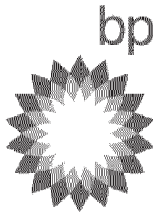


INCIDENT REPORT

Drift Off and Emergency Riser Disconnect

Transocean Horizon

June 30, 2003

Investigation Initiated:
July 1, 2003

Riser Disconnect
MC 725 #1

TABLE OF CONTENTS

Executive Summary

The purpose of this report is to document the findings, causes, recommendations/action items from the investigation into the drift off and disconnect of the Transocean Horizon from the MC 725 #1 Well (OCS-G 22898) on Monday June 30, 2003 at approximately 10:15 AM. The team utilized the BP CLC methodology to identify causal factors and root causes of the incident prior to developing recommendations.

On June 30, 2003 the Transocean Horizon experienced the combination of a loop current of 3.8 knots, winds of 44 knots and waves of 12 to 14 feet. This combination of environmental loads and the decision of the Horizon's Captain to maintain the current on the beam resulted in the Horizon being pushed to the limit of its watch circle, 36 m. At this point the driller activated the emergency disconnect sequence. The drill pipe had been previously hung off on the pipe rams prior to the drift off. The shear rams cut the drill pipe and the LMRP disconnected from the BOP. This sequence went entirely as planned and there was no damage to the rig or drilling equipment, with the exception of the sheared joint of pipe. The rig was able to stabilize its station keeping position, after turning stern to the current, approximately 50 meters from the original drilling location. The total estimated volume of SOBM discharged to the sea was 1,817 bbls.

The Investigation Team has identified three immediate causes of the incident.

2.1 – Improper use of equipment

This is based on the observation that the Captain had given orders to keep the current on the beam rather than follow the recommendation of the DP model System Selected Heading (SSH) that would have taken the current approximately on the bow of the Horizon.

4.1 – Improper decision making or lack of judgment

This is based on the decision to maintain the current on the beam (90 degrees to vessel's heading) and not considering a different heading until it was too late to take corrective actions. The criticality of early warning signs (having to shed power at less than design environmental loads) was not fully appreciated, and consequently the Synthetic Oil-based Mud (SOBM) was not displaced out of the risr.

6.3 – Improperly prepared equipment

This is based on the finding that the hotel power was over-calculated by the Simrad Vessel Control (power management) system. This error was input into the DP simulator, which predicted a drift in excess of the vessel's watch circle while turning the bow into the current due to insufficient power availability. This contributed to the Captain's decision not to turn the Horizon. Subsequent modeling with accurate input for hotel power indicates the vessel heading could have been changed without going outside the watch circle.

Introduction

Terms of Reference

An Investigation Team was assembled at the request of Jake Skelton, NAX Wells Project Manager, on July 2, 2003 to conduct an inquiry into the drift off and disconnect of the Transocean Horizon that occurred on June 30th at approximately 10:15 AM.

The Investigation Team consisted of the following members:

Team Co-Leaders:	
Charles Taylor	BP Wells Project Manager
Doug Halkett	Transocean Operations Manager
Members:	
Roger Gatte	BP Drilling Supervisor
Pierre Beynet	BP UTG
Edward Peterson	BP DWP HSE

The Investigation Team was assisted by:

Terry Loftis	Transocean Discipline Manager
Bill Ambrose	Transocean Operations Engineer
Olivier Cadet	Transocean Design Engineer
Pete Fougere	Transocean Senior Engineering Manager
Judy Wagner	Frontline Group Project Consultant

The purpose of the investigation was to evaluate the following aspects:

Operations Procedures

1. Are there gaps in the current operations procedures that need to be closed?
2. While carrying out the operations were there any conflicts between BP's and Transocean's procedures?

Decision Making

1. Did the personnel involved in making decisions have all the sufficient information on hand when making the decisions?
2. What is the level of knowledge of the rig's operational limitations in both the office and rig site staff?

Design of the rig – Operational limitations

1. Validate the current rig's model by reviewing the environmental forces that were experienced by the rig.
2. Did the rig respond to the environmental forces as the rig's model would have predicted?

This report presents an assessment of the events leading up to the incident, identifies a number of findings and underlying causes of the incident and makes recommendations to prevent a recurrence.

Conduct of the Investigation

The team collected data pertinent to the incident, conducted interviews with personnel who were involved with the events leading up to the incident or who had relevant knowledge. Site visits were made by key Transocean personnel to evaluate the operation of the DP system. The results of this investigation were presented to the team. The data was analyzed and a sequence of events established from verbal information collected. The team utilized the BP CLC methodology to identify causal factors and root causes to the incident prior to developing recommendations.

The team was able to interview the pertinent members of the Horizon crew by teleconference. Transocean representatives from their Houston office conducted on site investigations and interviews. This information was later shared with the Investigation Team and their report is included as an attachment to this report.

Interviewees:

Darrell Boudreaux – BP Wellsite Supervisor
Mike Marzolf – Transocean Horizon Captain
Steve Cross – Transocean Horizon Toolpusher
Van Williams – Transocean Horizon OIM (Offshore Installation Mgr)
Jake Skelton – BP Wells Project Mgr
John Keeton – Transocean Horizon Rig Mgr
Dan Vario – Transocean Horizon 3rd Mate (DP Operator)
Mark Franklin – BP Drlg Engr
Bryan Cook – BP Drlg Superintendent
Curtis Jackson – BP Wells Mgr

Acknowledgements

The Investigation Team wishes to acknowledge both the Transocean and BP personnel that assisted with the investigation. There was open and honest feedback during all interviews. We also want to recognize Transocean for their openness with the results of the DP system post-analysis.

Sequence of Events

Status of Operations at the Time of the Incident

At the time of the incident drilling operations were curtailed due to station keeping difficulties in the high current. The drill string was pulled into the 11 7/8" casing shoe and hung off on the pipe rams in preparation for severe weather conditions (loop currents and Tropical Storm Bill). All available power was diverted to the thrusters. This included shutting off some hotel functions such as air conditioning.

