average at 10 m elevation). Shell reported that the derrick and drill floor skidded 60 ft along the skid beams until it became wedged against a field gas compressor. No damage to the hull and mooring system (tendons) was reported. Shell concluded that the bolts for the clamps were not properly torqued, and developed updated procedures and added equipment to ensure that the bolts were tightened to the design torque values. These procedures were also applied to Shell's other TLPs.

Brutus was not significantly affected by Ivan. However, the visit to the Brutus TLP provided the opportunity to view and understand the sea fastening system and operational procedures that were developed based on the learnings from Ivan. See Figures 3.

Information pertaining to the Ram Powell and Brutus sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with Shell. Appendix B describes the information gathered from Shell and during the field trip.

BP (Horn Mountain, Mad Dog, and Holstein) - The skid base for a drilling rig on the Horn Mountain spar was moved across the skid beams during hurricane Ivan but remained onboard. Horn Mountain was located just east of Ivan's track and the eye of the storm likely passed over Horn Mountain. When the measurement system stopped recording data, the eye of Ivan was about 90 miles south and the last measured significant wave height was 42 ft (corresponding value for hindcast is 41 ft). About 8 hours later, the eye passed over Horn Mountain. The maximum hindcast significant wave was 52 ft and the maximum wind was 102 mph (30 min average at 10 m elevation). BP reported that the skid base skidded along the skid beams on the deck, and went off the end of the skid beams coming to rest on the deck. The incident resulted in only minor damage. BP concluded that the bolts on the clamps were not properly torqued down sufficiently, which was likely the result of an operational oversight during evacuation preparations since a drilling rig was not onboard. Storm evacuation preparation procedures have been modified to avoid such incidents in the future.

Holstein and Mad Dog were not significantly affected by Hurricane Ivan. However the visit to the Holstein and Mad Dog spars provided an opportunity to view and understand two different types of sea fastening systems.
The rig skidding system on Holstein is a hydraulically driven rack and pinion system. The sea fastening system is a set of locking dogs that are forced into the cogs by locking screws. See Figures 4.
Mad Dog - The rig skidding system on Mad Dog is a hydraulically driven clamping and pulling system. The sea fastening system locks the clamps on the skid beams with tapered pins. See Figures 5.

Information on the Horn Mountain, Holstein, and Mad Dog sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with BP. Appendix C describes the information gathered from BP and during the field trip.

Table 1. FPS's in Ivan Considered in Phase 1 Study

Floating Production System		Operator	Selected for study in Phase 1?	Reason/Remarks	Tie Down System	Assessment	
						Gather Data	Field Visit
TLPs	Ram Powell	Shell	Yes	Rig movement during Ivan.	Bolted	✔	
	Mars	Shell	No	No rig movement during Ivan. East of storm track	Bolted		
	Brutus	Shell	Yes	No rig movement during Ivan. East of storm track. Same tie down as Ram Powell.	Bolted	✔	✔
	Ursa	Shell	No	No rig movement during Ivan. East of storm track	Bolted		
	Marlin	BP	No	No rig not onboard during Ivan	Bolted		
	Mattehorn	Total	No	No rig movement during Ivan. possible analysis case in Phase 2?	Bolted		
Spars	Medusa	Murphy	Yes	Rig movement during Ivan. No rig currently onboard	Bolted	✔	
	Devils Tower	Dominion	Yes	Rig movement during Ivan	Bolted		
	Front Runner	Murphy	Yes	No rig movement during Ivan. East of storm track. Same sea fastening as Medusa.	Bolted	✔	✔
	Horn Mountain	BP	Yes	Rig movement during Ivan.	Bolted		
	Mad Dog	BP	Yes	No rig movement during Ivan. Unique sea fastening system. Far east of storm track.	Hydraulic clamps that are integral part of rig hydraulic skidding system	✔	✔
	Holstein	BP	Yes	No rig movement during Ivan. Unique sea fastening system. Far east of storm track	Locking cogs that are integral part of rack & pinion rig skidding system	✔	✔
	Genesis	Chevron	No	No rig movement during Ivan. Far east of storm track	Bolted		
	Neptune	Kerr McGee	No	No rig on board during Ivan.	Bolted		

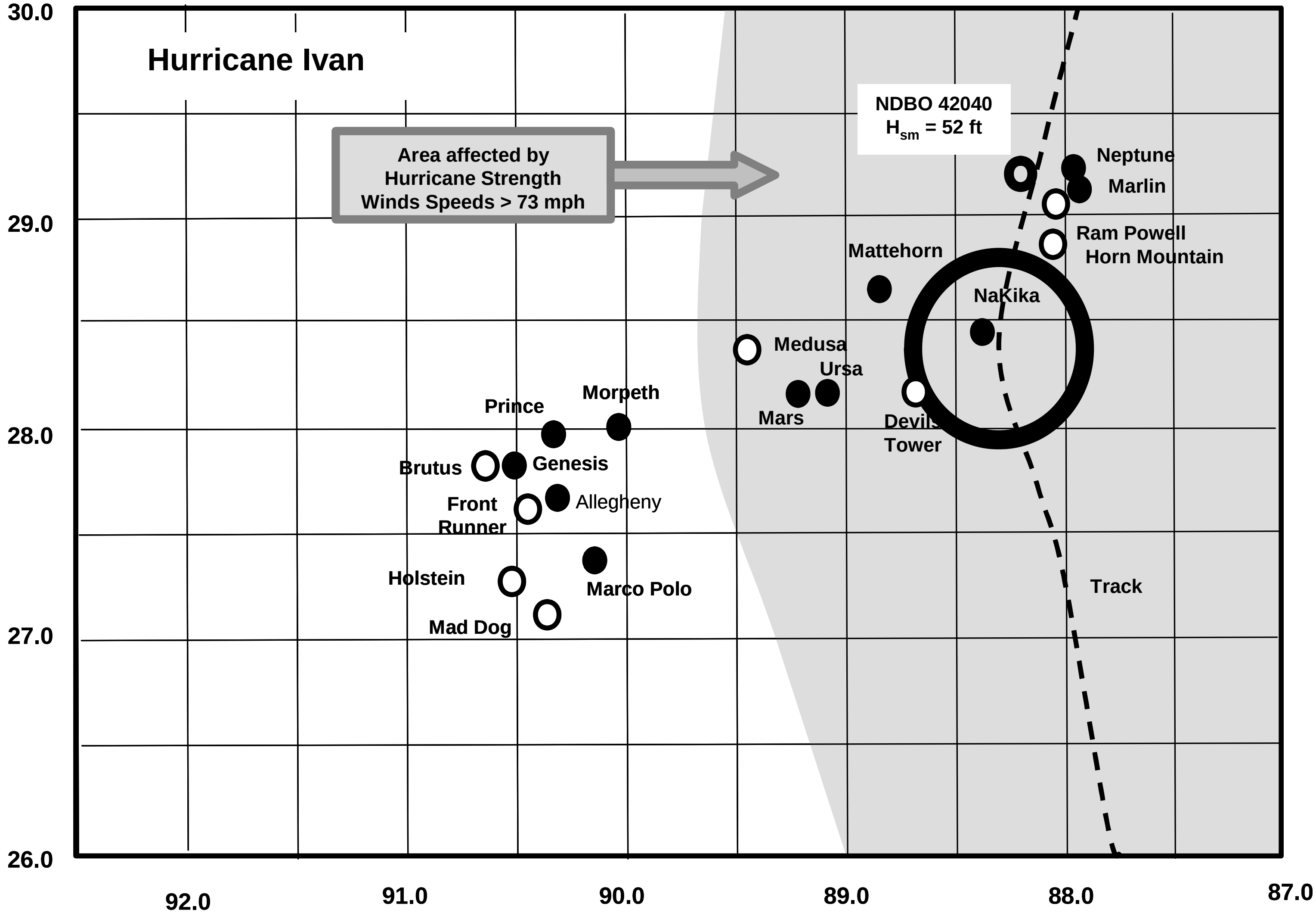


Figure 1 - FPSs Exposed to Hurricane Ivan

Skid Beam to Deck with Bolted Stop

Skid Beam to Deck with Weldment Stop

Figures 2 - Front Runner

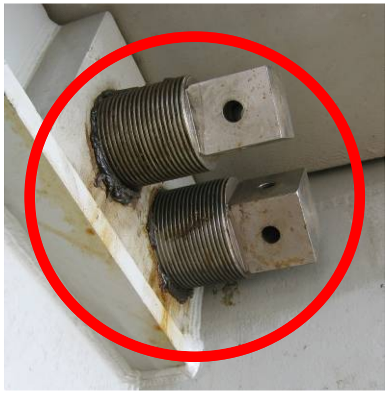
Drill Floor to Skid Beam

Skid Beam to Deck

Torqued Bolt

Figure 3 - Brutus

Rack & pinion system to
move skid base across deck



Locking bolts to secure
toothed dog into rack

Figures 4 - Holstein

Skid base on deck skid beam - beam on
bolted runner guide & hydraulic clamp

Hydraulic clamp
with tapered pin

Figures 5 - Mad Dog

Appendix A

Murphy Exploration & Production Company - USA

Hurricane Ivan Experience

Assessment of Drilling & Workover Rig Storm Sea Fastenings On Offshore Floating Platforms During Hurricane Ivan Phase I (MMS 551)

United States Minerals Management Service

Murphy Exploration & Production Company - USA Hurricane Ivan Experience

Client Doc. No.:	Doc. No.: 303859-000-RT-3800-0001

EXECUTIVE SUMMARY

Several floating production platforms in the Gulf of Mexico support drilling rig packages that must be secured from movement during severe storms by means of sea fastenings (also termed tie-downs). This document describes sea fastenings for drilling rig packages on board the Medusa and Front Runner platforms operated by Murphy Exploration and Production Company – USA. The information was gathered from correspondence, a meeting with Murphy and Nabors staff, and a visit to the Front Runner platform.

The Medusa derrick and substructure toppled during Hurricane Ivan. Front Runner was not significantly affected by Hurricane Ivan. However, Murphy and Nabors modified the sea fastening design and procedures based on learnings from Medusa during Ivan, and applied these learnings to Medusa and Frontrunner. A visit to Front Runner provided an opportunity to understand a sea fastening system and operational procedures used by the same rig owner/operator as on Medusa. Information pertaining to the Medusa and Front Runner sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with Murphy and Nabors.

On August 26, 2005, the Front Runner platform was visited during a field trip that also included the Holstein and Mad Dog platforms (operated by BP) and the Brutus platform (operated by Shell). Information for Holstein, Mad Dog and Brutus is presented in companion documents. By happenstance, these visits took place on the day before Hurricane Katrina passed through this portion of the Gulf, and it provided an opportunity to witness hurricane evacuation procedures in progress.

The sea fastening systems observed during the field trip illustrate the variety of systems in use by the offshore industry and the challenges in developing and applying a simple standard for sea fastenings for drilling and workover rigs.

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1.0 QUESTIONNAIRE RESPONSES

Two platforms operated by Murphy Exploration & Production Company - USA were included in the MMS Sea Fastening Project: the Medusa Platform and the Front Runner Platform. Questionnaire responses received for these two platforms are presented in the following sub-sections.

1.1 Murphy Medusa Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: Murphy
Partner Names: Agip (ENI) / Callon Petroleum

Platform Name: Medusa
Type of Platform: SPAR
Platform Location (Block No.): Mississippi Canyon Block 582
Platform Latitude: 28.392410104
Platform Longitude: -89.45346089
Water Depth: 2223 ft
No. of SCRs: 2 - 12" export lines
No. of TTRs: 6 - Producers in place
Mooring Lines / Tendon condition Pre Hurricane Ivan: 10 Mooring Lines Approx. 5.25"
Mooring Lines / Tendon condition Post Hurricane Ivan: 10 Mooring Lines, only brush mark on a chain after the rig incident.

Drilling / Workover Rig Information:
Rig Owner: Nabors
Rig Operator: Nabors
Rig Type: Drilling and completion

Design Criteria used for Rig Sea fastenings:

API Spec 4F criteria for wind loads were used (wind speed and profile, 30% blockage factor on front and back faces, shape factor of 1.25). Hull motions were provided by Murphy (values below). Design loads and sea fastening designs were determined by Nabors. The Medusa spar was designed for the Nabors drilling rig that was in place during Ivan

Design Criteria used for Hull Motions with Rig on board:

Design criteria for hull motions with the drilling rig on board were 100-year return period hurricane criteria. The design heave/surge/sway accelerations were 02g/.459g/.459g, respectively. It should be noted that maximum heave/surge/sway accelerations during Hurricane Ivan were significantly less than the design values.

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   On 9/15/04 Hurricane Ivan passed by the Medusa platform. The closest Hurricane Ivan came was about 61 nm at around 4 pm. Data on metocean conditions and the spar's responses were measured during Ivan. The spar experienced a 72 ft maximum wave height with a 41.4ft significant wave height when the eye of the storm was about 80 nm away at around noon. Data showed a slight variation in the mean static pitch angle at 10:20, which was interpreted as an indication that the derrick had toppled.

The "dynamic base" (a braced skid base with equipment inside) moved 8 ft West, and the rig floor slid South on the dynamic base, toppled off the dynamic base, and the rig fell off the spar.

2. Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?

The clamps failed to prevent movement at both levels.

3. Did you have movement or failure in both of the above noted locations or only one?

Both locations.

4. Did you have a skid adaptor in use at the time of Hurricane Ivan?

Yes. See response to item 1 above.

5. Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?

Yes, the rig tie downs were designed for the combination of spar motions and wind loads. All environmental and spar motion criteria were supplied to Nabors Offshore for their use in design. A third party Zentech verified the design criteria and loads, and this data was then in turn reviewed by McDermott to verify the spar/drilling rig interface loads, i.e. the design loads for the sea fastenings.

6. What rig design criteria was used for storm safe tie-downs?

API criteria for wind speed and profile were used, and wind load was calculated in accordance with API 4F with a 30% blockage factor front and back and a shape factor of 1.25. Design values for spar accelerations were provided by Murphy.

7. Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.

The sea fastening system consisted of 4 friction clamps to secure the skid base to the deck (skid beams), and 4 friction clamps to secure the drilling floor to the skid base. The clamps were bolted in place, and the bolts were tightened with sled hammers. There was no redundancy incorporated in the design other than the design code safety factors. There were no back-ups for the sea fastening clamps, e.g., stoppers to limit sliding.

8. What procedures were in place for rig storm safe conditions?

The Nabors storm evacuation procedures were in place for storm safe conditions. Clamps were tightened down using wrenches and sledge hammers immediately after each rig move. The setback and hook load were removed, and the mud tanks were emptied.

9. To what extent were these procedures followed for Hurricane Ivan?

All procedures that were in force at the time of Hurricane Ivan were implemented.

10. What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?

All of the procedures were completed.

11. What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?

Nabors has the primary responsibility for ensuring that the proper tie-downs were in place prior to evacuation. Murphy has the secondary responsibility.

12. What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?

A better clamp design was needed. The clamp was able to prevent the rig from being blown over, but was not able to prevent sliding. The rig simply slid off of the end of the skid beams on top of the skid base.

a. What worked and what did not work?

The sea fastening system failed to prevent the drilling rig from skidding off the skid base and falling over the side of the spar.

b. What areas were damaged and what was the extent and severity of the damages?

The derrick scraped the living quarters and put a slight indention into a support member of one of the cranes. Little damage to platform - “it fell in the best possible place”

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

The rig was evacuated 9/13/04, and Hurricane Ivan passed the facility 9/15/04. On 9/17/04 the damage was evaluated and clean-up began. Rig was removed on 10/05/04. All repairs on spar were completed, regulatory approval was obtained, and the wells were returned to production on 10/14/04.

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

Murphy provides more specific requirements for the procedures for the sea fastening systems on each platform, including specified torques for the bolts used to secure the clamps. High strength bolts are used. The clamps are secured after each rig move. A third party service company accurately torques and measures the high strength bolts. Torque values used after Hurricane Ivan are shown in Table 1 in the Notes below.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

Originally, the dynamic base (see responses to items 1 and 4 above) was secured to the deck skid beams by 4 clamps. The drill floor was secured to the dynamic base by 4 more clamps, making an original total of 8 clamps. As an improvement, Murphy/Nabors proposed to add 2 more clamps outside each of the 8 original clamps, bringing the total number of clamps to 24.

See additional discussion under item 15 for Front Runner.

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

An EPMS monitoring system (by SMS) was in place and recorded metocean and spar motions. A copy of the report describing the data and analyses has been requested from Murphy (Paul Fourchy).

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Zentech completed a design verification, and a copy of the report was requested from Nabors (George King).

18. Has a damage investigation report been completed and if so what are the major findings?

No formal report was discussed, but the incident has been investigated and measures to prevent future occurrences have been developed and implemented. See remarks in the above sections.

The position and the orientation of the derrick after it tipped over the deck agrees well with the directions of waves, wind and the spar horizontal accelerations as well as the tilt vectors at the time of the incident. The change of the mean pitch angle was most likely caused due to relocation of the upper part of the derrick from its original location. The measured and calculated accelerations during hurricane Ivan are smaller than the maximum strength design values for the derrick. Thus, it is likely that the derrick would not have experienced any damage had it not slid off the beams on top of the skid base.

Medusa Notes:

- SMS performed a post Hurricane Ivan Assessment in which the platform was shown to have smaller accelerations than the design acceleration.

- Meeting attendees were:

  George King - Nabors
  Mary Ann – Regulatory representative
  Denver Lee - Nabors Engineering Dept
  Aaron St. John – Nabors Houston Office Structural Dept
  Paul Fourchy – Murphy
  Representative from Murphy operations

- The P141 rig was on the Medusa platform.

- The drill floor is 135 ft above the water line.

- A schematic and report was requested for the dynamic base from George King.

- There is 66 ft spacing on the drill deck which is comprised of the dynamic base and extra beams for tanks to sit upon.

- The dynamic base which slides on top of the platform beams moved 8 ft toward the quarters where at the bottom of the drill floor the rig subsequently slid off and toppled over.

- One hour and twenty minutes before the peak of storm is when the rig moved. The peak of the storm had winds around 84.4 mph but the rig had already toppled.

- On the Front Runner platform, Nabors has included 8 safety clamps on each elevation as a post-Ivan mitigation measure. The same system is now intended to be used on Medusa also.

- Clamp bolts are torqued hydraulically after every move. Successively higher torques are applied when moving to each new location to allow for stretching of the bolts.