Events Leading Up To and Following the Incident

Date	Event
9/2001	Horizon makes transit from Korea. During the transit, both Captains discover that higher transit speeds are achieved using 6 thrusters rather than 8 thrusters. This becomes the basis for the conclusion that thruster efficiency is reduced when thrusters are aligned with each other. This leads to the decision to maintain the current on the beam while in DP mode. This keeps 4 rows of thrusters directed into the current, as opposed to 2 rows when the bow is oriented into the current.
10/2001	DP trials are conducted prior to rig acceptance. A Transocean audit is done while the Horizon is drilling its first well in "DP Assist Mode" (rig was moored at time of audit). The Captains' decision to keep the current on the beam in DP mode is not addressed during the trials or audit.
1/2002-6/2003	The Horizon encounters currents in the 1 to 2 knot range while drilling in DP mode. Under these conditions the decision to keep the current on the beam is not an operational problem. The Captain's preference to keep the current on the beam is not challenged.
6/26 05:00	A barge strikes the Port Aft column and as a result the ADCP is lost. While this is not believed to have contributed directly to the incident, it did remove one source of loop current information 4 days before the disconnect.
6/27 12:00	Drilling operations are suspended for 2 hours because power is diverted to the thrusters. At this time the Kongsberg current is 3.2 knots. *(Kongsberg current is a value calculated by the Simrad DP system based on the station keeping force required of the thrusters, adjusted for measured wind speed. All references in this document to current speeds are based on the calculated Kongsberg current.)*
6/28 11:30	Three mud pumps are taken off line for 90 minutes in order to allocate more power to the thrusters. One pump continues to circulate bottoms up. The highest current reported is 3.6 knots at 12:00.
6/28 20:30-23:30	Drilling operations are suspended for 3 hours to divert power to the thrusters. The highest current calculated is 3.5 knots with 19 knots of wind.
6/29 12:30-14:30	Drilling operations are suspended for 2 hours to divert power to the thrusters. The current is calculated as 3.4 knots.

6/29	14:30	Decision is made by rig site leadership, Transocean management, and BP management to circulate bottoms up, pull drill string into 11 7/8 inch casing, get into hang off position, and monitor current and TS Bill.
6/29	14:30-19:30	The rig back-reams and pumps out of hole to 24, 571 feet due to concerns of swabbing. (The 11 7/8" casing shoe is at 24,258'.)
6/29	16:00	The Incident Management Team (IMT) convenes to review the situation relative to TS Bill.
6/29	17:00	In teleconference between the rig and the Houston Office, a discussion is held concerning the allowable hang off weight on the rams, and whether timing would allow for a storm packer to be set.
6/29	19:30-22:30	With under reamer in open hole directly below the casing shoe, the rig circulates bottoms up to the BOP (bit at 24,571 feet).
6/29	22:30-23:30	The rig performs weekly well control drill and then pulls bit into shoe.
6/29	23:30-02:00	The rig circulates bottoms up from wellhead with boost pumps.
6/30	02:00-04:00	The rig monitors well at hang off point.
6/30	04:00	The rig makes the decision to hang off. At this point it is not possible to set storm packer or displace riser due to power constraints and safety issues due to the high winds and rain.
6/30	05:15	The rig reports "position holding was marginal at best." The rig is 16 meters off location with all 6 engines at 100%. The current is calculated to be 3.8 knots and the wind is steady at 20 knots with gusts to 51 knots. The seas are running 12 to 14 feet.
6/30	06:00	The rig runs model simulations to determine if a heading change could be made to head the rig into the current. The analysis indicates that the Horizon would drift off location a total of 60 meters before the heading change could be completed (based on a 5 degree/minute turn rate). The Captain decides not to attempt the heading change.
6/30	10:16	A controlled emergency disconnect was initiated when the Horizon drifts 34 meters off location. The current is calculated as 3.8 knots. The wind is 44 knots and the seas are estimated as 12 to 14 feet.
6/30	11:00	After disconnect, the Horizon turns to take the current on the stern and then later on the bow. The station keeping stabilizes at a new set point, approximately 50 meters off location. The power demand stabilizes between 80 to 85 %.

6/30	12:00	The drill pipe is retrieved. The sheared joint of drill pipe is bent. The LMRP is inspected with ROV and found undamaged.
7/03	07:00	The Horizon reconnects the LMRP to the BOP and begins to displace seawater from the riser.

Conclusions and Findings

In response to the specific questions referred to in the Terms of Reference above, the Investigation Team reached the following conclusions:

Operations Procedures

1. Are there gaps in the current operations procedures that need to be closed?

   The following gaps have been identified in the operations procedures:
   - *Transocean had no follow up audit of Horizon's DP procedure and their effectiveness in full DP operation*
   - *Transocean's DP Operations Guidelines did not require the Captain to notify Transocean's Regional Field Support Group at yellow alert*
   - *Lack of review by Headquarters DP Operations Superintendent of the Transocean Horizon's Bridge Procedures Guide (position has been vacant for 12 months)*
   - *BP Assurance plan does not address Contractor DP Operational Procedures*

2. While carrying out the operations were there any conflicts between BP's and Transocean's procedures?

   The Investigation Team found no conflicts.

Decision Making

1. Did the personnel involved in making decisions have all the sufficient information on hand when making the decisions?

   In general, personnel had sufficient information on hand, with the exception that BP and Transocean rig site personnel and Rig Manager were not aware of the impact of the chosen vessel heading with regard to station keeping ability. The BP office personnel were not aware that the Horizon was operating with the current on the beam.

2. What is the level of knowledge of the rig's operational limitations in both the office and rig-site staff?

   There was not a high level of awareness on the rig, and between the Transocean and BP office personnel, of the rig's operational limitations.
   - *There was a limited awareness that the rig was designed to conduct drilling operations in up to a 3.5 knot current with a 60 knot wind.*

- *The increased power requirements to hold station while keeping the beam on the current was not fully understood nor considered during the events leading up to the disconnect.*
- *There were a number of Houston-based Transocean personnel that were aware of the operational limitations of the vessel, however they were not consulted.*

Design of the rig – Operational limitations

1. Validate the current rig's model by reviewing the environmental forces that were experienced by the rig.

   Preliminary findings by Transocean technical staff indicates that the Horizon station keeping ability meets design criteria.

2. Did the rig respond to the environmental forces as the rig's model would have predicted?

   Transocean modeling confirmed the rig behaved as predicted.