- Nabors reported that although they prefer to keep mud tanks full on floaters during a hurricane, it has become a standard practice to empty the mud tanks due to owner preferences.

- Bolt torque values implemented following Hurricane Ivan are now:

Table 1 - Bolt Torque Values

	Operating (ft-lbs)	Storm (ft-lbs)	Survival (ft-lbs)
Drill Floor	50	900	1500
Skid Beam	100	3810	6550
Storm Clamp	N/A	1300	2300

- Drill personnel are evacuated before production personnel. Tool pushers and crane operators are the last to leave.

- Lessons Learned:

  - "Redundancy is key". Added redundancy to the design.

  - Changed design of clamps, adding flat bar to the bottom part of the clamp to increase the direct load path into the flange.

  - Positive contact with the skid beam versus the unknown load transferred between the clamp and the flange before.

- Question that are being investigated by Murphy include:

  - Was the skid claw engaged during Hurricane Ivan? If so, did the skid claw prevent two-way motion and allow one-way motion only, hence not allowing the rig to come back the other way?

- The direction of the storm was aligned with the direction of the skid.

- Observations:

  - There has not been a back calculation for the friction coefficient at which the rig moved. The API equations are static, so the wind forces are designed for the rigs are based on static calculations.

  - The bolt clamps were modified as well as adding shear stops that are not friction-based and are removable and relocated. This has been currently implemented on Medusa since Hurricane Ivan.

  - Nabors uses the same procedures for abandonment for the TLP and Spar. They would move a rig from Front Runner to Conoco-Phillips Magnolia without changes in clamp design procedures but will check deck accelerations.

1.2 Murphy Front Runner Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: Murphy
Partner Names: Dominion, Spinnaker

Platform Name: Front Runner
Type of Platform: SPAR
Platform Location (Block No.): Green Canyon Block 338
Platform Latitude: 27.62484093
Platform Longitude: -90.44104746
Water Depth: 3330 ft
No. of SCRs:' 4 total, 2 exports plus 2 tiebacks
No. of TTRs: 8 slots total, 5 producers in place with a sixth being drilled
Mooring Lines / Tendon condition Pre Hurricane Ivan: 9 total, 3 by 3 chain and wire
Mooring Lines / Tendon condition Post Hurricane Ivan: 9 total, 3 by 3 chain and wire

Drilling / Workover Rig Information:
Rig Owner: Nabors
Rig Operator: Nabors
Rig Type: Drilling

Design Criteria used for Rig Sea Fastening: API Spec 4F (same as Medusa)

Design Criteria used for Hull Motions with Rig on board: The design criteria for hull motions with the drilling rig on board were 100-year return period hurricane criteria (same as Medusa).

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   N/A (Case 1)

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   N/A (Case 1)

3. **Did you have movement or failure in both of the above noted locations or only one?**

   N/A (Case 1)

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   Yes

5. **Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?**

   Yes

6. **What rig design criteria was used for storm safe tie-downs?**

   API Specification 4F

7. **Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.**

   No

8. **What procedures were in place for rig storm safe conditions?**

   The setback is set upright, and the mud and fluids are emptied from the tanks prior to evacuation for a hurricane.

9. **To what extent were these procedures followed for Hurricane Ivan?**

   N/A

10. **What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?**

    N/A

11. **What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?**

    Nabors has the primary responsibility for ensuring that the proper tie-downs were in place prior to evacuation. Murphy has the secondary responsibility.

12. **What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?**

    a. **What worked and what did not work?**

       N/A

    b. **What areas were damaged and what was the extent and severity of the damages?**

       N/A

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

N/A

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

Due to the Medusa incident, changes as noted for Medusa have been implemented.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

See response to item 14 above and introductory discussion under item 15 for Medusa.

In the process of installing additional clamps on Front Runner, Murphy/Nabors ran into some practical challenges, which relate to having enough space or the correct geometry to locate 2 new clamps adjacent to each original clamp. In one case, Murphy/Nabors replaced one of the two additional clamps with a welded shear plate on the skid beam because a bracket underneath the skid beam flange prevented addition of a clamp. (See Figure 5) In another case, which is on the drill floor, there was no room for a welded plate in one direction, so a welded piece was added between the two skid beams on a separate structure. (See Figure 7)

It should be noted that each of the original clamps had 8 @ 1-3/4" bolts, four on each side of the clamp, while each of the new clamps has 6 @ 2" bolts, 3 on each side of the clamp. (See Figure 6)

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

N/A

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

18. Has a damage investigation report been completed and if so what are the major findings?

N/A

Front Runner Notes:

- The dynamic base runs from north to south.
- The drill floor runs from east to west.
- The Mods 200 rig was on Front Runner.
- Zylon coated bolts can be used for 8 loading cycles.
- The bolts were tightened using a hydraulic torque, no flat bar was observed.
- On the drill floor skid there is no room for a welded plate beyond the clamp, so a welded piece is added between the skid beam on a separate structure (See Figure 7)
- Gorilla grease is used to lubricate the skidding beam.
- A checklist is usually completed in case of an evacuation for a hurricane.
- The drilling rig doesn't have to move back to the center before a hurricane.
- 24 3" bolts per side and 2" storm clamps at the dynamic base.
- There are eight inner well slots, 5 are producing and the 6th is being drilled.

2.0 SUPPORTING MATERIALS

2.1 Murphy Medusa Damage Photographs

Figure 1 - Side View of Medusa Platform after Hurricane Ivan

Figure 2 - Overhead View of Medusa Platform after Hurricane Ivan

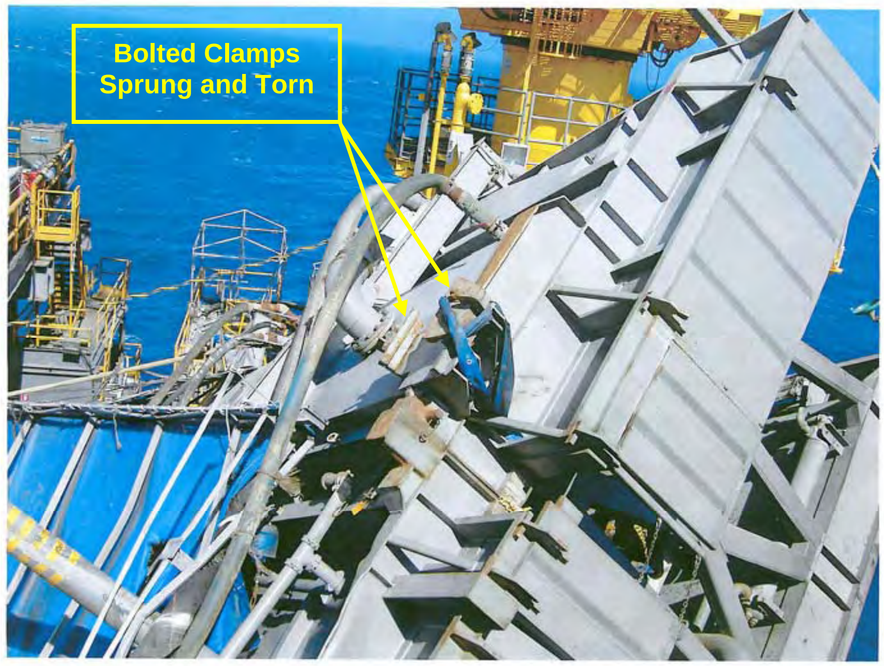

Figure 3 - Bolted Clamps Sprung and Torn on Medusa

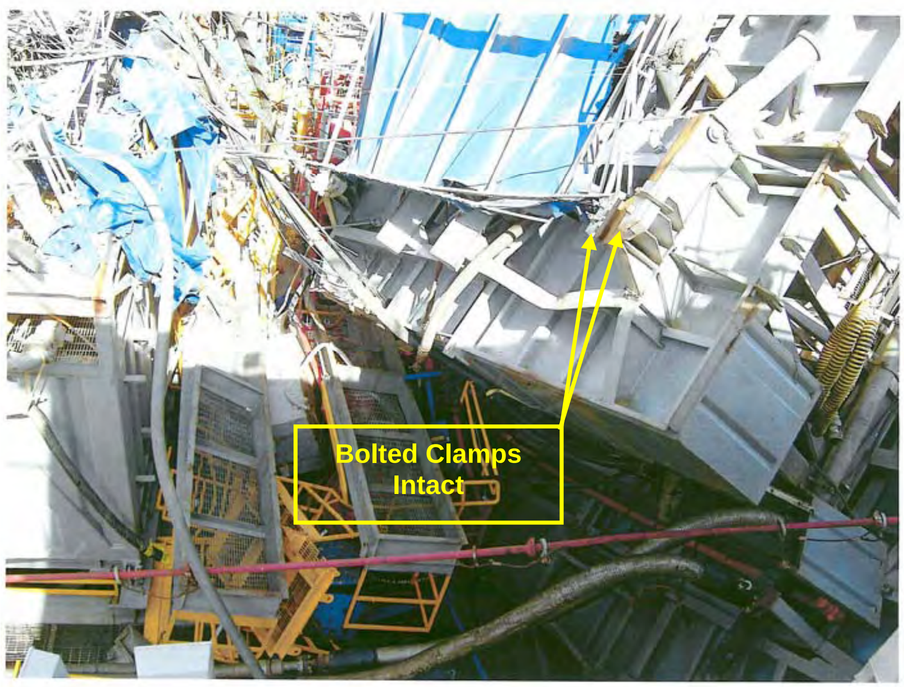

Figure 4 - Bolted Clamps Intact on Medusa

2.2 Murphy Front Runner Photographs

Figure 5 - Rig Clamps on Front Runner

Figure 6 - Reinforced Rig Clamps on Front Runner

Figure 7 - Rig Clamps at End of Skid Beam on Front Runner

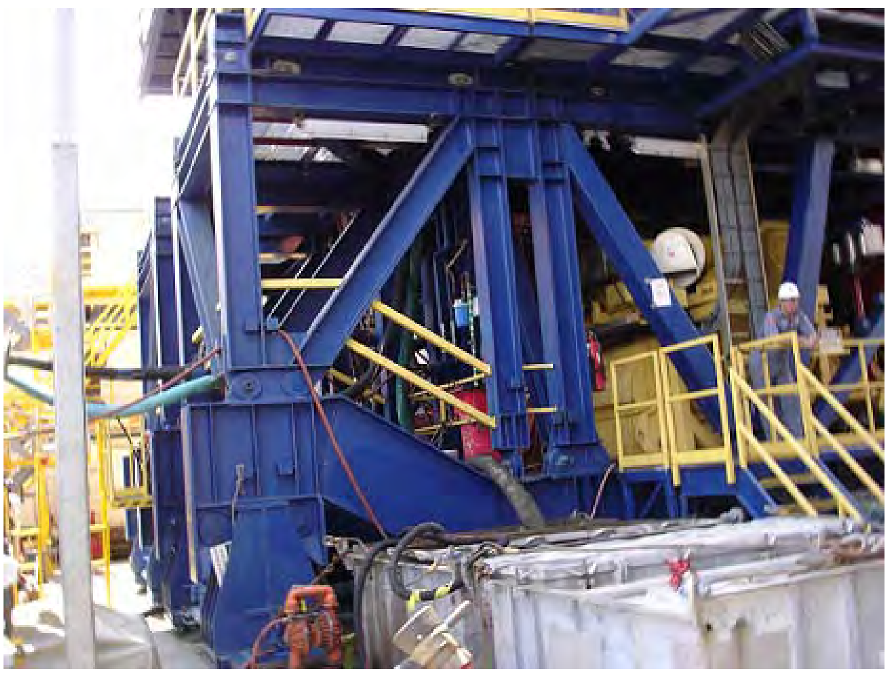

Figure 8 - Substructure (Dynamic Base) on Front Runner

Appendix B

Shell Exploration & production Co.

Hurricane Ivan Experience

TECHNIP OFFSHORE, INC.

Assessment of Drilling & Workover Rig Storm Sea Fastenings On Offshore Floating Platforms During Hurricane Ivan Phase I (MMS 551)

United States Minerals Management Service

Shell Exploration and Production Co.
Hurricane Ivan Experience

Client Doc. No.:	Doc. No.: 303859-000-RT-3800-0003

EXECUTIVE SUMMARY

Several floating production platforms in the Gulf of Mexico support drilling rig packages that must be secured from movement during severe storms by means of sea fastenings (also termed tie-downs). This document describes sea fastenings for drilling rig packages on board the Ram Powell and Brutus platforms operated by Shell Exploration and Production Co. The information was gathered from correspondence, meetings with Shell staff, and a visit to the Brutus platform.

The Ram Powell drilling rig moved and became wedged against a field gas compressor during Hurricane Ivan. Brutus was not significantly affected by Hurricane Ivan. However, Shell has applied learnings from Hurricane Ivan to both Ram Powell and Brutus. A visit to Brutus provided an opportunity to understand the sea fastening system and operational procedures used by the same rig owner/operator as on Ram Powell. Information pertaining to the Ram Powell and Brutus sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with Shell.

On August 26, 2005, the Brutus platform was visited during a field trip that also included the Holstein and Mad Dog platforms (operated by BP) and the Front Runner platform (operated by Murphy). Information for Holstein, Mad Dog and Front Runner is presented in companion documents. By happenstance, these visits took place on the day before Hurricane Katrina passed through this portion of the Gulf.

The sea fastening systems observed during the field trip illustrate the variety of systems in use by the offshore industry and the challenges in developing and applying a simple standard for sea fastenings for drilling and workover rigs.

Subsequent to the start of this study, the Mars Platform sustained damage during hurricane Katrina due to failure in the rig sea fastening. Shell indicates that the improvements (better methods to properly achieve bolt tensions) probably worked as designed as there was no lateral movement of the Mars rig prior to the tensile failure of the bolts due to the excessive uplift forces produced by the extreme metocean effects generated by Katrina. At this time the Mars platform is not part of this study scope of work.

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1.0 QUESTIONNAIRE RESPONSES

Two platforms operated by Shell Exploration and Production Co. were included in the MMS Sea Fastening Project: the Ram Powell Platform and the Brutus Platform. Questionnaire responses received for these three platforms are presented in the following sub-sections.

1.1 Shell Ram Powell Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: Shell
Partner Names: Exxon, BP

Platform Name: Ram Powell
Type of Platform: TLP
Platform Location (Block No.): Viosca Knoll Block 956
Platform Latitude: 29.06062965
Platform Longitude: - 88.09172006
Water Depth: 3,214 ft (980m)
No. of SCRs:
No. of TTRs:
Mooring Lines / Tendon condition Pre Hurricane Ivan: 12
Mooring Lines / Tendon condition Post Hurricane Ivan: 12

Drilling / Workover Rig Information:
Rig Owner: Helmerich & Payne
Rig Operator: Helmerich & Payne
Rig Type: Drilling

Design Criteria used for Rig Seafastening: API Spec 4F

Design Criteria used for Hull Motions with Rig on board: The design criteria for hull motions with the drilling rig on board were 100-year return period hurricane criteria.

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   During the storm, the drill floor moved approximately 60 ft across the skid base and became wedged against the Field Gas Compressor. See more complete description in Appendices 1 and 2.

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   Failure occurred between the skid base and the drill floor.

3. **Did you have movement or failure in both of the above noted locations or only one?**

   Movement occurred between the drill floor and the skid base

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   Yes, a skid base structure is part of the drill package.

5. Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?

Yes.

6. What rig design criteria was used for storm safe tie-downs?

API Specification 4F

7. Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.

The design that was used prior to and after Ivan is not considered redundant, as failure of the bolts will overload adjacent bolts.

8. What procedures were in place for rig storm safe conditions?

Prior to Ivan no explicit procedures were in place other than ensuring that the bolts are in place and tensioned. No specific tension torque or torque process was required. Following Ivan a torque tensioning procedure was developed which included tensioning the bolts with a hydraulic torque that is carried on the vessel, as well as the requirements of:

i. Replacing the bolts after they have been tensioned for a Hurricane safe condition
ii. After tensioning the bolts, in preparation for a Hurricane and before Hurricane evacuation, the rig sea fastening is to be verified by pushing on the rig using the skidding hydraulic system.
iii. Bolt tensioning was also to be applied and/or checked after all setback and mud tank levels have been adjusted. It is worth noting that the TLP was designed not to require the mud tanks and the setback to be reduced in case of a Hurricane.

9. To what extent were these procedures followed for Hurricane Ivan?

All procedures that were in force at the time of Hurricane Ivan were implemented.

10. What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?

All of the procedures were completed.

11. What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?

H&P had the primary responsibility for ensuring that the proper tie-downs were in place prior to evacuation. Shell had the secondary responsibility.

12. What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?

a. What worked and what did not work?

The sea fastening system failed to prevent the drill floor from moving approximately 60 ft. across the skid base. The skid base did not move.

b. What areas were damaged and what was the extent and severity of the damages?

The completions spool sheared off, the index spool, drilling riser frame, guideline winch system, and BOP well bay hatches were damaged. FGC 2 was damaged and there were missing grating and handrails.

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

The time to reset the rig properly back on the skid beams was approximately 24 hours, however, it took days to properly stabilize the rig, followed by weeks of analysis and planning to properly jack the rig up and reset it on the skid beams. In addition there was extensive damage to the well system (tensioners and drilling riser spool) that required weeks of repair.

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

See response to item 15.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

The current plan is to use high strength bolts and load indicating washers and partially tension the bolts after a rig move. The bolts will not be pre-tensioned to the required tension until the storm is coming. A torque wrench is located on each TLP to ensure that the prescribed torque is properly applied. Sea fastenings will be load tested by pushing with jacks.

When a high strength bolt is used and torqued to storm tension/torque criteria, it should then be replaced.

Also see response to item 18.

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

No monitoring system in place on the drilling platform.

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Yes.

18. Has a damage investigation report been completed and if so what are the major findings?

As a result of the Ram Powell incident, Shell has reviewed and updated procedures. These procedure are applicable to all Shell TLP's

Ram Powell Notes:

- H&P 205 is on Ram Powell
- After a high strength bolt is loaded up it should not be re-used.
- The current plan, as suggested is to use load indicating washers and partially tension the bolts. The bolts will not be pre-tensioned to the required tension until the storm is coming, potentially saving thousands of dollars replacing bolts.
- The rig floor sits and slides in an the platform east and west direction on top of the skid base that slides in the platform north and south direction on the TLP skidding beams.
- The Ram Powell skid beams, which are owned by Shell are above the drill deck beams. There is no movement between the skidbase and the skidway that is on the deck. The deck skid way is approximately 1 ft above deck level.
- Shell relied on H & P to ensure that the load is properly passing through the clamp.
- For storm stability on the TLP, Shell does not need to dump mud from the tanks. Removing the setback before tensioning the bolts may result in over-tensioning the bolts. This a good reason for not tensioning the bolts until a hurricane event.
- Shell is did not observe rig movements during Hurricane Ivan on the Mars, Brutus and Ursa TLPs.
- Load testing after bolt tensioning was prescribed following Hurricane Ivan.

1.2 Shell Brutus Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: Shell
Partner Names:

Platform Name: Brutus
Type of Platform: TLP
Platform Location (Block No.): Green Canyon Block 158
Platform Latitude:
Platform Longitude:
Water Depth: 2,985 ft (910m)
No. of SCRs:
No. of TTRs:
Mooring Lines / Tendon condition Pre Hurricane Ivan: 12
Mooring Lines / Tendon condition Post Hurricane Ivan: 12

Drilling / Workover Rig Information:
Rig Owner: Helmerich & Payne
Rig Operator: Helmerich & Payne
Rig Type: Drilling

'

Design Criteria used for Rig Seafastening: API Spec 4F (same as Ram Powell)

Design Criteria used for Hull Motions with Rig on board: The design criteria for hull motions with the drilling rig on board were 100-year return period hurricane criteria (same as Ram Powell).

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   N/A (Case 1)

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   N/A (Case 1)

3. **Did you have movement or failure in both of the above noted locations or only one?**

   N/A (Case 1)

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   Yes, a skid base structure is part of the drill package.

5. **Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?**

   Yes

6. What rig design criteria was used for storm safe tie-downs?

API Specification 4F

7. Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.

The design that was used prior to and after Ivan is not considered redundant, as failure of the bolts will overload adjacent bolts

8. What procedures were in place for rig storm safe conditions?

Prior to Ivan no explicit procedures were in place other than ensuring that the bolts are in place and tensioned. No specific tension torque or torque process was required. Following Ivan a torque tensioning procedure was developed which included tensioning the bolts with a hydraulic torque that is carried on the vessel, as well as the requirements of:

i. Replacing the bolts after they have been tensioned for a Hurricane safe condition
ii. After tensioning the bolts, in preparation for a Hurricane and before Hurricane evacuation, the rig sea fastening is to be verified by pushing on the rig using the skidding hydraulic system.
iii. Bolt tensioning was also to be applied and/or checked after all setback and mud tank levels have been adjusted. It is worth noting that the TLP was designed not to require the mud tanks to be emptied on Brutus, however, unlike Ram Powell on Brutus the maximum setback allowed during a Hurricane by design is 57 kips. Ideally H&P have worked under the premise of emptying the setback prior to a Hurricane.

9. To what extent were these procedures followed for Hurricane Ivan?

N/A

10. What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?

N/A

11. What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?

The rig operator has primary responsibility for ensuring that the tie-down bolts are torqued properly. Shell has secondary responsibility.

12. What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?

a. What worked and what did not work?

N/A

b. What areas were damaged and what was the extent and severity of the damages?

N/A

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

N/A

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

See response to item 15. Also, see response to item 18.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

The current plan is to use high strength bolts and load indicating washers and partially tension the bolts after a rig move. The bolts will not be pre-tensioned to the required tension until the storm is coming. A torque wrench is located on each TLP to ensure that the prescribed torque is properly applied. Sea fastenings will be load tested by pushing with jacks.

When a high strength bolt is used, it should then be replaced.

Also see response to item 18.

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

N/A

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Yes.

18. Has a damage investigation report been completed and if so what are the major findings?

Shell concluded that the bolts were not torqued properly. As a result of the Ram Powell incident, Shell has reviewed and updated procedures. These procedures are applicable to all Shell TLPs.

Brutus Notes:

- H & P 202 is being used on the Brutus TLP
- There are 16 bolts per side on the bottom of the large beams. The bolts are ideally torqued to a value of 10,000 ft.-lbs during a storm. During our visit to the platform the bolts were torqued to a value of 8,500 ft.-lbs. B7 grade bolts were in use.
- After a skid move is completed to a new location, the outer bolts are reattached. When the rig is skidded to the extreme south slot, the operator is unable to gain access to all the bolts.
- When the rig operator torques the bolts, the heads of the bolts are painted. The date and the magnitude of torque are recorded on each bolt head.
- There are no stops at the end of the drilling deck beams.
- The skid adaptor has a Chartek fire prevention coating.
- The drilling rig does not have to be moved to the center in time of a hurricane.
- There is a load limit of 57 kips on the setback in the derrick, but normally H&P would like to empty the setback.
- Normally the drilling operator would like to keep all fluids and mud in the tanks in time of a hurricane.
- On the drill floor there are 4 clamps that consist of 4 bolts outside and 2 bolts inside per side.
- Environmental grease is used as a lubricant to skid the drill floor. Soap can cause the steel to rust and make translation even more difficult.
- After bolting is completed, the sea fastening system is tested using jacks.
- The hydraulic TX 16 torque wrench shown in Figure 5 stays on the platform.
- The entire process to torque the bolts takes a little over 12 hours to complete.

2.0 SUPPORTING MATERIALS

2.1 Shell Brutus Photographs

Figure 1 – Aerial View of Brutus

Figure 2 – Loosened Bolt for Tie-Down

Figure 3 – Bolt After Torque Is Complete

Figure 4 – Tie-Down Bolt on Clamp

Figure 5 – Hydraulic Wrench

Figure 6 – Corner of Rig Substructure on Skid Beam

Figure 7 – Drill Floor

Figure 8 – Drill Floor on Substructure

Appendix 1 – "Shell's Experience with Hurricane Ivan," API 2005 Hurricane Readiness and Recovery Conference

Shell's Experience with Hurricane Ivan

G. E. Sgouros

W.M. Pritchett

D.R. Schafer

D.L. Jones

Shell Exploration and Production Co.

API – 2005 Hurricane Readiness and Recovery Conference

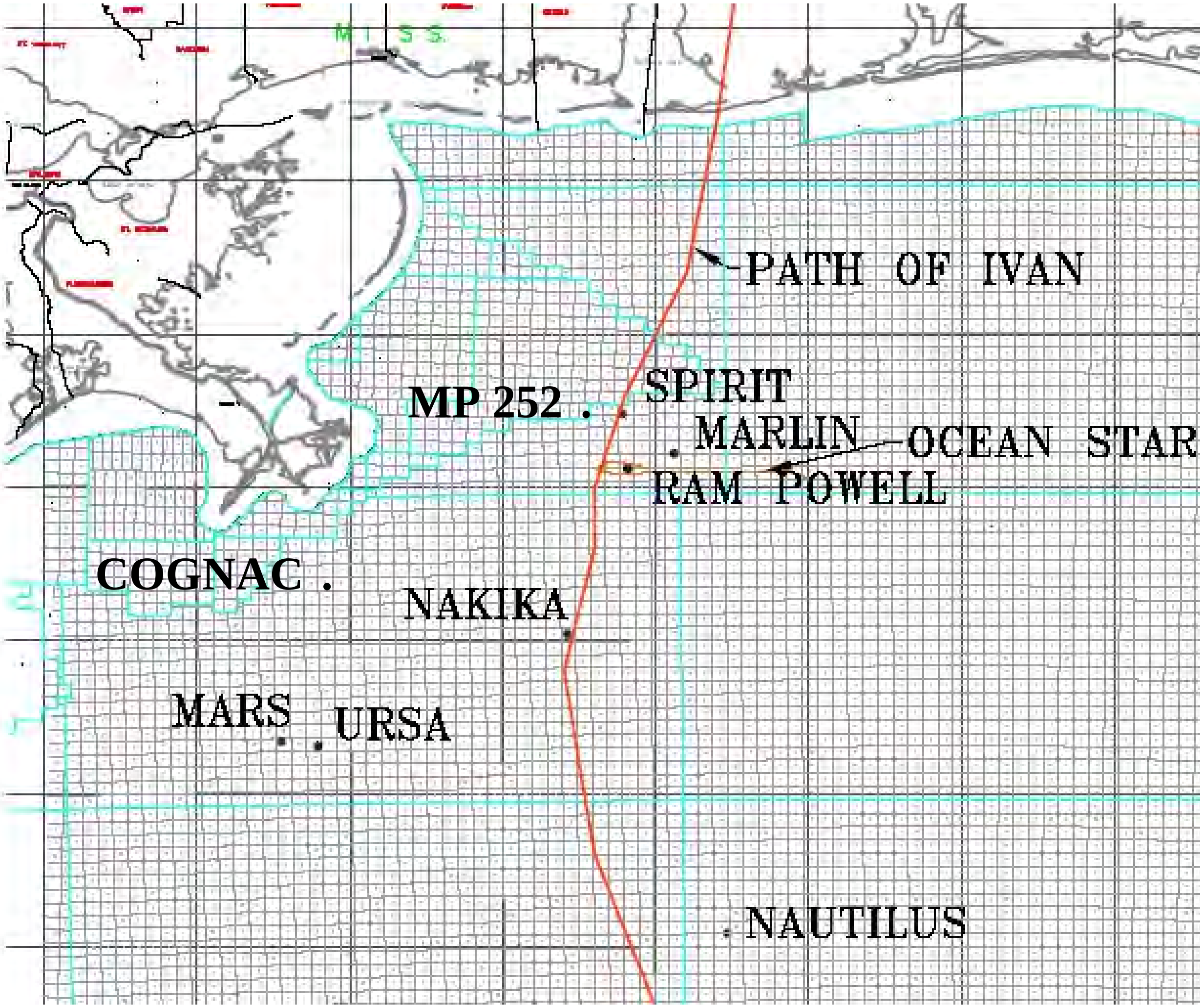
Objectives

- **Describe Hurricane Incident Command Team**
- **Describe Response Post Landfall**
- **Describe Damage and Repairs on Shell Assets**

Hurricane Incident Command Team

- Team members include:
- Team is multi-disciplined.
  - Drilling - Logistics
  - Production - Regulatory Affairs
  - Construction - Engineering
- Equipment and Resources secured.
- Evacuation and recovery plans updated and changed as hurricane approaches.
- On September 13, 2004, 850 people evacuated safely.

Path of Ivan



PATH OF IVAN
MP 252
SPIRIT
MARLIN
OCEAN STAR
RAM POWELL
COGNAC
NAKIKA
MARS
URSA
NAUTILUS

Response Post Landfall

- Damage Assessment
  - Non Severe Storm → Use helicopter operations
  - Severe Storm → Use Fixed Wing Planes
- Fixed wing plane was used Post Ivan.
- Fixed wing plane mission to determine suitability for helicopter operations.
- Damage assessments performed as soon as heliports were okay.

Cognac Description

- Mississippi Canyon 194 A (Cognac) is a drilling and production platform in 1025 ft of water, installed in 1978.

Damage Assessments – MC 194

- Evidence of Green Water in the deck, 45 feet above the water line; platform 100 miles from the eye of the storm.

- Platform damage consisted of:
  - Missing Grating and Handrails
  - Minor Facilities equipment
  - Gaugers Shack

Damage Assessments – MC 194

Main Pass 252 Description

- The Main Pass 252 complex consists of 2 bridge connected platforms in 300 feet of water. The 252 complex primarily supports 7 subsea wells.


Damage Assessments – MP 252

- Evidence of Green Water in the deck, 50 feet above the water line. Platform was near the eye of the storm.

- Estimated wave height 65 - 70 ft which corresponds to the maximum design wave of 72 feet.

- Platform damaged consisted of:
  - Missing Grating and Handrails (100 % at boatlanding to 20 % on lower deck)
  - Facilities equipment, cable tray and mostly support utilities

Damage Assessments – MP 252

Viosca Knoll 956 A Description

- Viosca Knoll 956 A (Ram Powell) is a TLP in 3214 feet of water.

Damage Assessments – VK 956

- Evidence of Green Water in the deck, 90 feet above the water line.   Platform near the eye of the storm.
- Estimated wave height at this location is around 100 ft. Design wave was around 87 ft.
- Platform damaged consisted of:
  - Drilling rig moved off location
  - FGC 2 exhaust
  - Missing Grating and Handrails (100 % at boatlanding to 20 % on lower deck)
  - Facilities equipment, cable tray and mostly support utilities

Damage Assessments – VK 956

Damage Assessments – VK 956

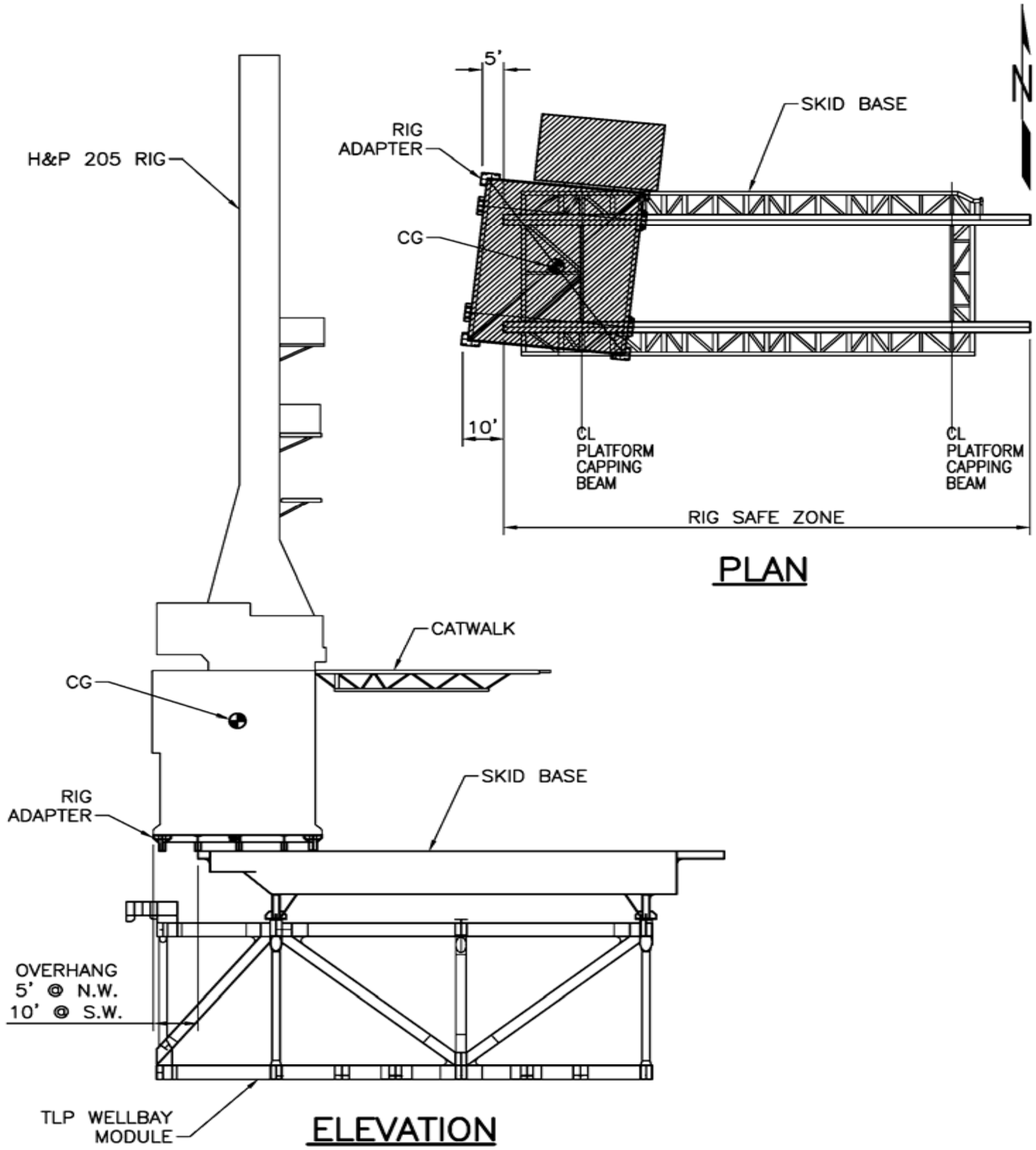
Damage Assessments – VK 956

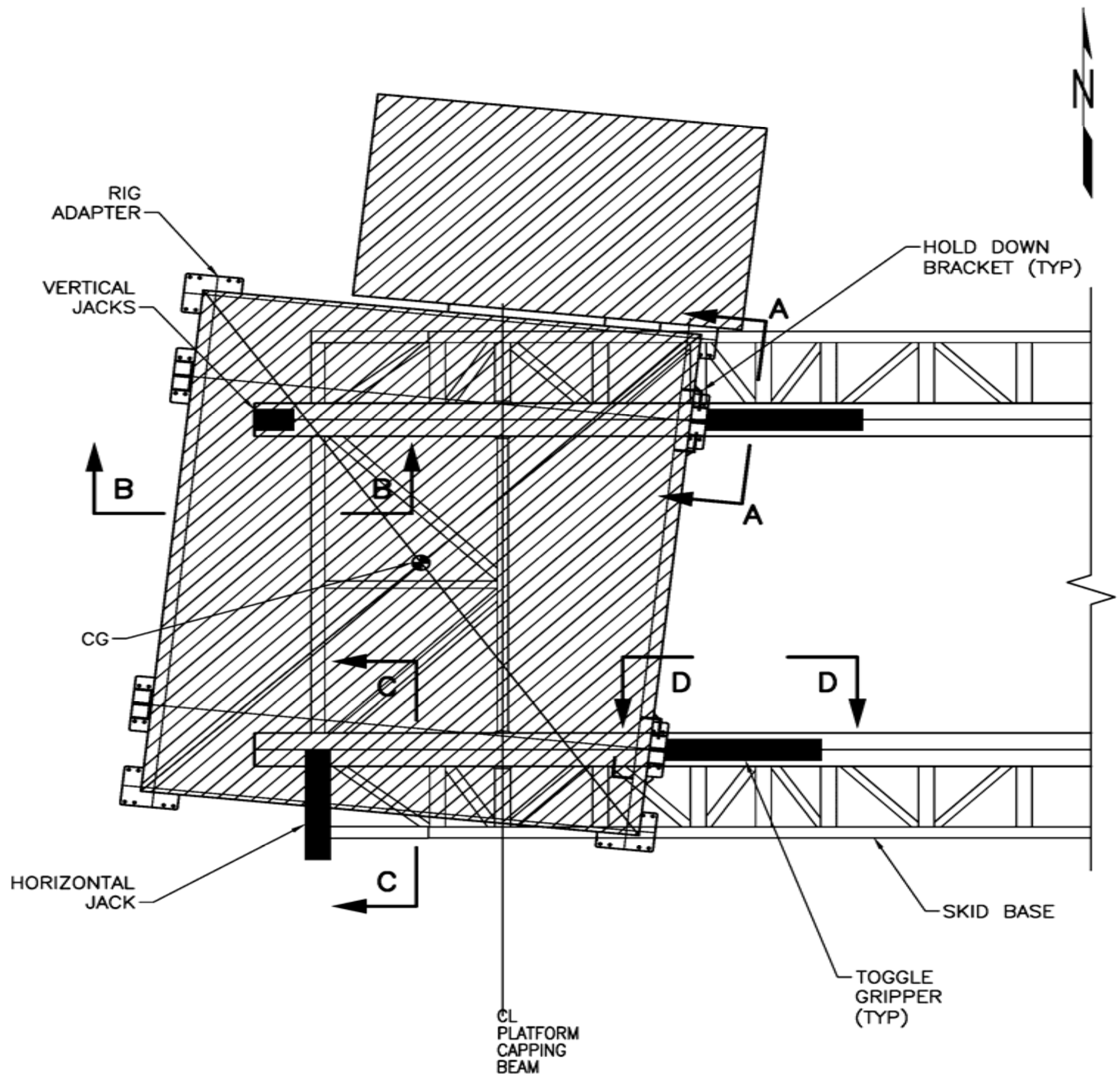
Damage Assessments – VK 956

VK 956 A – Drilling Rig Recovery

– Challenges

- Rig was located in potentially unstable position.
- Rig had to be secured to prevent further damage.
- 2500 ton rig to be a) lifted vertically then slid back into position or b) disassembled and then reassembled.
- Option a) was selected