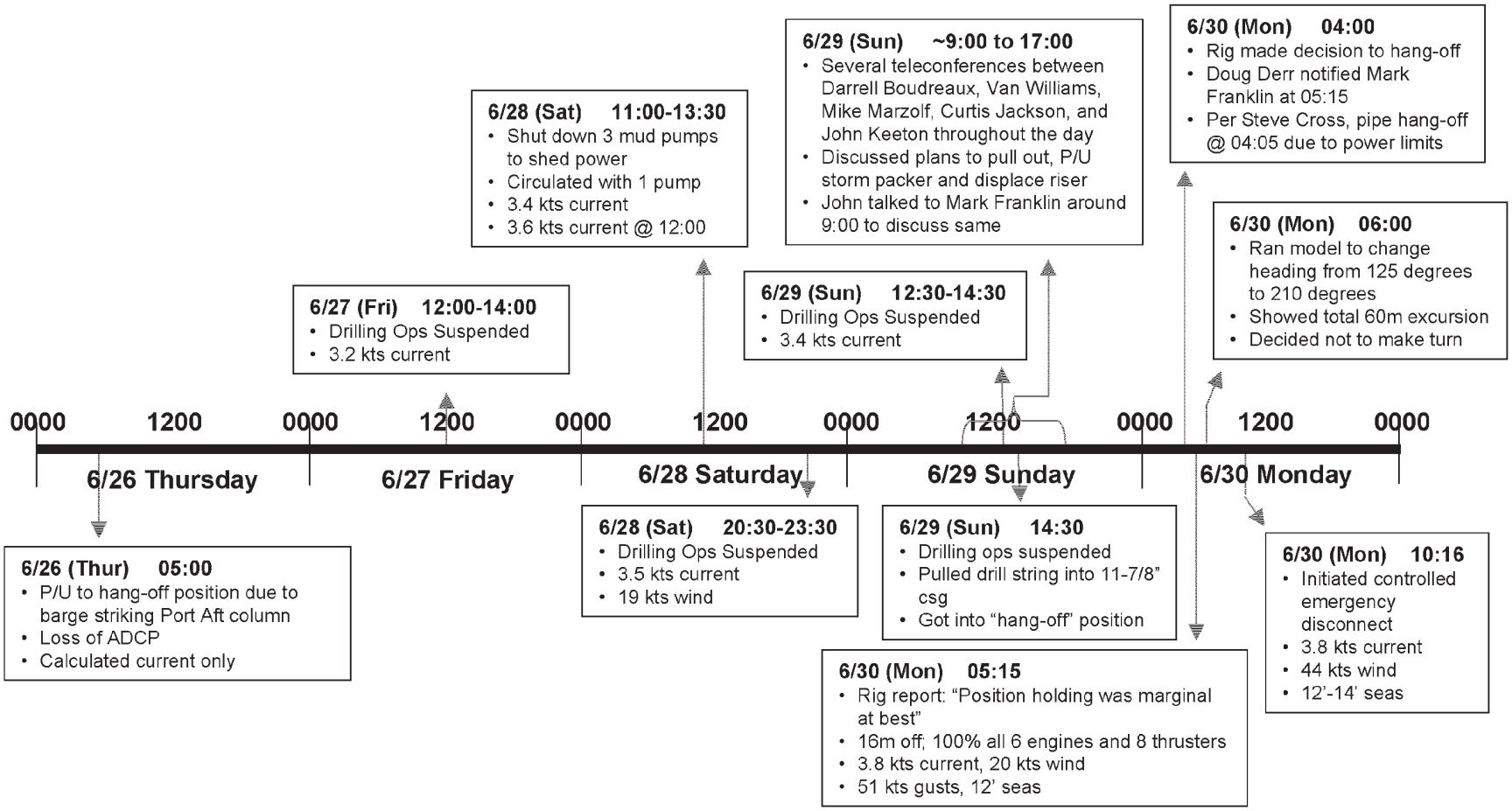
Other Findings

Other important findings/observations gathered from the interviews include:

- Safety of rig personnel was a key consideration as plans were being developed both on the rig and in the office.
- Rig-site team developed a site-specific plan that enabled immediate communication between key personnel. Radio communication between the Captain, OIM, Toolpusher, and BP Well Site Leader during this situation is consider a best practice
- Primary and back-up communications systems functioned well in inclement weather.
- The overall wells organization (BP & Transocean) communicated effectively throughout the incident, with the exception that the Rig Manager was not made aware when the decision to set the storm packer was changed.
- All rig equipment required to perform the EDS functioned as designed, preventing damage to the wellhead and rig, while safely securing the well.

APPENDICES

Horizon Riser Disconnect Timeline



Appendix B Findings, Causes and Recommendations Table

The incident Investigation Team did not identify a responsible party or target date for the recommendations/action items. This has been left for the NAX Wells Team and Transocean management to decide based on acceptance of the recommendations and available resources.

Findings	Causes (from CLC)	Recommendation/Action Item	Responsible Party	Target Date
2.1) Improper use of equip (SSH not used)	11.6) Inadequate audit inspection and monitoring Transocean had no follow up audit of Horizon's DP procedure and their effectiveness in full DP operation 13.1) Inadequate assessment of needs & risk Decision not to use SSH was flawed 15.4) Inadequate communication between work groups Lack of communication between Capt/OIM and Houston Engineering & Regional Mgmt	Transocean to develop audit, inspection, and training scheme covering DP procedures, competencies, and effectiveness of DP system and operations BP to develop an assurance plan for DP operations in conjunction with appropriate contractors Transocean DP Operation Guidelines should be changed to reflect that when yellow alert level is reached, Captain should establish communication with rig manager and technical support group		

Findings	Causes (from CLC)	Recommendation/Action Item	Responsible Party	Target Date
4.1) Improper decision-making or lack of judgment 4.1a) Captain's conclusion: Beam on to current was best heading	6.3) <u>Infrequent performance of skill</u> 1st time Horizon has worked in high current 7.5) <u>Misapplication of previous experience</u> Application of transit experience to DP mode 7.5) <u>Training</u> Lack of understanding of design of vessel with respect to thruster interaction 7.5) <u>Training</u> The bridge ran simulations only at 5 degrees/min turn rate. (Simulations run by Transocean Engineering in Houston were done at 5 and 10 degrees/min; 10-degree/min rate predicted less drift.) 11.6) <u>Inadequate audit inspection and monitoring</u> Transocean had no follow up audit of Horizon's DP procedure and their effectiveness in full DP operation	Transocean to develop audit, inspection, and training scheme covering DP procedures, competencies, and effectiveness of DP operation Transocean to clarify how interaction between thrusters is managed by DP system, and results included in training and on-board DP documentation.		