5'
SKID BASE
N
RIG
ADAPTER
H&P 205 RIG
CG
10'
CL
PLATFORM
CAPPING
BEAM
CL
PLATFORM
CAPPING
BEAM
RIG SAFE ZONE
PLAN
CATWALK
CG
SKID BASE
RIG
ADAPTER
OVERHANG
5' @ N.W.
10' @ S.W.
TLP WELLBAY
MODULE
ELEVATION


RIG
ADAPTER
VERTICAL
JACKS
CG
HORIZONTAL
JACK
HOLD DOWN
BRACKET (TYP)
A
A
B
B
C
C
D
D
SKID BASE
TOGGLE
GRIPPER
(TYP)
CL
PLATFORM
CAPPING
BEAM
N

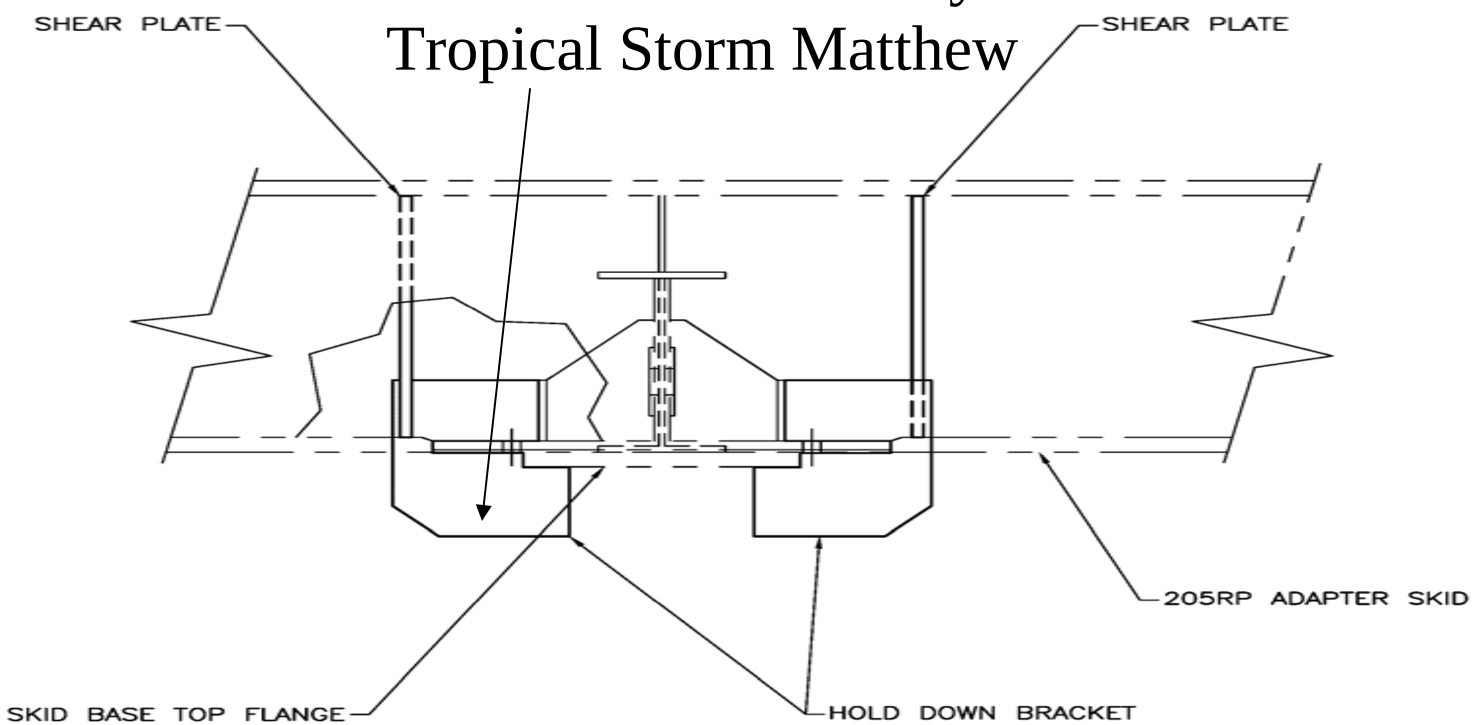
PLAN

VK 956 A – Drilling Rig Recovery

– Strategy

- Secure rig using hold down brackets.
- Hold down brackets designed for additional hurricane force conditions.
- Use a system of strategically placed jacks, cylinders and grippers to recover rig.

Brackets load tested by
Tropical Storm Matthew



HOLD DOWN BRACKET CLIPS
TYPICAL AT FOUR LOCATIONS.

SECTION "A–A"

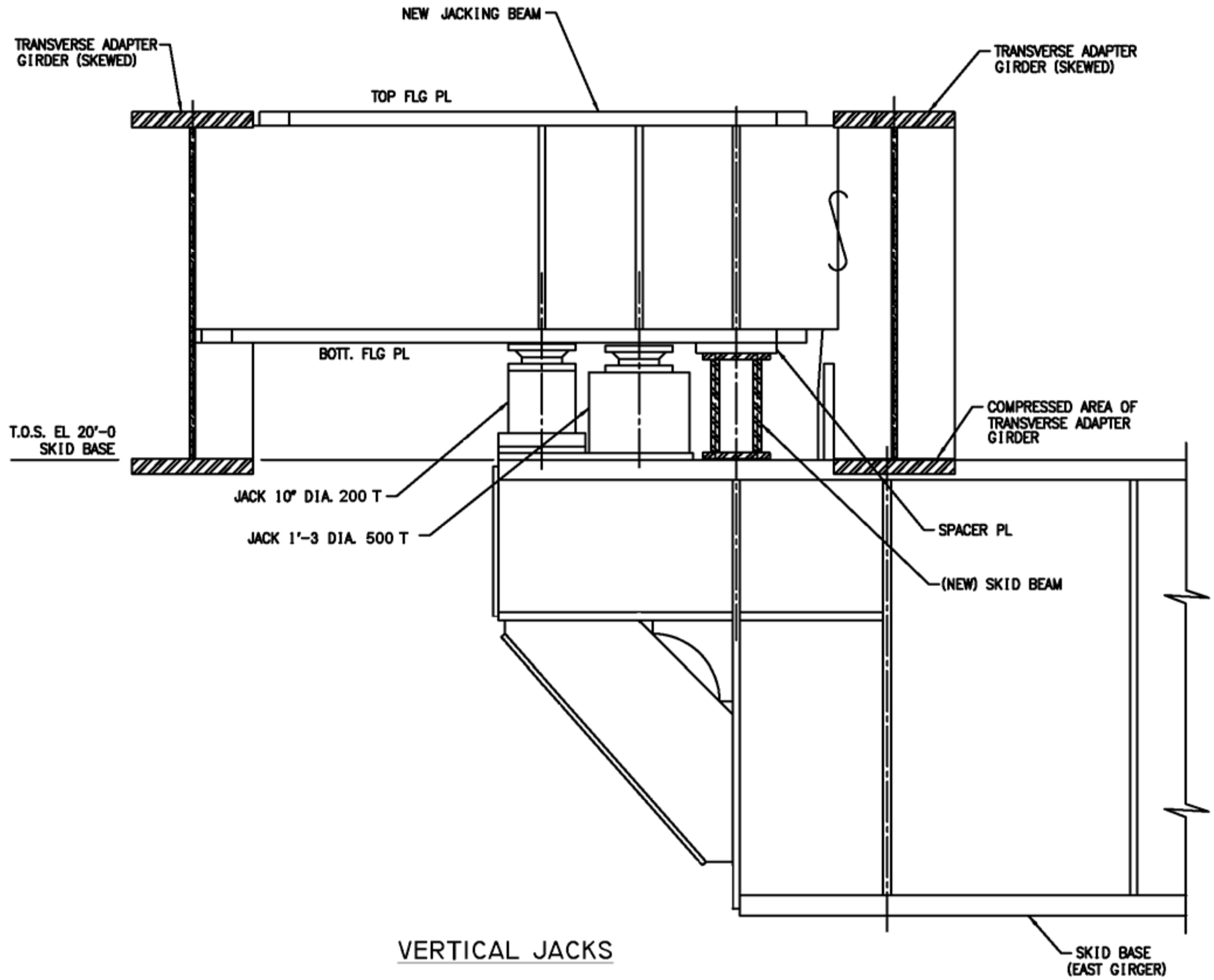
VK 956 A – Drilling Rig Recovery

– Vertical Recovery:

- Weld reaction and jacking beams in place.
- Use 500 ton and 200 ton vertical jacks in combination to lift rig vertically. Actual force to lift the rig 3 inches was 1300 kips.
- Apply lubricant to skidding surfaces.

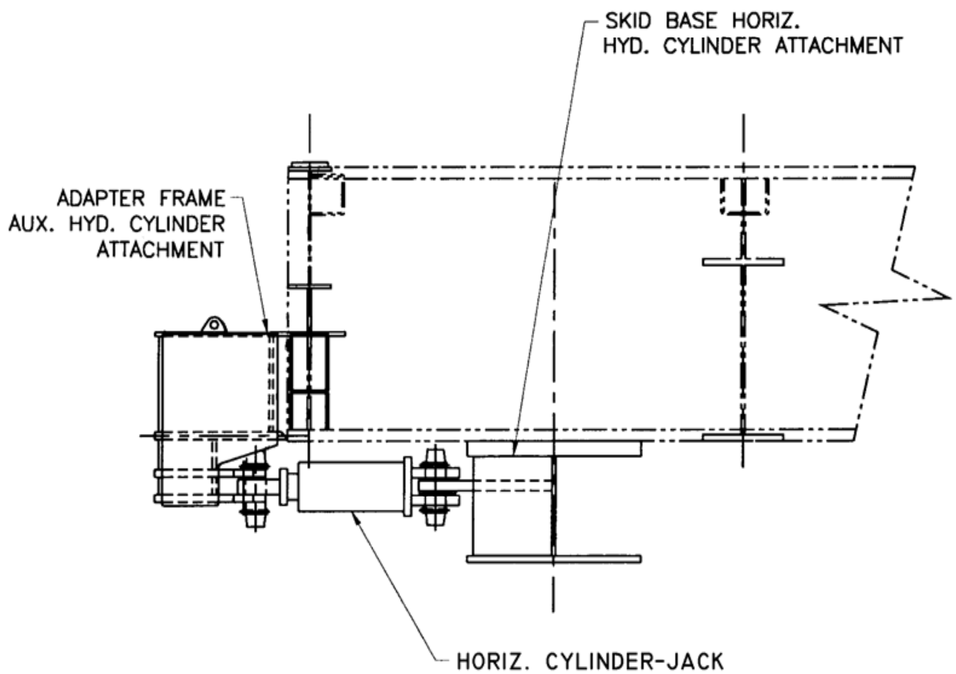
– Horizontal Recovery:

- Use hydraulic horizontal cylinder and horizontal gripper to “square” rig on support beams and pull back to proper operating location. Actual force required was around 500 kips.



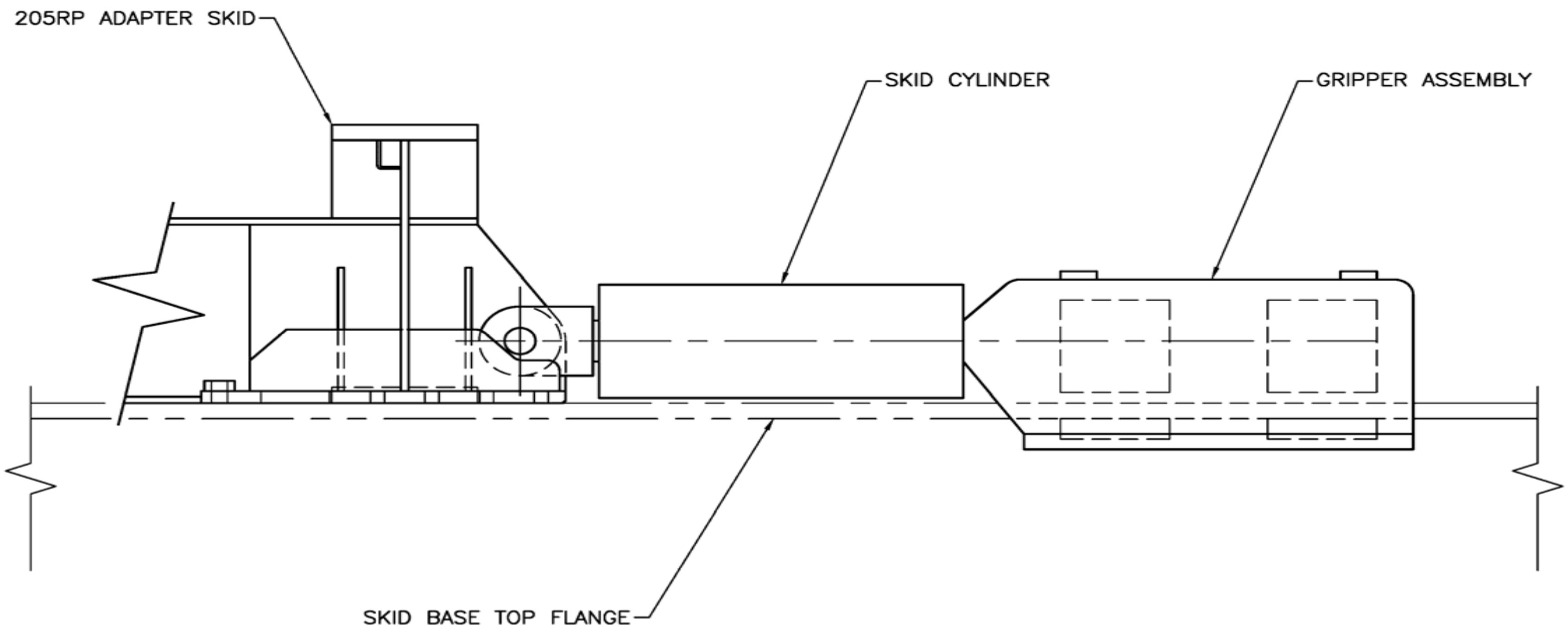
VERTICAL JACKS

SECTION "B-B"



HORIZONTAL JACK

SECTION "C-C"



TOGGLE GRIPPER

(SE LOCATION ONLY FOR RECOVERY)

SECTION "D—D"

Conclusions / Learnings

- Rig tie-down criteria exceeded.
- Wave design criteria probably exceeded.
- Shell participating in industry-wide efforts to address findings.
- An equipment replacement strategy is an enabler.
- Consider temporary offshore housing vs. day tripping.
- Coordinated approach allowed synergy.
- Repairs executed without major safety or environmental incidents.

Appendix 2 – "Shell's Experience with Hurricane Ivan," OTC Paper No. 17733, May, 2005.

OTC 17733

Shell's Experience with Hurricane Ivan

George E. Sgouros, Ph. D., P.E., William M. Pritchett, P.E., Dennis R. Schafer, Douglas L. Jones – Shell Exploration and Production Company, EP - Americas

This paper was prepared for presentation at the 2005 Offshore Technology Conference held in Houston, TX, U.S.A., 2–5 May 2005.

Abstract

Like many Operators in the Gulf of Mexico Shell Exploration and Production Company's (Shell) production was impacted by Hurricane Ivan. Three Shell operated facilities sustained major damage as a result of Hurricane Ivan: Ram-Powell (VK 956A), Bud (Main Pass 252) and Cognac (MC194A). This paper only addresses surface facilities damage to Shell operated properties. Shell Pipeline response to address pipeline damage from Hurricane Ivan will be addressed in OTC paper 17734. The following areas will be covered:

- Upfront planning efforts
- Response and recovery efforts
- Surface facility damage and repairs at each location
- Conclusions and learnings.

Organizational Response Prior to Landfall

The Shell Hurricane Incident Command Team is a multi-disciplined team that consists of team members with backgrounds in Drilling, Construction, Logistics, Regulatory Affairs and Production. The team meets anytime / anywhere / anyway depending on the circumstances of a specific storm. Typical planning includes monitoring of a wave or low while in the Atlantic or in the Gulf of Mexico. Once a wave or low is established preliminary evacuation and recovery plans are developed. A week before the storm impact is predicted, the team conferences several times a day to make sure plans are moving forward. As a storm approaches, a small team stays behind in New Orleans or at Shell's Robert Training Center in Robert, LA depending on landfall location to begin recovery efforts. As part of the planning process, blocks of hotel rooms are reserved, emergency generators are placed on standby, transportation logistics are coordinated, diving crews and remotely-operated vehicles are readied and emergency communications systems are set up. These plans are communicated to Shell management, key operational, drilling and construction personnel. Evacuation plans and production forecasts are updated and modified every 24 hours and then on a more frequent schedule as the storm approaches. Typically 72 hours before a storm is predicted to make landfall the planning team meets every 4 to 6 hours and updates the evacuation strategy as needed.

Shell's Hurricane Incident Command Team began meeting and carefully watching Hurricane Ivan on September 9, 2004. Around September 13, 2004 the Hurricane Incident Command Team directed more than 850 Shell personnel to evacuate from production and drilling platforms in the eastern and central Gulf of Mexico. All affected facilities were shut-in, secured and evacuated. All evacuations and return to work activities were executed safely.

Initial Response After Landfall

Shell's post hurricane response and return to normal activities is based on the severity of a storm. Due to the severity of Ivan Shell decided an initial fly-over would be the best way to assess the initial damage. Therefore, on the morning of September 17, 2004 Shell contracted a long-range fixed wing plane to fly over the assets nearest the eye of the storm and the assets with the largest loss of production implications. The objective of the plane mission was to evaluate if the asset was damaged and to determine if the heliport was functional so that operations could fly out and land on the asset via helicopter.

From the plane mission Shell was able to determine that operations leadership could fly out via helicopter to give initial on-site reports of damage. The plane mission also revealed that the Semi-Submersible Deepwater Drilling Rig Nautilus was off location and that additional searches would be required to locate the rig. The rig was eventually found and recovered.

On the afternoon of September 17, 2004 operations leadership used helicopters to make the first visit to each of their respective assets. The mission of the operations trips was to assess damage and the condition of the asset to house personnel. It would be the discretion of the Operations Installation Manager (OIM) to make an on-site call on the fitness of the asset.

The results of the operations personnel assessments indicated little or no damage to most Shell assets with the exception of three locations: Ram Powell, Main Pass 252 and Cognac.

The OIMs for each of these three damaged assets determined their locations had suffered damage and that they were not fit for permanent human occupation. Further recommendations from the OIMs was that Shell Engineering would be required to make assessments of the safety of the platforms and of the overall damage.

On September 18, 2004 Shell Engineering staff and key operations personnel flew out to Ram-Powell, Main Pass 252 and Cognac. At this time other Shell locations without damage started to return to production, increase manning and return to more normal operations.

The initial engineering assessments of Ram-Powell, Main Pass 252 and Cognac indicated severe damage and also indicated that production at these three locations would be offline for a minimum of 30 days. It was also determined that some cleanup and repair would have to take place before a complete damage assessment could be made. Engineering assessments also indicated that the three assets were not habitable and that operations would have to day trip (fly in and out from land locations daily) until the platforms were made safe and subsistence support was restored to the quarters buildings. Shell's Logistics team was informed of the increased requirements of helicopters and boats to accommodate the day tripping.

Overall, Ram-Powell, Main Pass 252 and Cognac were structurally sound but had facilities damage and minor levels of topside structural damage. Specifically, the Ram Powell asset had a unique problem; the drilling rig had moved over 60 feet across the platform skid beams to end up in a position that made it potentially unstable.

Engineering reports were issued for the three damaged assets. These reports documented safety issues and provided a line item listing of damage.

On September 19, 2004 Operations and Construction began what would be many days or weeks at some locations of day tripping. Operations and Construction staff was asked to focus first on the safety and living infrastructure (grating, handrails, life boats, living quarters, galley, etc).

When Shell staff returned to work after the voluntary evacuation of the New Orleans metropolitan area, there was a heightened demand for information, reports, recovery plans and resources. In the beginning each asset team began independent recovery efforts. Shell management recognized that the independent assets would compete for resources not only within the industry but also with each other. Therefore, a member of Shell Senior Management was named to lead the Hurricane Ivan Recovery Coordination Team. The focus and charter of the coordination team would be to meet twice a week with the following objectives:

- Share information, learnings, resources and staff
- Provide required resources to the execution teams
- Provide HSE resources, guidance and requirements for the repairs
- Clarify funding issues
- Resolve resource conflicts (internal and external)
- Validate high level restoration priorities and execution plans for each location
- Manage internal and external communication needs
- Manage regulatory needs
- Enhance communication and coordination between those involved in the recovery activities.

The Shell Oil and Gas Pipeline groups were also included as much of the Ivan damage was pipeline related. With downstream pipeline damage it was important to stay informed of downstream repairs to manage platform repairs most efficiently, prioritize resources and optimize the overall critical path for restoring production.

The Hurricane Ivan Recovery team included representatives from the following disciplines:

- Senior Management
- Production
- Engineering Projects
- HSE
- Logistics
- Regulatory Affairs
- Oil & Gas Pipeline
- Individual Project Managers for the Damaged Assets
- External Affairs

Ram Powell Repairs

Description. The Shell Ram Powell complex is a tension legged platform (TLP) installed in 1998 and is moored by 12 tendons in 3214 feet of water. The TLP supports a drilling rig and production processing facilities.

Damage Assessment. The damage at Ram Powell can be categorized as follows:

Drilling Rig Related. During the storm the drilling rig moved approximately 60 feet across skid beams and became wedged against the Field Gas Compressor 2 (FGC 2). This movement caused the shearing of a completions spool, and damaged an indexing spool, the drilling riser-tensioning frame and accessories, the guideline winch system, the BOP and wellbay hatches, the high-pressure frac line and other minor support systems damage. Additionally, when the completions spool sheared it fell into the oil export launcher / receiver causing minor damage.

FGC 2. As the drilling rig moved across the skid beams it "crashed" into the FGC 2 on the west side of the platform. When the rig collided with the FGC 2 it caused extensive damage to the turbine exhaust, the intake ducting and the high-pressure discharge piping. This ducting is considered specialty equipment and is a long lead repair item.

General Damage: Throughout the platform there was other damage that included missing/damaged grating and handrails. It is estimated that approximately 5% of the platform grating and handrail was lost. Cable trays and other small support equipment were also damaged.

The speculation that green water reached the lower deck is supported by the evidence of water standing in the generator room, the fast rescue boat being separated from the platform and the structural beams supporting the safe welding area being bent up vertically to an angle of approximately 20 degrees.

Team Organization. The Recovery team responded to the situation by prioritizing the list of damage. The immediate focus was on three areas: 1) replace all grating / handrails and make the TLP safe to occupy, 2) restore power and other systems to the quarters so that the TLP could function with subsistence services and 3) secure the unstable drilling rig to prevent further loss and or damage to the asset.

The team established project management protocols. Roles and responsibilities were assigned. Morning call-ins occurred daily in an effort to address hot issues, problems and coordinate all work activities. Site visits by the Engineering and Management teams were made weekly and an integrated project schedule including production, drilling and construction was established with the critical path identified.

Challenges. The Ram Powell team had a unique challenge of recovering the drilling rig from its potentially unstable position as shown in Figure 1.

In order to recover the rig, a sub-team was established with the heavy involvement of numerous contractors.

Two options were considered viable for the rig recovery. Option 1 would be to disassemble the rig and then reassemble it in its proper location. Option 2 would be to jack up the rig from it's deflected, unleveled / unaligned position and then skid the rig back into the safe operating region, see Figures 2, 3 & 4. Option 2 was selected with the idea of using Option 1 as a fall back in the event that the jacking and skidding option did not succeed.

The first order of business for the rig recovery team was to secure the rig. The method of securing the rig made use of a system of clips or hold down brackets, see Figure 5. The clips were designed to withstand hurricane forces acting on the rig. The clips were installed on September 30, 2004. This step turned out to be very useful because on October 8, 2004 Tropical Storm Matthew passed almost directly over Ram Powell as the rig was still in it's unstable position.

While the offshore construction crew was securing the rig, the recovery team focused on a plan of using jacks, hydraulic cylinders and the rig's grippers to recover the rig. The recovery plan is very similar to the principles used to move a house onshore. The plan was to jack up the deflected NW corner of the rig approximately 3 inches so that the rig was once again level. Once level, a system of strategically placed hydraulic cylinders and rig grippers would be engaged to pull the rig back on to the skid beams as shown in Figures 2, 3 & 4. Once aligned on the skid beams the rig would be skidded to a safe normal operating position, see Figure 6.

The rig recovery operations were executed on October 19, 2004. The recovery effort required approximately 24 hours and was flawless.

Once the rig was recovered, efforts shifted towards restoring production and resuming drilling operations.

The Ram Powell team continued with it's prioritized listing and critical path schedule punch list until partial production was restored on October 29, 2004. At the time this paper was written it was estimated that full production should be restored around March 1, 2005.

Learnings. Shell is currently performing an After Action Review on all of its drilling rig tiedown systems in an effort to determine the Root Cause of the rig movement. A picture of the rig in its unstable position is shown in Figure 7. A picture of the sheared hurricane clamp bolts is shown in Figure 8. Figure 9 shows the rig in its post recovery operating position.

Main Pass 252 Repairs

Description. The MP 252 complex consists of two bridge-connected platforms in 300 feet of water. The A platform was installed in the late 1980's and the B platform in the mid 1990's. The "A" platform is both a drilling and production platform with direct vertical access wells while the "B" platform serves as a hub for seven subsea wells.

Damage Assessment. Both platforms experienced significant damage to grating, handrails and equipment on the lower decks (+45 foot elevations), to drain and sump systems below the lower decks and to grating at the boat landings. Grating losses ranged from almost 100% at the boat landing to between 10 and 20% on the lower decks. The sump systems and piping below the lower decks on both platforms were almost entirely destroyed and equipment on the platform lower levels suffered significant damage. Damaged equipment included the gas sales meters, lighting, the SSDS systems, instrument air skids, injection and control tubing, the MEOH injection system, the ESD system, the fusible plug system and most support utilities. The damage could only be attributed to wave action and was concentrated on the south and southeast sides of the platforms. Very limited damage was experienced on the upper decks, which was limited to lightning in the flare tower, communication dishes and minor wind and rain damage to the living quarters. Figure 10 gives a representative sampling of the damage.

Team Organization. The project team was organized with a lead project engineer with construction focal points in charge of the offshore rebuilding effort. The project team interfaced with field personnel in charge of platform operations during the rebuild. Detailed roles and responsibilities were outlined and additional supervisory operational staff was added to coordinate the construction effort. A parallel effort in engineering was established under the lead project engineer to evaluate what systems justified upgrading and redesign. Daily telephone conferences were established to coordinate offshore activities and a base schedule was established. The base schedule was reviewed and updated in detail twice a week with offshore construction, field operations and engineering. The base schedule changed significantly for the first four weeks of the project as additional damage was discovered.

Challenges. The primary project challenge was to secure the platform to allow work to proceed in a safe manner. Handrails, grating and communication systems were the initial focus as well as installation of a temporary construction camp and support systems. Crews were flown out to the platform daily for two weeks to secure the platform. This severely limited crew efficiency due to shorter workdays. Also the lack of availability of temporary housing near the onshore heliport necessitated long commutes before and after work. After the establishment of platform safety systems and the installation of a temporary construction camp, system evaluations were performed and repairs and redesigns initiated. Adjustments to the facility production equipment were made since the throughput of the facility had changed from its original design. The MP 252 complex facilities began ramp up around the end of January 2005.

Learnings. Major project learnings were: a) the project team had to remain flexible and to react to almost daily changes in priority. This required significantly more coordination as priorities and understanding of the extent of damage changed constantly during the execution phase, b) significant amount of electronic equipment becomes outdated before the end of its service life. Unexpected events like hurricanes tend to shorten the service life. A pre-agreed replacement strategy for older equipment (especially instrumentation and logic equipment) is a great enabler in these cases.

Cognac Repairs

Description. The Cognac complex is a drilling and production facility in 1025 feet of water. The Cognac platform was installed in 1978 and was at the edge of deepwater technology at the time of its installation. Cognac is a production processing facility and also has two wellbays capable of supporting two rigs simultaneously. Cognac suffered the least amount of damage between the three installations.

Damage Assessment. The gaugers shack which contained one of the two gas pipeline flow computers, the LACT panel, sand monitoring equipment, as well as several other monitoring systems were damaged and required replacement. There was evidence of green water in the deck from the watermarks inside the gaugers shack. The North Gas Lift manifold was damaged but not beyond repair. Two of the three survival boats had to be sent in for repair.

Throughout the platform the damage included missing /damaged grating and handrails. It is estimated that approximately 5% of the platform grating and handrail was lost. Cable tray damage and other small support equipment were also damaged. Figure 11 shows representative damage at Cognac.

Team Organization. The Cognac Recovery team organized itself and responded to the situation very similar to the other teams.

Once the platform was made safe and habitable, the recovery team developed a plan to isolate the damaged equipment (N. Gas Lift Manifold and Gaugers Shack) from the rest of the equipment and developed alternatives to bring the facility back on partial production. A re-commissioning plan was also developed to check the equipment prior to attempting to return it to service. Partial production was restored on October 13, 2004. Full Production was restored a few weeks later.

Conclusions and Learnings

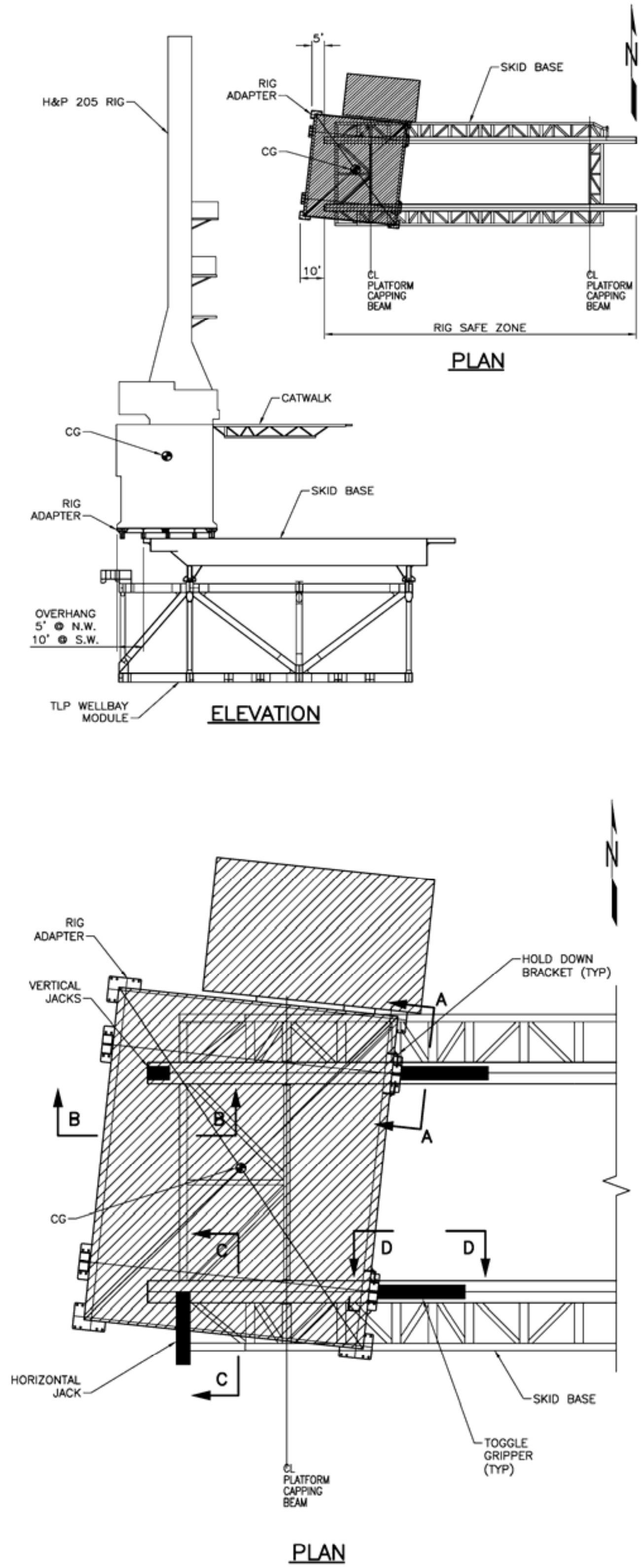
The following conclusions and learnings can be drawn from Shell's experience with Hurricane Ivan.

- The drilling rig tie down design criteria were exceeded. Shell is currently revisiting rig tiedown specifications.
- Damage at all three locations tends to support the theory that green water did contact the lower deck.
- Day tripping was physically demanding of the offshore crews. The time-cost benefit of temporary offshore housing should be considered in the future.
- A strategy for replacement of older equipment (especially instrumentation logic equipment) should be in place and updated every few years.
- A company wide coordinated repair effort allowed synergy and optimization of resources.
- Repairs were executed safely with minimal environmental impact and no OSHA recordable injuries.

Acknowledgements

The authors would like to thank Shell and it's partners for permission to publish this paper. We also would like to recognize the many contributions that were made by numerous Shell staff and third party contractors.