Findings	Causes (from CLC)	Recommendation/Action Item	Responsible Party	Target Date
4.1b) Did not appreciate criticality of early warning signs	6.3) Infrequent performance of skill 1st time the Horizon has worked in high current environment 6.4) Lack of coaching on skill Transocean should have provided closer supervision during Captain's initial assignment to the Horizon 14.2) Inadequate development of PSP BP & BP Contractors did not have adequate guidelines in dealing with loop currents and loop current/storm combination 14.4) Inadequate monitoring of work Failure of BP & Transocean to realize the criticality of power shedding on Friday & Saturday (June 27-28) and potential for station keeping problems with increasing weather and current	Transocean to develop audit, inspection, and training scheme covering DP procedures, competencies, and effectiveness of DP operation		

Findings	Causes (from CLC)	Recommendation/Action Item	Responsible Party	Target Date
4.1c) Failure to recognize the likelihood of losing station, and the need to displace riser	6.3) Infrequent performance of skill This was the first time the combination of storm, currents, and improper heading was sufficient to force the Horizon off location 14.1) Lack of PSP for task No guidelines for dealing with loop currents and loop current/storm combination 15.4) Inadequate communication between work groups Rig manager not informed of change of plan regarding setting of storm packer and displacement of riser	BP to develop general guidelines around how to manage drilling operations in high loop currents Conduct DP seminar/presentation for BP Drlg groups and other stakeholders on the effects of loop currents on position keeping, and riser management in the GoM Consider DP familiarization course for BP Engineers/Foremen prior to assignment to DP operations		
6.3) Improperly Prepared Equipment	10.1) Design Input not correct Hotel power load over-calculated by the Simrad power management system leading to decision to maintain original heading based on simulation prediction of excessive drift due to insufficient power available to thrusters	Transocean to rectify calculation of hotel loads Transocean to develop audit, inspection, and training scheme covering DP procedures, competencies, and effectiveness of DP system and operations BP to develop an assurance plan for DP operations in conjunction with appropriate contractors		

Appendix C Transocean DP Event Summary and Analysis

(Following pages)

REA # 6087 001 H024	Transocean	Prepared by: O. Cadet
Issued: 23-July-2003	**DP Incident Summary and Analysis**	Reviewed by: T. Loftis, D. Halkett, P. Fougere

Summary

Rig: *Deepwater Horizon*	Date of Events: *30-June-03*	Location: *GOM*	Client: *BP*

Type of DP Event: *DP Incident (drift off)*

Result of DP Event: *Disconnect*

DP System: Kongsberg Simrad *SDP32 + SDP12 (SW 3.0.7)*

Causes	
→ **Primary Cause**	***Incorrect heading*** → *The vessel was beam into the current. Sway action was not enough to keep the vessel on location. Vessel drifted off.*
→ **Probable contributing factors**	→ *Incorrect Hotel Load indicated on SVC. This value was used in the simulator to find out if the heading change to the System Preferred Heading could be made. 6MW Load value was used for the simulation. Result of the simulation indicated a drift off of the vessel (about 59m) exceeding red limit (36m) when attempting the heading change to the System Preferred Heading.* → *Very strong environment (especially current)*

Chronology of events

- **04:09:08** – Insufficient Thrust Alarm in Surge and Sway. Alarms coming on and off from that point to the time of disconnect. Alarms caused by lack of power in power plant (42MW limit reached).
- **04:11:50** – 9m excursion from setpoint (position out of limits alarm). Drill Floor informed.
- **04:12:03** – Heading change from 145º to 125º.
- **04:58:00** – 17m excursion from setpoint. Rig came back on setpoint.
- **05:22:22** – 23m excursion from setpoint. Rig came back on setpoint.
- **Around 06:00:00** – Crew ran offline simulation to simulate turn to System Selected Heading. Under simulating conditions, and with the data entered by the crew, a 60m-drift off during heading change was found. Red limit was set to 36m. Decision was made not to attempt heading change at that point.
- **06:35:59** – 13m excursion from setpoint. Rig came back on setpoint.
- Environment slowly picking up. Forces acting on the vessel increasing (especially SWAY).
- **10:16:00** – Emergency Disconnect (EDS#1) initiated and successful.