Figures



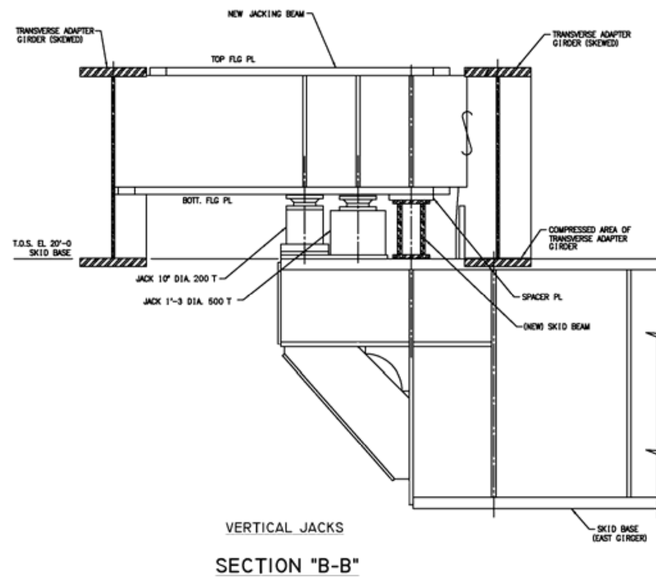


Figure 2 –Vertical jacking system (see plan in Figure 1 for location)

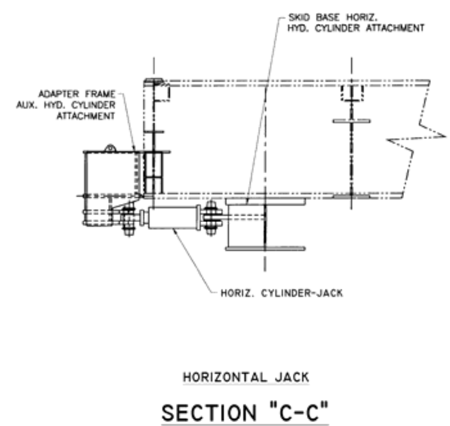


Figure 3 – Horizontal jacking system (see plan in Figure 1 for location)

Figure 1 – Drilling rig in unstable position

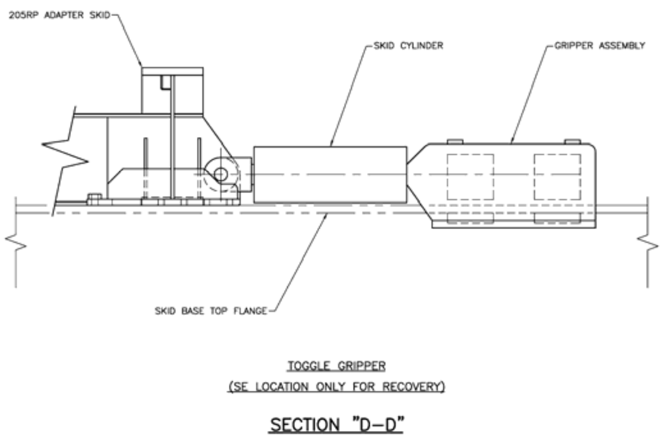


Figure 4 – Rig gripper system (see plan in Figure 1 for location)

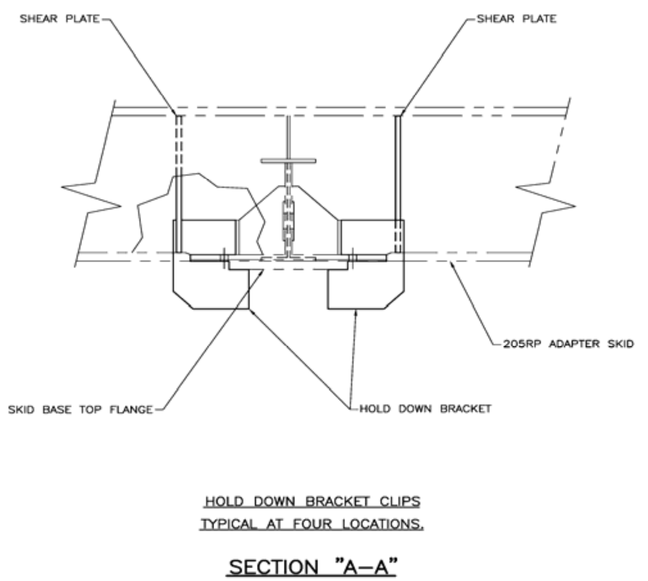


Figure 5 – Hold down clamps / brackets (see plan in Figure 1 for location)

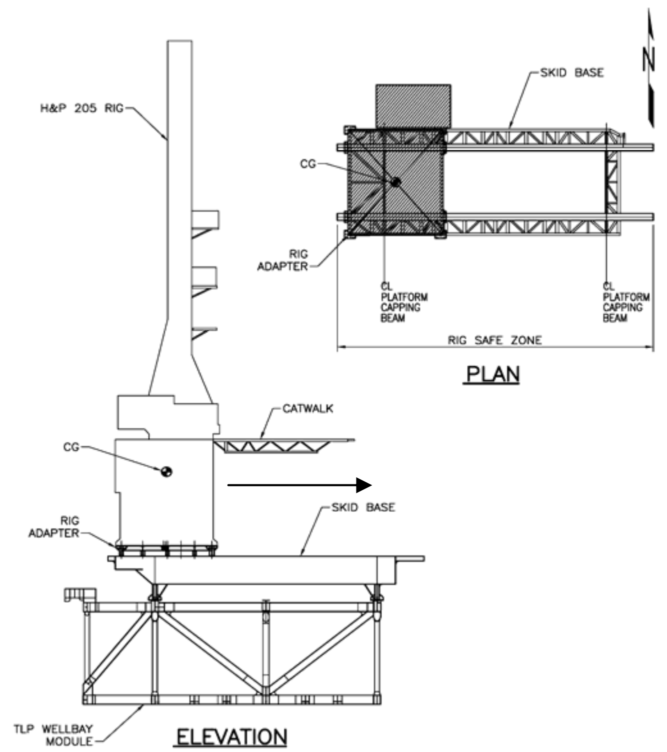


Figure 6 – Rig skid to safe position

Figure 7 – Ram Powell rig after moving 60 feet to the west from storm motion

Figure 8 – Sheared bolts in Ram Powell rig hurricane clamps

Figure 9 – Ram Powell post rig recovery

Figure 10 – Main Pass 252 damage

Figure 11 – Cognac damage

Appendix C

BP Exploration & Production Company Inc.

Hurricane Ivan Experience

TECHNIP OFFSHORE, INC.

MMS

Assessment of Drilling & Workover Rig Storm Sea Fastenings On Offshore Floating Platforms During Hurricane Ivan Phase I (MMS 551)

United States Minerals Management Service

BP Exploration and Production, Inc. Hurricane Ivan Experience

Client Doc. No.:	Doc. No.: 303859-000-RT-3800-0002

EXECUTIVE SUMMARY

Several floating production platforms in the Gulf of Mexico support drilling rig packages that must be secured from movement during severe storms by means of sea fastenings (also termed tie-downs). This document describes sea fastenings for drilling rig packages on board the Holstein, Mad Dog and Horn Mountain platforms operated by BP Exploration and Production, Inc.

While Holstein and Mad Dog were not significantly affected by Hurricane Ivan, they provide an opportunity to understand sea fastening systems of two different designs. A skid base remaining after the drilling rig was removed from Horn Mountain did experience movement during Hurricane Ivan. Information pertaining to all three sea fastening systems is presented in the form of responses to questionnaires that were completed in cooperation with BP.

On August 26, 2005, the Holstein and Mad Dog platforms were visited during a field trip that also included the Front Runner platform (operated by Murphy) and the Brutus platform (operated by Shell). Information for Front Runner and Brutus is presented in companion documents. By happenstance, these visits took place on the day before Hurricane Katrina passed through this portion of the Gulf, and it provided an opportunity to witness hurricane evacuation procedures in progress.

The sea fastening systems observed during the visit illustrate the variety of systems in use by the offshore industry and the challenges in developing and applying a simple standard for sea fastenings for drilling and workover rigs.

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APPENDICES

1.0 QUESTIONNAIRE RESPONSES

Three platforms operated by BP Exploration and Production, Inc. were included in the MMS Sea Fastening Project: the Holstein Platform, the Mad Dog Platform and the Horn Mountain Platform. Questionnaire responses received for these three platforms are presented in the following sub-sections.

1.1 BP Holstein Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: BP Exploration and Production, Inc.
Partner Names: Shell

Platform Name: Holstein
Type of Platform: SPAR
Platform Location (Block No.): Green Canyon Block 645
  Platform Latitude: 27.32122996
  Platform Longitude: -90.53546944
Water Depth: 4,344 ft (1324m)
No. of SCRs: 2
No. of TTRs: 15
Mooring Lines / Tendon condition Pre Hurricane Ivan: 16
Mooring Lines / Tendon condition Post Hurricane Ivan: 16

Drilling / Workover Rig Information:
Rig Owner: BP
Rig Operator: Pride International
Rig Type: Drilling and Completion

Design Criteria used for Rig Seafastening: 100-year Hurricane

Design Criteria used for Hull Motions with Rig on board: 100-Year Hurricane

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   N/A (Case 1)

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   N/A (Case 1)

3. **Did you have movement or failure in both of the above noted locations or only one?**

   N/A (Case 1)

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   Yes. A skid base structure is part of the drill package, and the drill package is welded to the topsides of the Spar.

5. **Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?**

   Yes.

6. **What rig design criteria was used for storm safe tie-downs?**

   100-Year Hurricane.

7. **Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.**

   The sea fastening system is an integral part of the hydraulically driven rack and pinion rig skidding system. Eight hydraulic motors and pinion gears move the skid base and the drill floor along racks mounted on the slid beams on the deck and on the top of the skid base. There are 4 hydraulic motors that drive the skid base and the drill floor, two on each of the two skid beams at each level, for a total of 8. The sea fastening system consists of dogs that are forced into the rack by bolts to prevent horizontal movement. Vertical movement is restrained by runner guides that engage the top flange of the skid beams. The lower skid beams are welded to the deck by shear plates.

   An undetermined level of redundancy is provided by the two motors and locking systems on each beam. There are no stops on the skid beams.

8. **What procedures were in place for rig storm safe conditions?**

   The rig is to be locked into place with dogs and secured by the locking bolts after each rig move. The dogs and locking bolts are checked as a part of the rig evacuation procedure. See Hurricane Evacuation Procedure and Final Check Sheet for Hurricane Evacuation in Appendices 1 and 2. The motor with isolated hydraulics acts as an additional brake.

9. **To what extent were these procedures followed for Hurricane Ivan?**

   Checklist process required by operator and reviewed when platform was visited prior to Hurricane Katrina.

10. **What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?**

    See response to item 9 above.

11. What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?

Rig is owned by BP and operated by Pride. Pride is responsible for tie-downs prior to hurricane shut-down. Before rig evacuation, the BP Marine Supervisor will walk through the rig tie-downs after the Pride Rig Superintendent for verification purposes.

12. What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?

a. What worked and what did not work?

Hurricanes Katrina and Rita both went within 40 miles of Holstein, and no rig movement was reported.

b. What areas were damaged and what was the extent and severity of the damages?

N/A (Case 1)

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

N/A (Case 1)

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

Prior to rig evacuation, the BP Marine Supervisor is to walk through the rig tie-downs after the Pride Rig Superintendent for verification purposes.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

Yes, however Hurricane Ivan was sufficiently distant from Holstein to preclude collection of data that would be meaningful to the study. Data from Hurricanes Katrina and Rita could be useful to illustrate success stories.

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Yes. The sea fastening system is an integral part of Holstein and was designed specifically for Holstein. It is beyond the scope of this study to review the details of the design.

18. Has a damage investigation report been completed and if so what are the major findings?

BP completed an internal post-Ivan evaluation of the Holstein rig tie-downs.

Holstein Notes:

- The hydraulic motor will lock automatically if hydraulic lines are broken (fail safe), so that system cannot move.
- There are no stops on the skid beams. The motors with pressure locked in act as an additional brake.
- The full set back can be left in place during a hurricane.
- The mud and fluids can be left in the tanks during a hurricane.
- The set back pipe joints are secured in the derrick by wrapping with cables and air hoist cables. A plug is set in the well.
- All four motors are required to move the rig.
- The full setback contains 30,000 ft of pipe. It takes approximately 1.5-2 hrs to remove 1,000 ft of pipe to deck.
- The tie down system contains 4 rack and pinion clamps on the bottom and 4 rack and pinion dogs on the top.
- The drill floor can be over any of the well slots during a hurricane.
- Before rig evacuation, the BP Marine Supervisor will walk through the rig tie-downs after the Pride Rig Superintendent.
- Future phases of this study will evaluate the capacities of different rig tie-down design types in order to make further recommendations.

1.2 BP Mad Dog Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: BP Exploration and Production Co.
Partner Names: BHP Billiton, Unocal

Platform Name: Mad Dog
Type of Platform: SPAR
Platform Location (Block No.): Green Canyon Block 826
Platform Latitude: 27.18836886
Platform Longitude: -90.26871119
Water Depth: 4,420 ft (1374m)
No. of SCRs: 2
No. of TTRs: 9
Mooring Lines / Tendon condition Pre Hurricane Ivan: 11 lines
Mooring Lines / Tendon condition Post Hurricane Ivan: 11 lines

Drilling / Workover Rig Information:
Rig Owner: BP
Rig Operator: Pride International
Rig Type: Drilling and Completion

Design Criteria used for Rig Seafastening: 100-Year Hurricane

Design Criteria used for Hull Motions with Rig on board: 100-Year Hurricane

Definition of Movement:
In the following questions, movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   N/A (Case 1)

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   N/A (Case 1)

3. **Did you have movement or failure in both of the above noted locations or only one?**

   N/A (Case 1)

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   Yes. A skid base structure is part of the drill package, and the rig base of the drill package is welded to the topsides of the Spar. See Figure 10 in Section 2.2.

5. **Were the rig tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?**

   Yes.

6. What rig design criteria was used for storm safe tie-downs?

100-Year Hurricane.

7. Was the design of the rig tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.

The sea fastening system is an integral part of the hydraulic push/pull clamp and move rig skidding system. Eight hydraulic rams and clamps move the skid base and the drill floor along the slid beams on the deck and on the top of the skid base. There are 4 hydraulic rams and clamps that move the skid base and 4 that move the drill floor, two on each of the two skid beams at each level. The rams are extended, clamps engaged, and the rig is skidded as the rams are retracted (or vice versa). The sea fastening system contains 16 separate hydraulic clamps - 8 that clamp the skid base to the drill package on the deck and 8 that clamp the drill floor to the drill package on top of the skid base. The clamps are located in pairs on the outside and inside of the beams. These clamps are actuated by a hydraulic cylinder that pushes a taper pin which wedges the clamp against the skid beam flange to prevent horizontal and vertical movement. The hydraulic lines to/from the cylinder are shut to lock these clamps to skid base. Vertical movement is also restrained by runner guides that engage the top flange of the skid beams.

There are welded stops on the skid beams, but they appear to be sized only to serve as travel stops to prevent accidental movement past the stops during a rig move.

8. What procedures were in place for rig storm safe conditions?

The rig is locked in place by the 16 clamps. Actuation is visually verified by the tapered pin position. The hydraulic supply system is locked by closing the supply/return lines. The only way to release is to supply pressure, so the system is fail safe to a pressure loss.

9. To what extent were these procedures followed for Hurricane Ivan?

Checklist process required by operator and reviewed when platform was visited prior to Hurricane Katrina.

10. What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?

See response to item 9 above.

11. What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?

Rig is owned by BP and operated by Pride. Pride is responsible for tie-downs prior to hurricane shut-down. Before rig evacuation, the BP Marine Supervisor will walk through the rig tie-downs after the Pride Rig Superintendent for verification purposes.

12. What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?

a. What worked and what did not work?

Hurricanes Katrina and Rita both went within 40 miles of Mad Dog, and no rig movement was reported.

b. What areas were damaged and what was the extent and severity of the damages?

N/A (Case 1)

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

N/A (Case 1)

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

Prior to rig evacuation, the BP Marine Supervisor is to walk through the rig tie-downs after the Pride Rig Superintendent for verification purposes.

15. What adjustments, if any, have been made to the rig system design to better accommodate severe environmental conditions?

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

Yes, however Hurricane Ivan was sufficiently distant from Mad Dog to preclude collection of data that would be meaningful to the study. Data from Hurricanes Katrina and Rita could be useful to illustrate success stories.

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Yes. The sea fastening system is an integral part of Mad Dog and was designed specifically for Mad Dog. It is beyond the scope of this study to review the details of the design.

18. Has a damage investigation report been completed and if so what are the major findings?

BP completed an internal evaluation of the Mad Dog tie-downs.

Mad Dog Notes:

- Hydraulic system is tied between a push/pull unit and brakes. The hydraulic system is a fail-safe parking braking system in a fully set position. If hydraulic failure of the brake occurs while it is not set; however, it will not close automatically.
- The braking system is comprised of 16 parking brakes - 4 per skid beam - 2 inside and 2 outside. Each break has teeth on bottom and on top.
- The parking brakes are to be checked manually.
- The valves are to be closed on the supply/return of all hydraulic lines coming to a brake.
- When the brakes are set, the only way to release is by pressure set. It can be closed / open or any steps in between.
- If indeed a line does break, the brakes will stay in the same position. If open, they remain open; if closed, they remain closed.
- Liquids and mud are not emptied from the tanks for a hurricane.
- Soap is used for slide friction reduction on the skid beams.
- A 250 kips setback can be left in derrick. The set back pipe joints are hydraulically latched at the top and secured by wrapping with cables and air hoist lines
- There is no clamp at the end of the skid beam opposite the brake, just a guide for lifting.
- The drill floor can be aligned over any of the four inner slots during a hurricane.
- Future phases of this study will evaluate the capacities of different rig tie-down design types in order to make further recommendations.

1.3 BP Horn Mountain Platform

MMS Rig Sea fastening Project Questionnaire – Hurricane Ivan Analysis

Operator Name: BP Exploration and Production Co.
Partner Names: Occidental Petroleum

Platform Name: Horn Mountain
Type of Platform: SPAR
Platform Location (Block No.): Mississippi Canyon 126/127
  Platform Latitude: 28.86601399
  Platform Longitude: -88.05626441
Water Depth: 5,423 ft (1653m)
No. of SCRs: 2
No. of TTRs: 10
Mooring Lines / Tendon condition Pre Hurricane Ivan: 550-660 kips each on 13 Sept.
Mooring Lines / Tendon condition Post Hurricane Ivan: Same range.

Drilling / Workover Rig Information: No rig on platform – rig skid base only.
Rig Owner: Previous rig was Helmerich & Payne completion rig
Rig Operator:
Rig Type: Previous rig was Helmerich & Payne completion rig.

*

Design Criteria used for Rig Seafastening: Unknown

Design Criteria used for Hull Motions with Rig on board: 100-Year Hurricane.

Definition of Movement:
In the following questions movement is defined as movement in any of the six degrees of freedom. Lateral movement in x and y direction, vertical movement, yaw with respect to the platform, or rotation around the x and y axis.

The following questionnaire is intended to document successes as well as incidents for three types of cases:

1. **No movement of rig with respect to the platform,**
2. **Movement occurred between the platform and the rig with no damage to report,**
3. **Movement occurred between platform and rig and damage was recorded**

For Case 1, please proceed to question No: 4, for all other cases please start with Question No. 1.

1. **Description of Incident:**

   Skid base skidded off platform skid beams.

2. **Did the failure occur between the skid beams and the skid base or between the skid base and the drill floor?**

   Failure occurred between skid base and platform skid beams.

3. **Did you have movement or failure in both of the above noted locations or only one?**

   Only the one indicated.

4. **Did you have a skid adaptor in use at the time of Hurricane Ivan?**

   The skid base remaining on the structure would have supported the remainder of the completion rig package had it been there.

5. **Were the rig /skid base tie-downs designed for the combination of floater motions, pitch acceleration and Hurricane winds?**

   Unknown

6. **What rig design criteria was used for storm safe tie-downs?**

   Unknown

7. **Was the design of the rig / skid base tie-downs redundant or did it have a single point failure? Please make sure that the answer covers the complete system and not one part of the system.**

   See response to item 10. There was no redundancy in the system – four clamps and four guides per corner. There were no travel stops attached to the skid beams to prevent the skid base from moving past the end. See Horn Mountain pictures in Section 2.3.

8. **What procedures were in place for rig storm safe conditions?**

   For storm safe condition of the skid base by itself, there apparently were no procedures in place.

9. **To what extent were these procedures followed for Hurricane Ivan?**

   Not applicable.

10. **What procedures or areas of operation, if any, were not completed prior to facility evacuation, as related to rig tie-downs?**

    Storm clamp bolts were likely not torqued down as an oversight, because rig had been removed.

11. **What are the roles of platform owner and rig owner in terms of overall responsibility for ensuring that the proper tie-downs were in place prior to evacuation?**

    Platform owner was responsible for tying down the skid base in this case.

12. **What were the major findings of the appropriateness of the storm safe procedures following Hurricane Ivan?**

    No procedures were in effect related to rig storm clamps because rig had been removed.

    a. **What worked and what did not work?**

    b. **What areas were damaged and what was the extent and severity of the damages?**

       Minor damage to topsides equipment impacted by end of skid base.

13. If movement with damage occurred, are you able to indicate or give an estimate how much time was required to repair the rig and any damage caused by its movement?

Damage was repaired within timeframe of other topsides equipment damaged by wind and water – approximately 10 days.

14. What adjustments, if any, have been made to the procedures for rig storm safe conditions as a result of these findings?

Platform crew have been instructed to re-torque storm clamp bolts before hurricane evacuation.

15. What adjustments, if any, have been made to the rig/skid base system design to better accommodate severe environmental conditions?

16. Was there a monitoring system in place on the drilling rig, and if so what kind of data was recorded by this system?

Yes. Data was recorded on the platform until approximately 10:00 a.m., when the emergency generator shut down. At this time, the maximum Hs was 42 ft, and the eye of the storm was approximately 94 nautical miles south of Horn Mountain. Approximately 8 hours later, at 6:00 p m , the eye passed within 9 nm to the west of Horn Mountain.

17. Was there any design reports completed on the rig clamps before it was installed on the floating production facility?

Does not apply in this case. Incident happened because clamp bolts were not torqued down.

18. Has a damage investigation report been completed and if so what are the major findings?

No. Damage was considered minor and repaired in the same timeframe as other miscellaneous topsides damage.

Horn Mountain Notes:

- None

2.0 SUPPORTING MATERIALS

2.1 BP Holstein Photographs

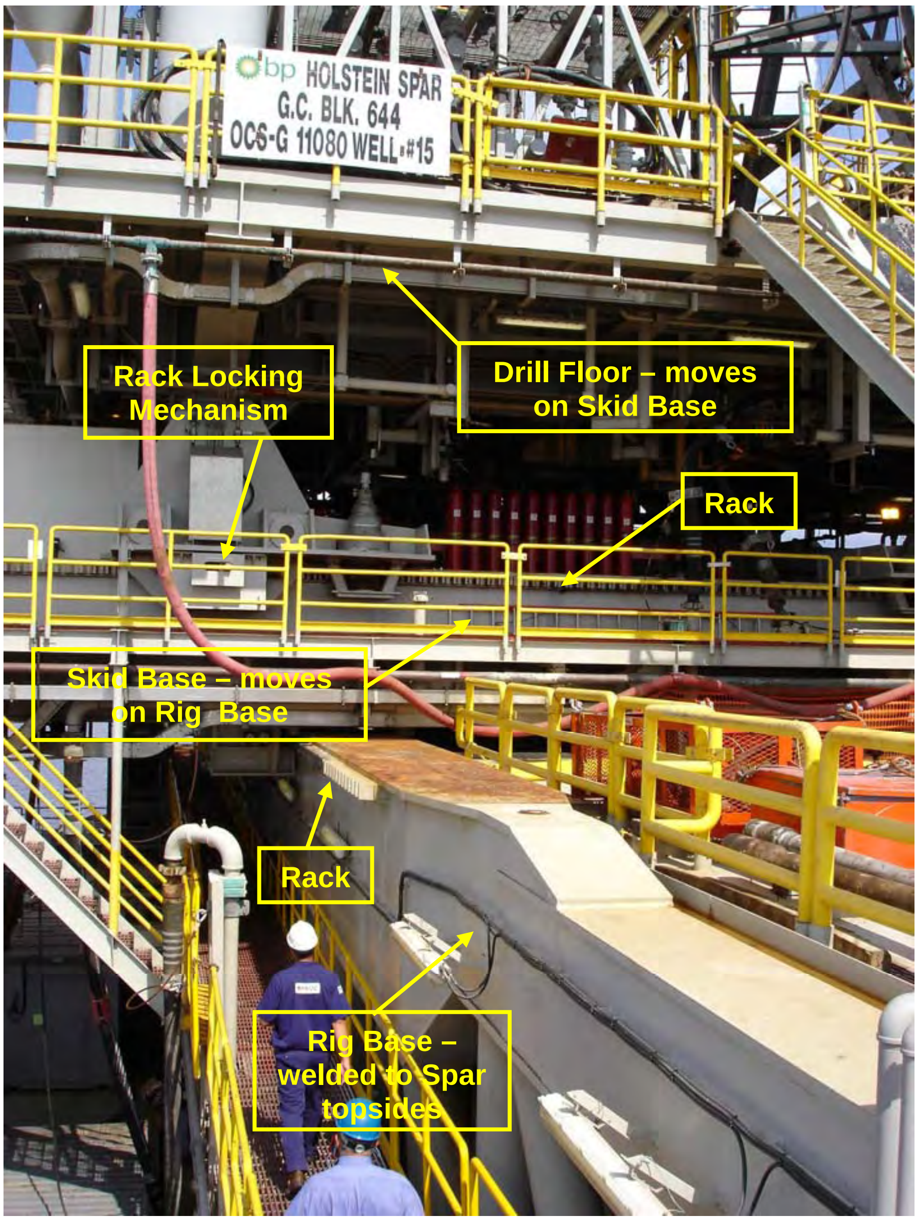


Figure 1 - Drilling Package on Holstein

Figure 2 - Holstein Rack and Pinion Gear Hydraulic Drive and Clamp Assembly

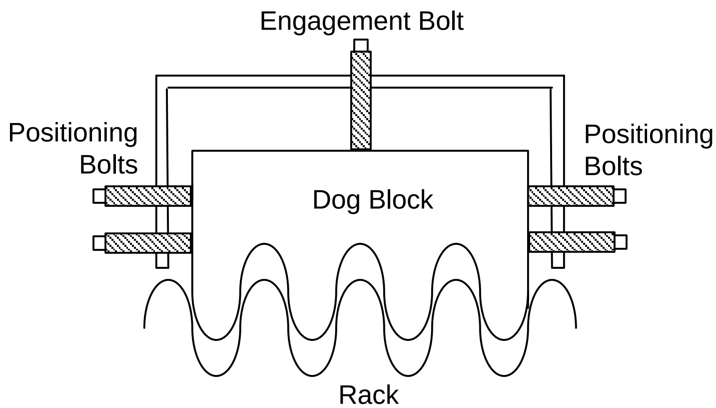


Figure 3 - Holstein Rack and Pinion Locking Mechanism Conceptual Sketch

Figure 4 - Positioning Bolts on Holstein Rack and Pinion Locking Mechanism

Figure 5 - Engagement Bolt on Holstein Rack and Pinion Locking Mechanism

Figure 6 - Skid for Holstein Substructure

Figure 7 - Holstein Skid Beam

Figure 8 - Setback Pipe in Holstein Derrick

2.2 BP Mad Dog Photographs

Figure 9 - Aerial View of BP Mad Dog

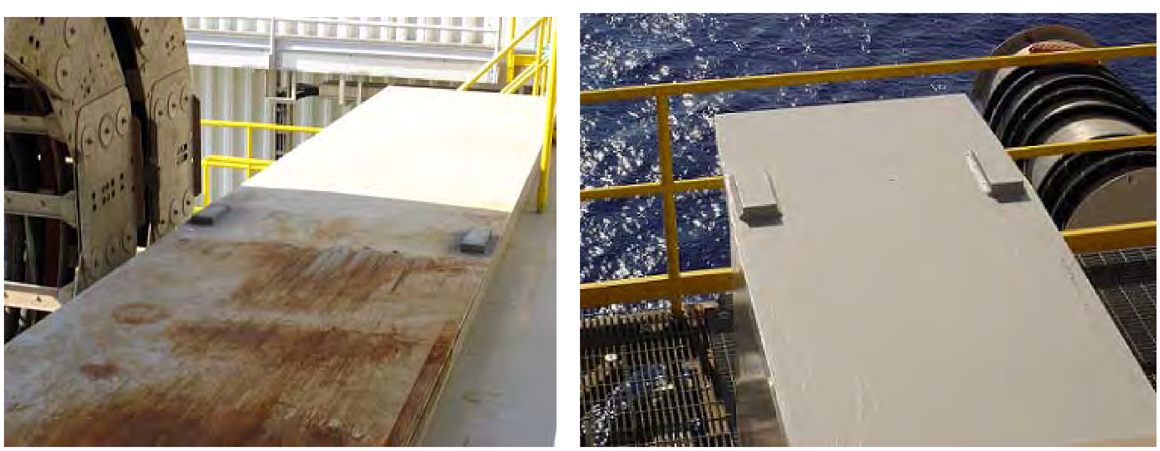


Figure 10 - Stops Welded to Top of Mad Dog Skid Beam

Figure 11 - Hydraulic Brake System on Mad Dog

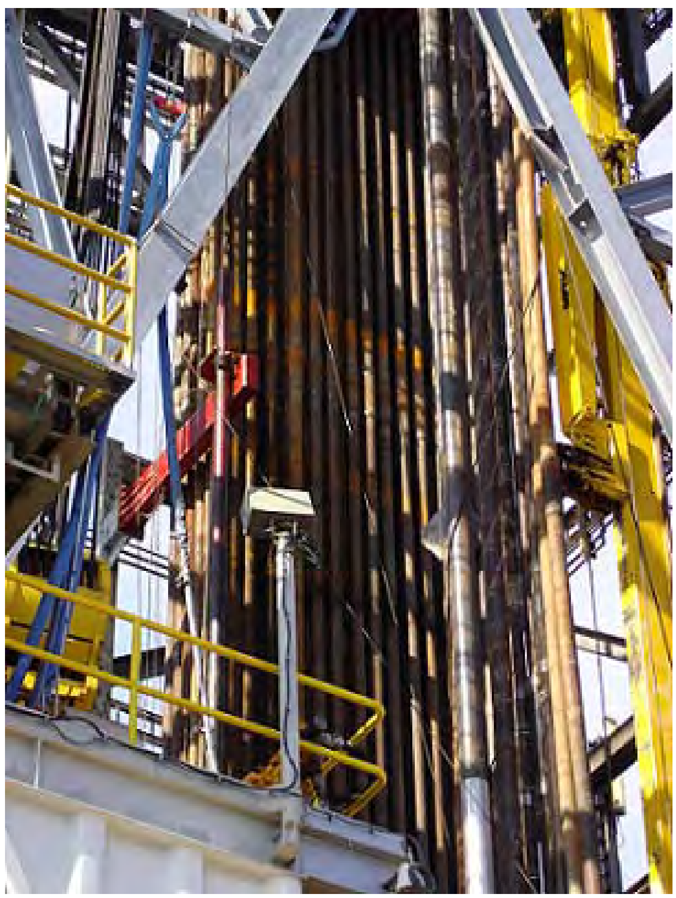


Figure 12 - Winch Wire Wrapped Around Mad Dog Setback

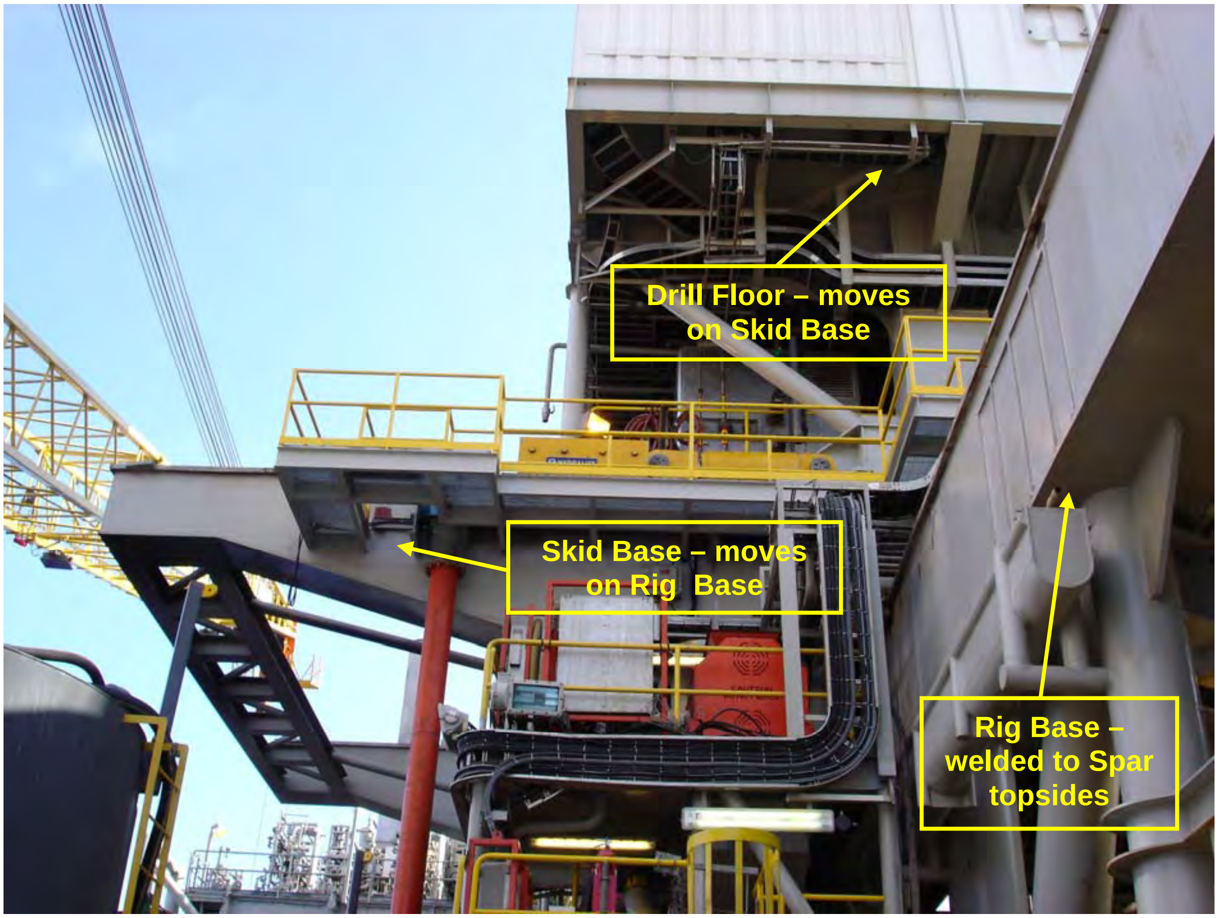


Figure 13 - Drilling Package on Mad Dog

2.3 BP Horn Mountain Photographs

Figure 14 - BP Horn Mountain Platform with Drilling Rig on Board Prior to Hurricane Ivan

Figure 15 - Horn Mountain Aerial View Showing Rig Skid Base Off Skid Beams

Figure 16 - Horn Mountain Rig Skid Beam Damage From Hurricane Ivan

Appendix 1 - Pride Hurricane Evacuation Procedure

PRIDE OFFSHORE

Holstein & Mad Dog
Hurricane Evacuation Procedure

The purpose of this job plan is to establish a safe and efficient means of controlled evacuation in the event of future severe tropical weather. This procedure is broken down by phases of the storm and the steps to be taken by each job description.

References

Emergency Response Manual – Offshore

Down Manning and Evacuation Procedure	Pride-05-03-705
Severe Storms or Weather Conditions	Pride-05-03-709

Applicable Rig Bridging Document

Wind Speed Guidelines

Tropical Depression	Maximum wind speed is 34 knots (39 MPH)
Tropical Storm	Wind speed of 35-64 knots (40-74 MPH)
Hurricane	Average wind speed exceeds 64 knots (74 MPH)

Plan Priority

Priority 1: Personal safety
To remove all personnel in a safe and timely manner to a safe location.

Priority 2: Well safety
To leave the well in a secure condition so that it will not flow.

Priority 3: Rig safety
To leave the rig in a secure conduction so that it will ride out the storm intact.

Do not deviate from this plan unless it is discussed with Pride Operations Manager.

Roles and Responsibilities:

Operations Manager

- Ensure that all Pre-TRS season requirements are met.
- Pass on all updated storm information to the Rig Superintendent.
- Coordinate all phase activities with the Rig Superintendent.
- Communicate with the Operator's shore-based Drilling Superintendent / Manager.
- Ensure activities in Phase 1, 2, and 3 are completed in a safe and timely manner.
- Maintain communications with weather service and track the course, speed, intensity and other pertinent information on the storm.

Rig Superintendent

- Responsible for the administration and implementation of this job plan.
- Maintain communication and rig status with Company Representative.
- Responsible for establishing and preparing a detailed plan to secure the well and the rig (evacuation of rig personnel is the responsibility of the BP OIM). This plan will be based on current operations anytime there is a TRS (Tropical Revolving Storm) within 1000 nautical miles of the rig location. These plans are to be updated at least once every 12 hours for as long as the TRS exists.

Toolpusher

- Assist Rig Superintendent and delegate job duties as directed.

Off-Duty Driller

- Assist Rig Superintendent with evacuation procedures as directed.

On–Duty Driller

- Perform well preparation procedures as directed.

Off-Duty Crane Operator

- Assist Rig Superintendent with evacuation procedures as directed.

ON–Duty Crane Operator

- Support well operations and secure rig as directed.

RSTR

- Provide weather information, POB status, readiness of emergency equipment, assist as directed.

Maintenance Department

- Assist Rig Superintendent as directed.

On-Duty Drill / Roustabout Crews

- Assist well operations and securing of rig as directed.

Remaining Pride Personnel, Service Personnel, and Visitors

- Assist as directed.

TRACKING OF POSSIBLE STORM

Rig Superintendent /Company Representative

- Maintain communication with Operations Manager of storm and rig operations
- Calculate the time relevant to operation and location of storm.
  Miles from rig is achieved by multiplying speed of storm by hours needed.
  (storm speed x hours needed = miles from rig)
- Make sure that the rig preparations are started at least 72 hours before 60 Mph winds reach current location.
- Begin any possible back loading or storage of any unneeded equipment.
- Make any needed repairs or modifications to be storm ready.
- Discuss lodging & transportation decisions for possible evacuation.