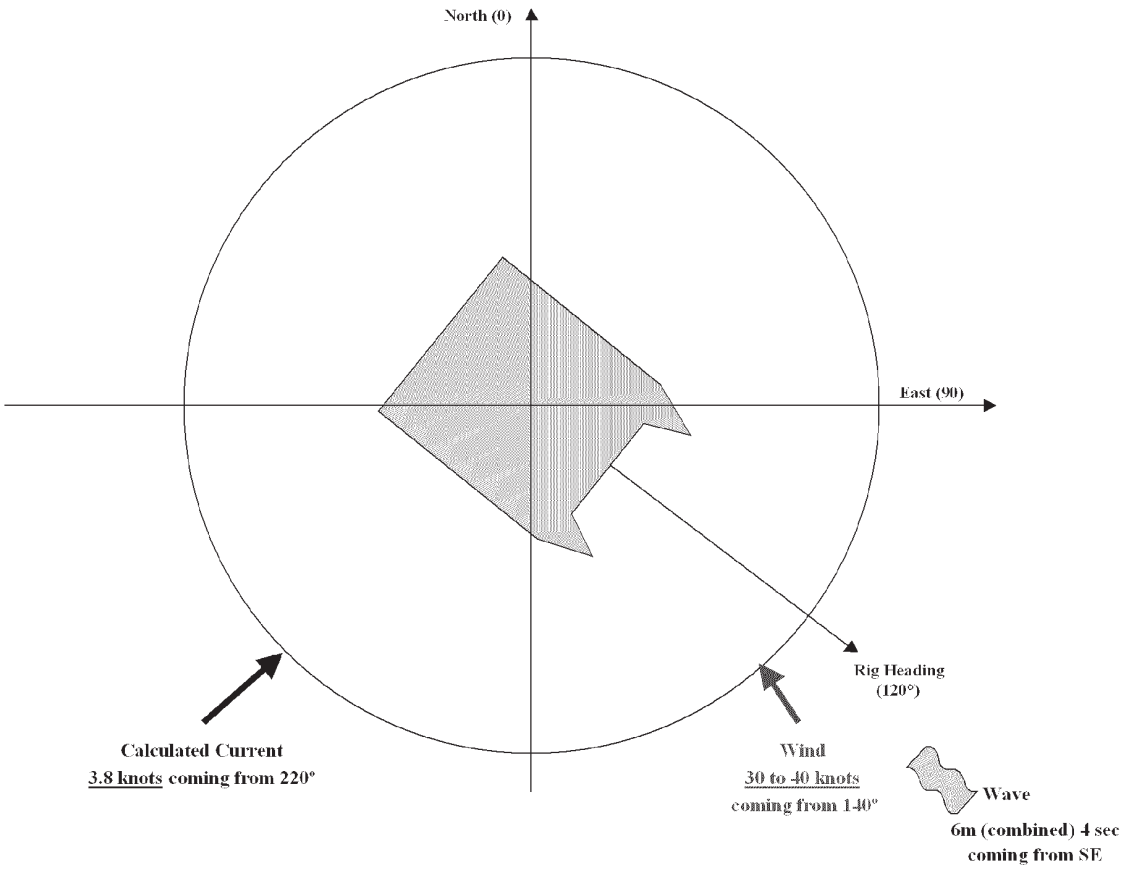
Consequences

→ *Disconnect (Disconnect successful)*

Structure of this report

1. DP System Set-up at the time of event

Date and Time	
Date of event	*30 June 2003*
Time of event	*Starting experiencing positioning problems around 04:00:00. EDS at 10:16:00*
DP Controller Configuration	
Gain in Surge	*Low (-10)*
Gain is Sway	*High (+10)*
Gain in Yaw	*Low (-10)*
Relaxed Mode in Use	*No*
Environment	
Wind Speed	*16 m/s (29 knots)*
Wind Direction	*Wind coming from 140-150°*
Preferred Wind Sensor	*Wind Sensor 2 top of derrick*
Calculated Current Speed	*2.0 m/s (3.8 knots)*
Calculated Current Direction	*Current coming from 215-220°*
Wave direction (coming from)	*SE (info taken from Bridge Rough Log)*
Wave height and period	*6m (combined seas) and 4 sec.*
Vessel Heading	*125°*
Operations	
Drilling Operations	*Hang Off*
Power Plant Configuration	
Number of GenSets on line (max = 6)	*6*
Propulsion Configuration	
Number of Thrusters on line (max = 8)	*8*
Position Reference Systems	
Position Reference Systems used	*DGPS1, DGPS2, DGPS3, DGPS4, HPR1*
LBL Priority Mode used	*No*
DP Software	
DP Software Release	*3.0.7*
Watchcircles settings	
Water Depth	*1,340 m (4,395 ft)*
Yellow Limit	*18 m (following Transocean's recommendations)*
Red Limit (disconnect)	*36 m (following Transocean's recommendations)*

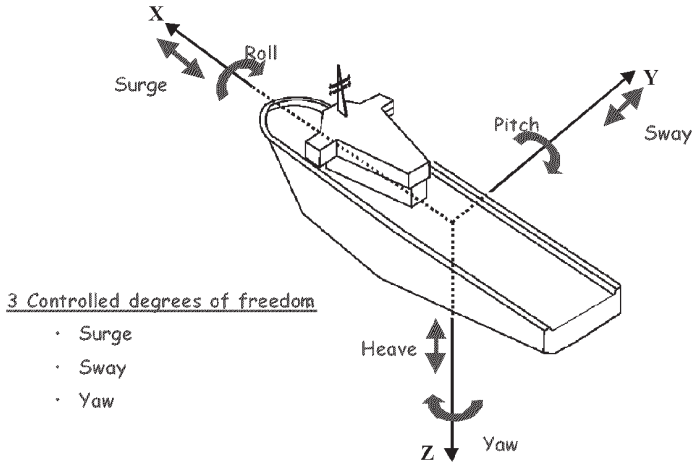


Deepwater Horizon Orientation vs. Environment

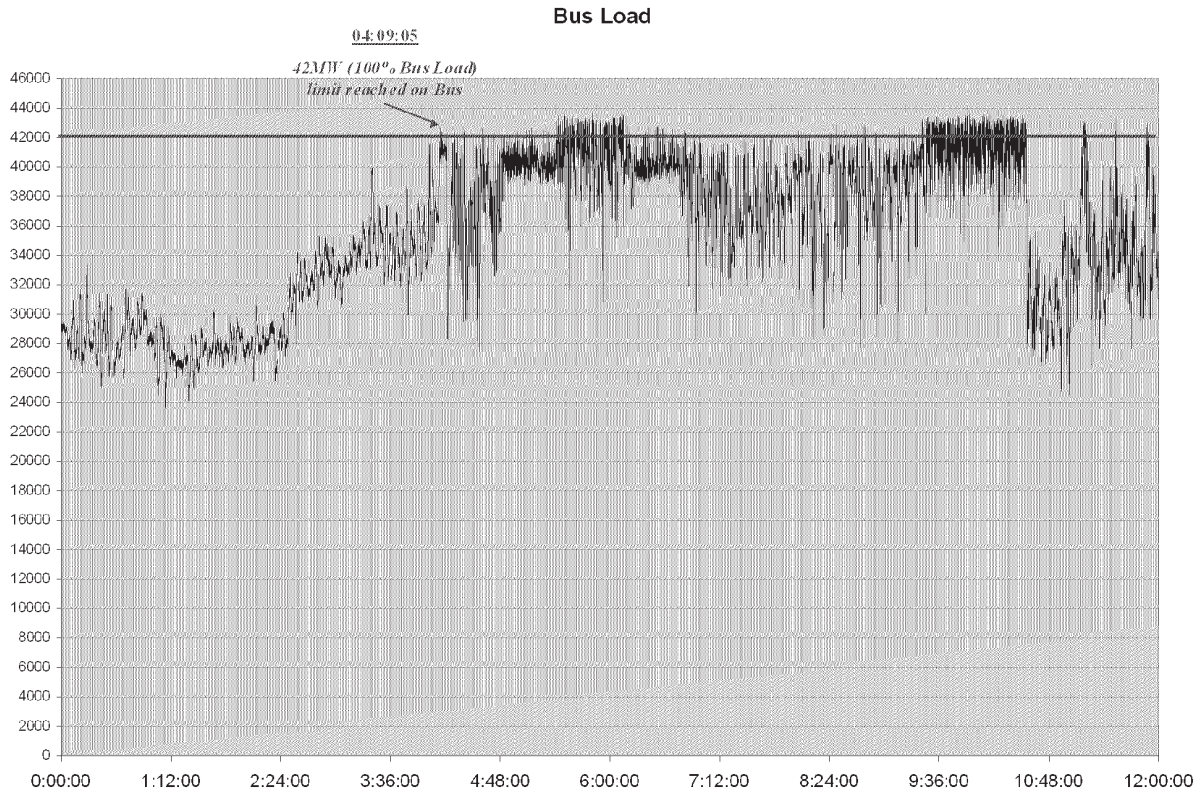
*Comment on **Calculated Current**: this "current" is calculated by the DP system. It represents all the disturbance forces acting on the vessel with the exception of wind (wind speed is measured directly). This calculated current will therefore include the effect of disturbance forces like current but also waves and any other un-modeled forces.* ***So there's more than just sea current behind this calculated current value.***

2. Chronology of events on 30-June-2003

Important comment: all the data presented below are taken from the DP Logger. In the next pages the following convention is used for signs and axis on the vessel:



- **04:09:05 - 42MW (100% of maximum load on bus) reached on Bus**

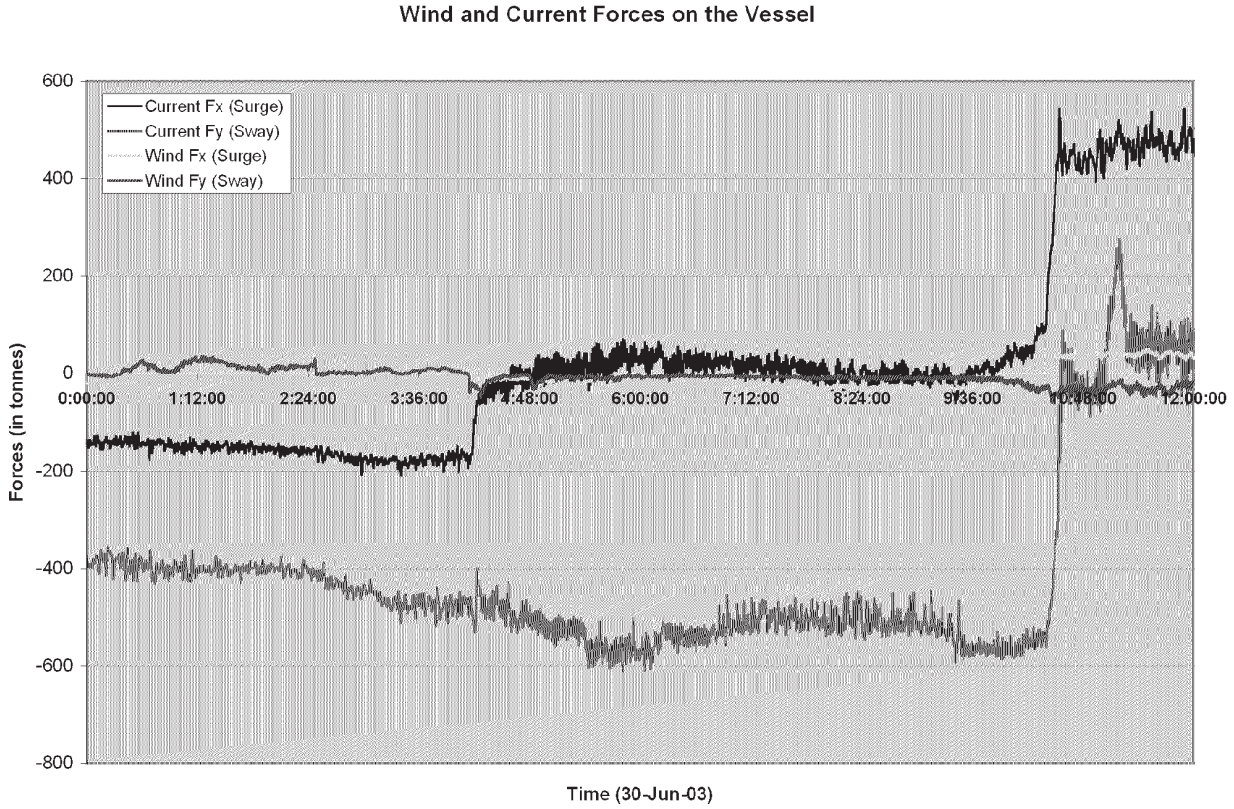


The Deepwater Horizon is fitted with six 7MW generators. That's a total of 42MW power available. The two main power consumers are Drilling and Propulsion. Propulsion is made of eight 5.5MW thrusters (total of 44MW). Both groups are using variable frequency drives. Because the Deepwater Horizon is a dynamically positioned vessel priority is given to thrusters in power phaseback situation.

In this case the DP system detected that the system load on the bus was over 100% of the available power and therefore limited the thruster speed command. Please note that the Simrad Vessel Control system is also able to send a power limit signal (4-20mA) to the ABB thrusters drives when the 105% limit is reached. That limit (44.1MW) was not reached during this incident[1].

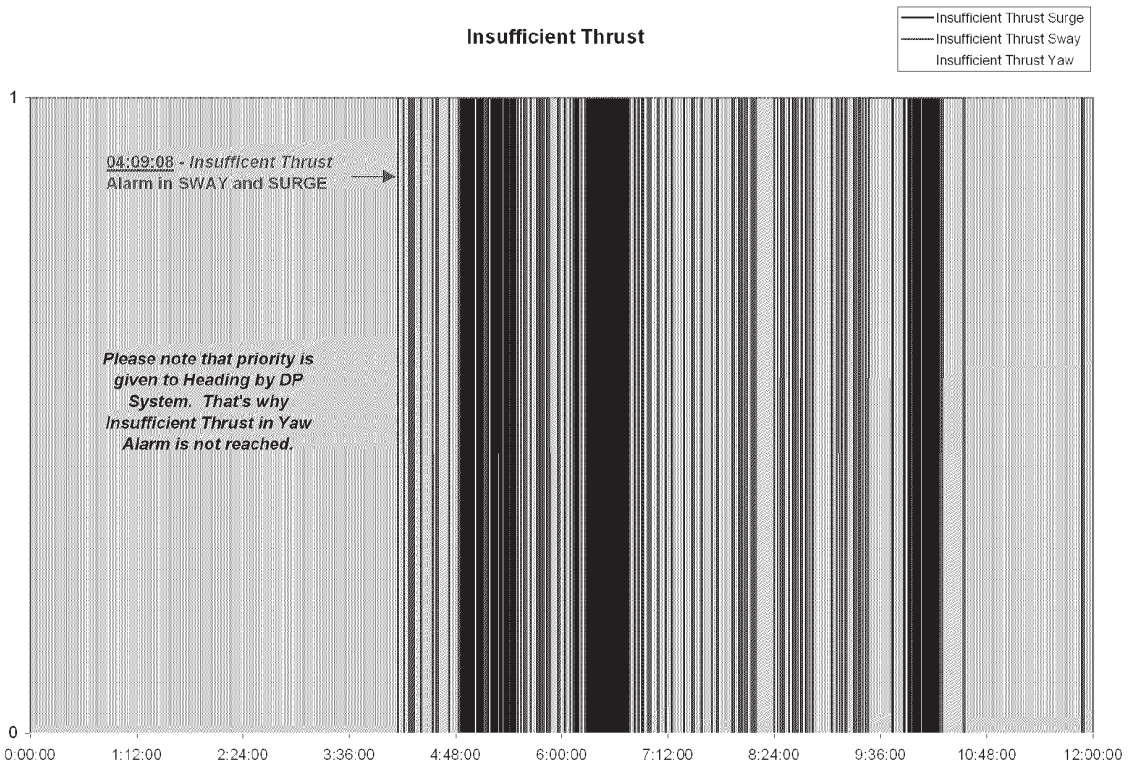
[1] For more information on Consumer Load Control / Limitation please refer to ***Kongsberg Simrad Functional Design Specification (FDS)*** for the Deepwater Horizon, rev C.

What caused the power limit to be reached? The strong environment acting on the vessel, mainly current which hit the vessel on the beam. This can be verified when looking at the forces acting on the vessel (increase in sway force acting on the vessel).