RSTR

- Update tracking chart at least every 12 hours.
- Setup weather report for morning and afternoon delivery.
- Discuss possible upcoming weather events with crews.
- Ensure that all lifesaving equipment is operational and ready for use.

PHASE 1 PREPARATION

Preparing the rig and well. This Phase should be completed 72 hours before storm condition winds are forecast to be at the rig's vicinity. Review all storm preparations at safety meeting with all rig personnel.

Rig Superintendent / Company Representative

- Prepare a plans for evacuation of personnel, securing of the well and securing of the rig.
- Check and discuss rig limitations, helicopter and boat status in regards to possible evacuation of personnel.
- Agree on the number of essential vs. non-essential personnel and reduce accordingly.
- Agree on equipment needed to continue operations and back load or secure remaining equipment.
- Maintain communications with Operations Manager.

Toolpusher

- Assist Rig Superintendent as needed with any well or evacuation procedures.

Maintenance Department

- Strap all tanks (fluid and bulk) advise Rig Superintendent of findings
- Ensure watertight integrity.
- Disconnect any small electrical equipment on deck and arrange for storage below deck.
- Verify that all batteries are charged and functional.
- Weld down any buildings or equipment that can't be secured.
- Secure all metal racks, bottle racks.
- Remove and store any welding leads and cutting torch hoses.

RSTR

- Inform any Operator furnished boats, Production Facilities, and shore based operations that the rig is in Phase 1 Operations.
- Discuss POB status with Rig Superintendent / Company Representative and update list as needed
- Fax current POB to Operations Manager as situation changes.
- Arrange transportation and lodging for evacuees as needed.
- Check all radios, telephones, and verify communication with boats and / or aircraft in area.
- Maintain current weather report and advise Rig Superintendent of any changes.
- Check and log weather / sea status at rig location every hour.
- Make sure that all liferafts are disconnected and secured on deck.
- Make sure that all liferings are secured and stored properly
- All outside fire extinguishers are removed and stored in a safe location.
- Make sure that all lifeboats are secured in cradle prior to leaving rig.

On – Duty Driller

- Secure well as directed (this step depends on status of well operations)

- Lay down all tubulars in derrick.
- Lower top drive to lowest point in track and install securing sub.
- Wrap air hoist around drill line from crown to block and secure
- All overboard dumps will be secured at the shakers and pits if accessible.
- Secure any non-use items in derrick. Remove any items that can't be properly secured.
- Close all equalizing valves between tanks.
- Secure any non-use items in the well bay, rig floor, shale shakers and pump areas.
- Secure any items on top of motorshed.
- Close blind rams and lock down.
- Lock down HCR valves and remove kill and choke lines.

On – Duty Crane Operator

- Continue support of well operations as needed.
- Back load equipment or people to boats as needed.
- Store and secure all steel and plastic drums below deck.
- Chain & bind down all tubulars and equipment.
- Store all mops, brooms, buckets, etc. in rstb. locker.
- Secure any loose items on top of tool house, parts house, tanks, etc.
- Remove and store take on hoses below deck.

PHASE 2 PREPARATIONS

Securing the rig begins when storm conditions are 48 hours from the rig, or sooner if deemed necessary by the Rig Superintendent and Company man. This phase should be completed by the time storm conditions are 24 hours from the rig.

Rig Superintendent / Company Representative

- Maintain communication with Operations Manager of storm and rig operations.
- Calculate the time relevant to operation and location of storm.
  Miles from rig is achieved by multiplying speed of storm by hours needed.
  (storm speed x hours needed = miles from rig)
- Make sure that the Phase Two rig preparations are started at least 48 hours before 60 mph winds reach current location.
- Notify helicopter or crew boat of pre-determined time to be at rig.

Toolpusher

- Assist Rig Superintendent as needed with any well or evacuation procedures.

RSTR

- Inform any Operator furnished boats, Production Facilities, and shore based operations that the rig is in Phase 2 Operations.
- Discuss POB status with Rig Superintendent / Co. Rep. Update POB list as needed.
- Fax current POB to Operations Manager as situation changes.
- Arrange transportation and lodging for evacuees as needed.
- Maintain current weather report and advise Rig Superintendent of any changes.
- Check and log weather / sea status at rig location every hour.
- Confirm all outside fire extinguishers are removed and stored in a safe location.

On – Duty Driller

- Continue (if not complete) securing of rig floor / drilling equipment.

On – Duty Crane Operator

- Backload equipment or people to boats as needed.
- Store and secure any other items that are loose on the deck.
- Cradle and secure crane booms before evacuating rig.

Maintenance Department

- Install protective boarding on drillers cabin.
- Cover exhaust on generators not in use.
- Assist in securing all equipment on the deck.
- Fill day tanks and cold start air compressor with diesel
- Line up air receiver to cold start air compressor.
- Close all diesel lines on day tanks.

PHASE 3 PREPARATIONS

The rig is evacuated and all personnel are at a safe location on shore. This phase is to be far enough in advance that it is completed by the time storm conditions are within 24 hours from the rig.

Rig Superintendent / Company Representative

- Maintain communication with Operations Manager of storm and rig operations.
- Calculate the time relevant to operation and location of storm.
- Miles from rig is achieved by multiplying speed of storm by hours needed.
  (storm speed x hours needed = miles from rig)
- Make sure that the Phase Three rig preparations are started at least 24 hours before 60 mph winds reach current location.
- Verify helicopter or crew boat of pre-determined time to be at rig.
- Notify Operations Manager just prior to evacuation that all people have left the rig.
- Notify Operations Manager upon arrival at hotel that all hands are accounted for.

Maintenance Department

- Ensure that all watertight doors and vents are dogged closed.
- Shutdown rig power and secure engines as needed.
- Disconnect main engine batteries and emergency lights.

RSTR

- Inform any Operator furnished boats , Production Facilities, and shore based operations that the rig is in Phase 3 Operations.
- Discuss POB status with Rig Superintendent / Co. Representative. Update POB as needed
- Fax current POB to Operations Manager as situation changes.
- Arrange transportation and lodging for evacuees as needed.
- Maintain current weather report and advise of any changes.

- Check and log weather / sea status at rig location every hour.
- Gather crew phone list, crew POB sheet, IADC report, Rig logbook, and timesheets.

On – Duty Crane Operator

- Backload equipment or people to boats as needed.
- Cradle and secure crane booms before evacuating rig.

Master – Use For Making Copies Only

EMERGENCY FORM AND CHECKLIST – SEVERE STORM OR WEATHER CONDITIONS

Date/Time Reported:		By:
Location Of Storm (Miles From Rig):		
Estimated Hours From Rig:		
Storm Conditions:		
Type of Storm:		
Actions Taken:		
Notified:		

EMERGENCY CHECKLIST	✔
1. Prepare rig and rig equipment for tropical revolving storm.	
2. Calculate key preparation times based on speed of storm's approach.	
3. Ensure all safety equipment is ready and operational.	
4. Maintain a constant radio storm watch.	
5. Disconnect and secure rig.	
6. Evacuate the rig.	

PRE-STORM INFORMATION
CURRENT RIG LOCATION

Block:			
Coordinates:			
Distance to Shorebase:			
Workboat Name:			
Running Time to Shorebase:			
Phone Number:			
Workboat Name:			
Running Time to Shorebase:			
Phone Number:			
Crewboat Name:			
Running Time to Shorebase:			
Phone Number:			
Helicopter Type:			
Call Sign:		Time to Base:	
Passenger Capacity:		Wt. Limitation:	
Helicopter Type:			
Call Sign:		Time to Base:	
Passenger Capacity:		Wt. Limitation:	
Wind Limitation for Landing Aircraft:			
Medical Facility Approved by POI:			
Phone:			
Hotels Approved by POI:			

Appendix 2 - Pride Final Check Sheet for Hurricane Evacuation

PRIDE OFFSHORE Holstein DEEPWATER DEVELOPMENT MAD DOG DEEPWATER DEVELOPMENT

FINAL CHECK SHEET FOR HURRICANE EVACUATION

MAINTENANCE TEAM

- ________ Insure that all parking brakes are in the locked position and all valves are in the closed position. (Mad Dog)
- ________ Run in all 4 pins on rack and pinion storm chocks, all 8 shoes. (Holstein)
- ________ Strap all tanks (fluid and bulk). Advise the Rig Superintendent of findings
- ________ Ensure watertight integrity.
- ________ Disconnect any small electrical equipment on deck and arrange for storage below deck.
- ________ Verify that all batteries are charged and functional.
- ________ Weld down any buildings or equipment that cannot be secured.
- ________ Secure all metal racks and bottle racks.
- ________ Remove and store any welding leads and cutting torch hoses.
- ________ Install protective boarding on drillers cabin.
- ________ Cover all pressurization fans with heavy plastic wrapping.
- ________ Wrap natural/powered vents and air conditioner for Transformer Room.
- ________ Wrap or board A/C condenser intakes and exhausts for MER and MCC's.
- ________ Cover exhaust on generators not in use.
- ________ Remove crank case breather jumper hose between the engine and hard piping and cover crankcase breather outlet.
- ________ Cover air breathers on all engines.
- ________ Wrap generators not in use with heavy plastic.
- ________ Assist in securing all equipment on the deck.
- ________ Fill day tanks and cold start air compressor with diesel
- ________ Line up air receiver to cold start air compressor.
- ________ Close all diesel lines on day tanks if no generators are in use.
- ________ Install plywood over front of radiators in engine room. (Mad Dog)
- ________ Isolate HP air system on drill package (Air Intensifier).
- ________ Secure all Computers throughout the rig package and living quarters.
- ________ Secure all tool boxes and heavy equipment room.

ETs

- ________ Shut down Varco V-ICIS HMIs.
- ________ Shut down Varco V-ICIS DWSs.
- ________ Power down VSRs.
- ________ Shut down Varco server.
- ________ Shut down PRS, TDS, ZMS, ADS, Aux, HPU, Fingerboard, PFII cabinets.
- ________ Power down UPS #3 and #4.
- ________ Switch 24v UPS to either "A" or "B" system (this is to save one bank for start up.
- ________ Unload and shut down running engines.
- ________ Power down UPS #1 and #2.

RSTR

- __________ Fax current POB to Operations Manager as situation changes.
- __________ Arrange transportation and lodging for evacuees as needed.
- __________ Ensure all outside fire extinguishers are removed and stored in a safe location.

DRILL CREW

NOTE: RIG NEEDS TO BE POSITIONED IN ONE OF THE FOUR CENTER WELL SLOTS. (Mad Dog)

- __________ Secure well as directed. (this step depends on status of well operations)
- __________ Lay down all tubulars in derrick.
- __________ Lower top drive to lowest point in track and secure same.
- __________ Wrap air hoist around drill line from crown to block and secure.
- __________ All overboard dumps will be secured at the shakers and pits if accessible.
- __________ Secure any non-use items in derrick. Remove any items that can't be properly secured.
- __________ Close all equalizing valves between tanks.
- __________ Secure any loose items in the well bay, rig floor, shale shakers and pump areas.
- __________ Secure all door and windows on rig floor. Duct tape and seal seams.
- __________ Secure any items on top of motor shed.
- __________ Close blind rams and lock down.
- __________ Lock down HCR valves and secure choke and kill lines. (Mad Dog)
- __________ Lock down HCR valves and remove choke and kill lines. (Holstein)
- __________ Lock Weatherford Torque Winder in parked position. (Mad Dog)
- __________ Lock AR 5000 in parked position. (Holstein)
- __________ Lock PRS-8I in parked position
- __________ Secure all gates on catwalk machine and re-check clamps on same. (Mad Dog)
- __________ Secure conveyor and re-check pins on same. (Holstein)
- __________ Secure the four Gaffey winches in the moon pool area. (Mad Dog)

DECK COORDINATOR

- __________ Store and secure all steel and plastic drums on the Drill Deck.
- __________ Chain & bind down all tubulars and equipment.
- __________ Store all mops, brooms, buckets, etc. in rstb. Locker.
- __________ Secure any loose items on top of tool house, parts house, tanks, etc.
- __________ Remove and store take on hoses below deck.
- __________ Chain down both Sea Trac cranes in cradles, secure crane and cover exhausts.
- __________ Secure knuckleboom pipe handler and manhole cover in pedestal.
- __________ Check to make sure that all deck drains are opened and not plugged.

Appendix 3 - Pride Mad Dog DES Parking Clamp Technical Description

1 TECHNICAL DESCRIPTION

1.1 DES PARKING CLAMP UNIT.

Drawing: T3699-D1263-G0001
General Arrangement

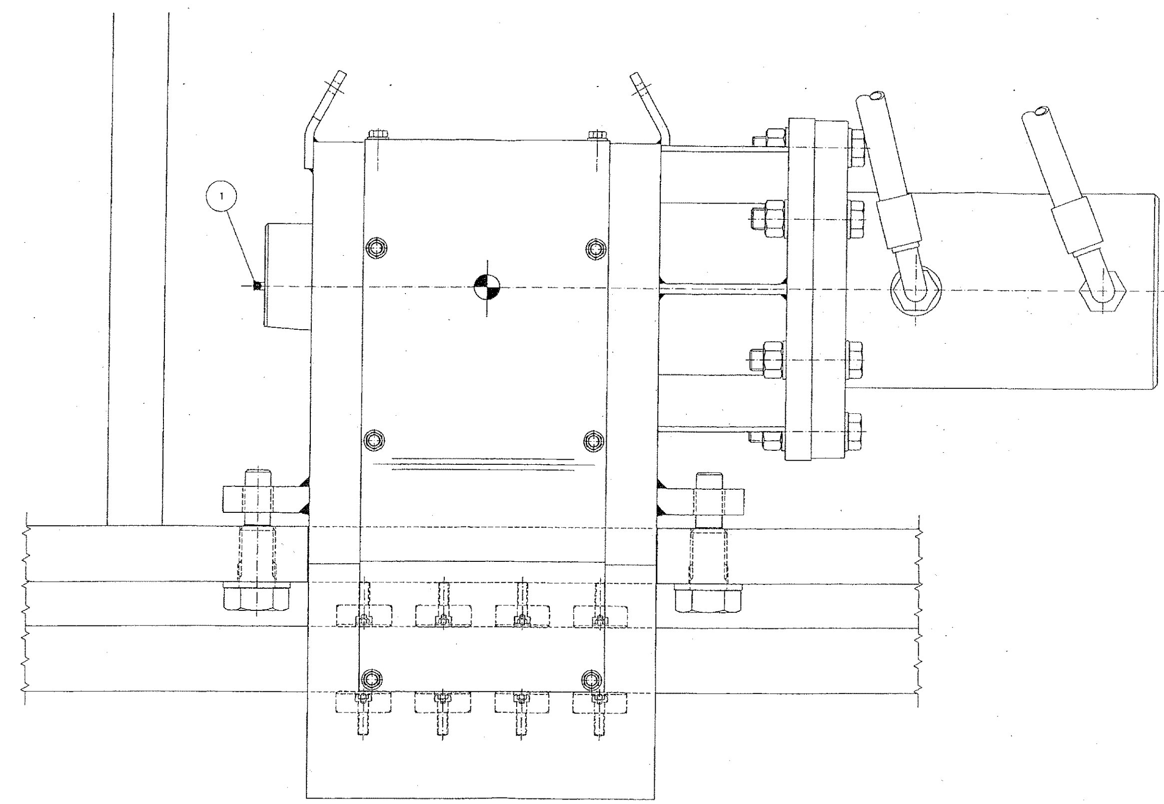
The skid shoe parking clamp units are designed to hold the DES structure stationary, i.e. resist all externally applied horizontal loads in the skidding direction. The resistance to horizontal movement (in the skidding direction only) is achieved by applying a vertical clamping force to the skid beam upper flange, to effectively lock the clamp units to the skid beam. Each skid shoe will be equipped with 2 clamp units. Each clamp unit is captured within an aperture located at the edge of the skid shoe, thus preventing the skid shoe from moving along the skid beam when the clamp is actuated. The clamp units are **not** designed to take any vertically applied loads (uplift) or loads in the transverse direction (these loads are to be taken be taken care of by client supplied units).
The vertical clamping force is generated by utilising a tapered wedge block, pushing horizontally against a mating (tapered) profiled hole housed within the upper clamping bracket. The wedge is integrated into the lower clamp bracket and connected to an hydraulic cylinder, which when stroked, pushes the wedge against a profiled hole within the upper clamping bracket. This action effectively lifts the lower clamping bracket against the underside of the skid beam flange, thus creating the clamping force required. The clamp unit is self-locking, therefore it does not require hydraulic pressure to maintain the clamping force. The clamp is released by retracting the hydraulic cylinder.

1.2 CONTROL SYSTEM

The hydraulic control system is designed to operate the parking clamp units in conjunction with the DES skidding system. When the DES skidding clamp units are activated the parking clamp units are inactive (unclamped), ensuring that the DES structure is free to be skidded along the skid base box girder. Inversely, as soon as the DES skidding clamp units are unclamped the parking brake clamp units are activated. To ensure that the DES structure is always under control (never unclamped on the skid base box girder) an accumulator is incorporated in to the hydraulic supply system for each DES skidding clamp unit. The accumulator maintains hydraulic pressure to the DES skidding clamp unit cylinders for a short period (even though the control lever for the clamp units has been operated to "unclamp"), allowing enough time for the parking clamp units to be activated.

1.3 SCOPE OF SUPPLY

- Clamp units (8 total), including all mounting hardware.
- Hydraulic hoses to adjacent manifold (all piping to manifold supplied by client).
- Control Console (combined with rig skidding and lift cylinders).



No.	LUBRICATION POINT	No. OFF	NOTE	TYPE	QUANTITY (LITRES)	INTERVAL	REMARKS
1	CLAMPING WEDGE	1	GREASE NIPPLE	MUKTIFAK EP2	0.05	WEEKLY	

Designed 11.09.03 EDP
Approved 11.09.03 HLA
Drawn 11.09.03 EDP
Scale 1:2.5
Format A1

HYDRALIFT

DES PARKING UNIT
LUBRICATION CHART

File: D1263-L0002 rev 0.dwg
D1263-L0002
Rev 0

R:\T36\T369 ER MANUAL\D1263-L0002 REV 0.DWG PLOTTED BY: JO 13.01.2004 19:04