As a result of the power limit being reached Insufficient Thrust Alarms in Surge and Sway are triggered.

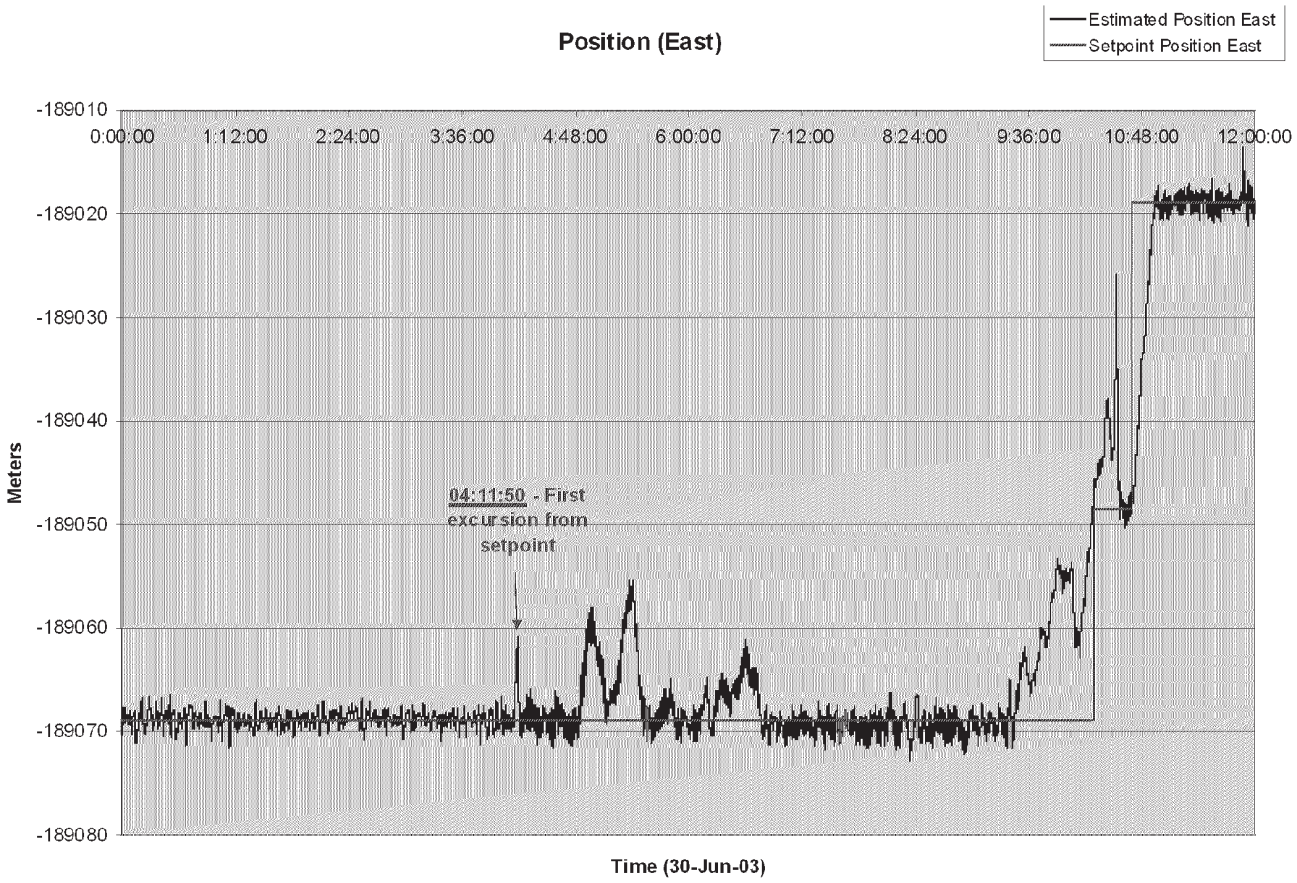
- **04:09:08** - ***Insufficient Thrust* Alarms in Surge and Sway**

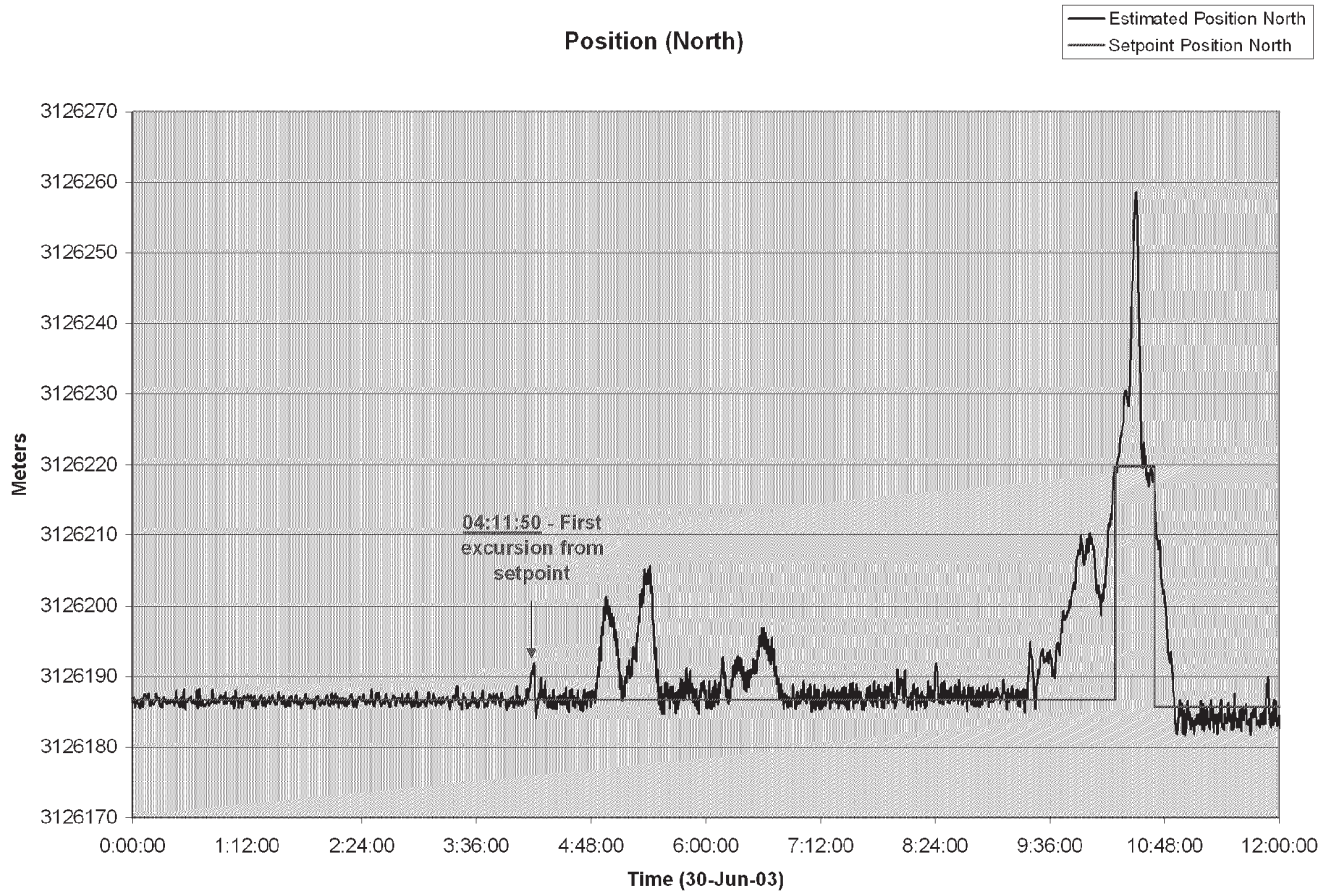


These alarms are triggered when the obtained thrust is different from the demanded thrust (beyond limits set in the system). That means that full station keeping is not guaranteed. Please note that the DP System gives priority to heading. That's why *Insufficient Thrust in Yaw* alarm is never reached during the incident. Whatever power was available to the thruster, the DP system always tries to satisfy yaw before thinking about surge and sway.

- **04:11:50 – 9m excursion from setpoint**

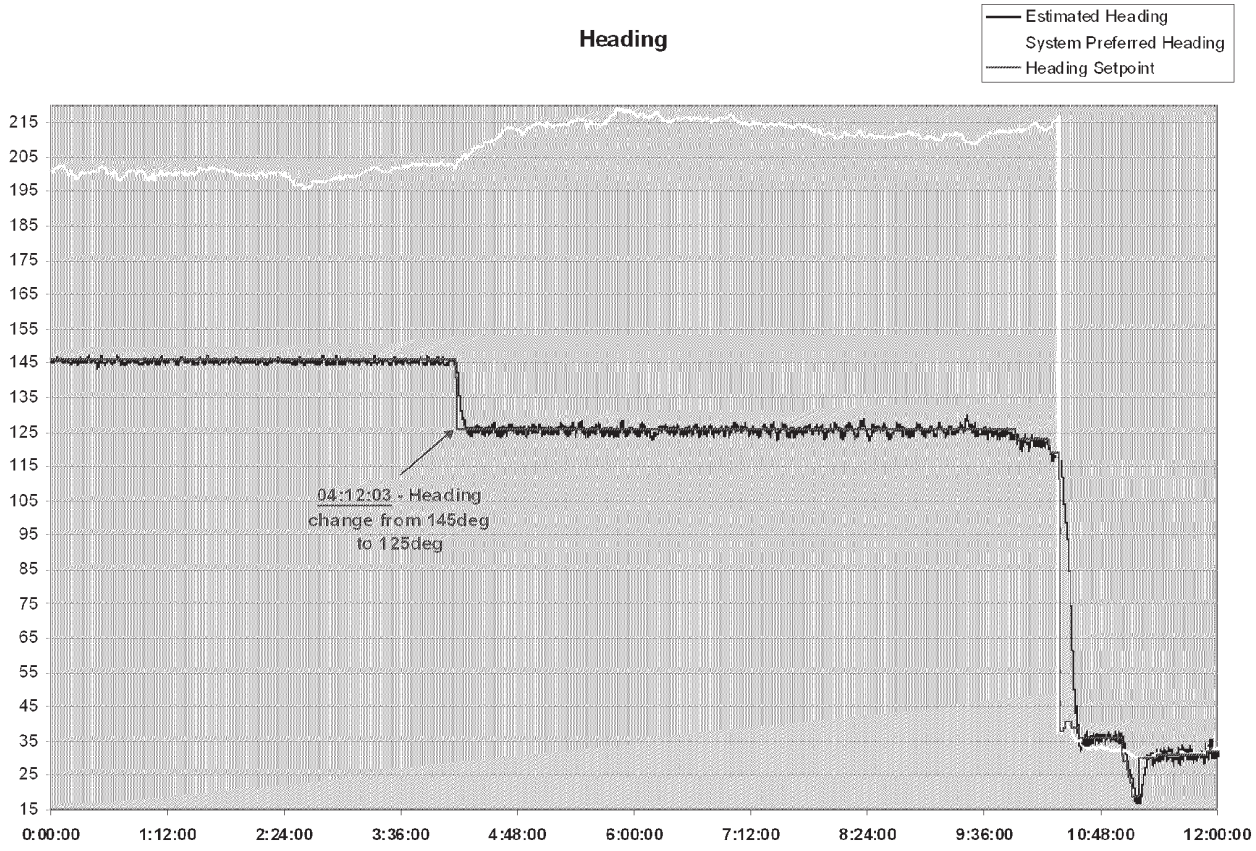
  This is a direct consequence from the insufficient thrust in surge and sway. This is indicated on the graphs below: both estimated positions in East and North differ from the setpoint at 04:11:50. This excursion is the first of several excursions within the boundaries of the watch circle, but prior to the DP incident.



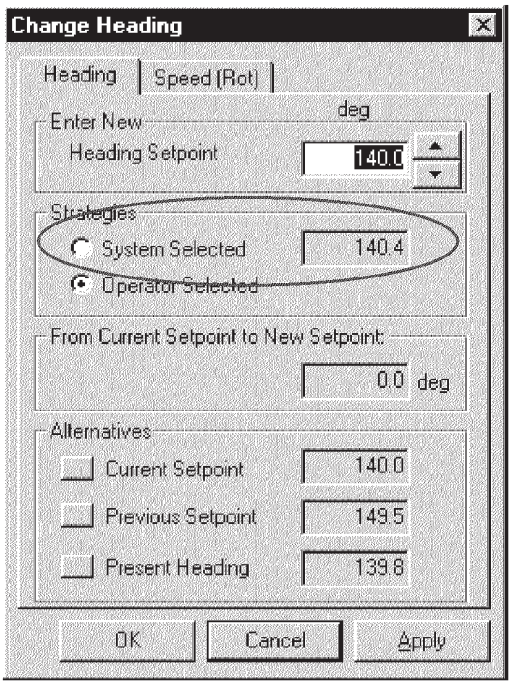


- **04:12:03 – Heading change from 145° to 125°**

  This heading change was initiated by the crew following the 9m excursion.

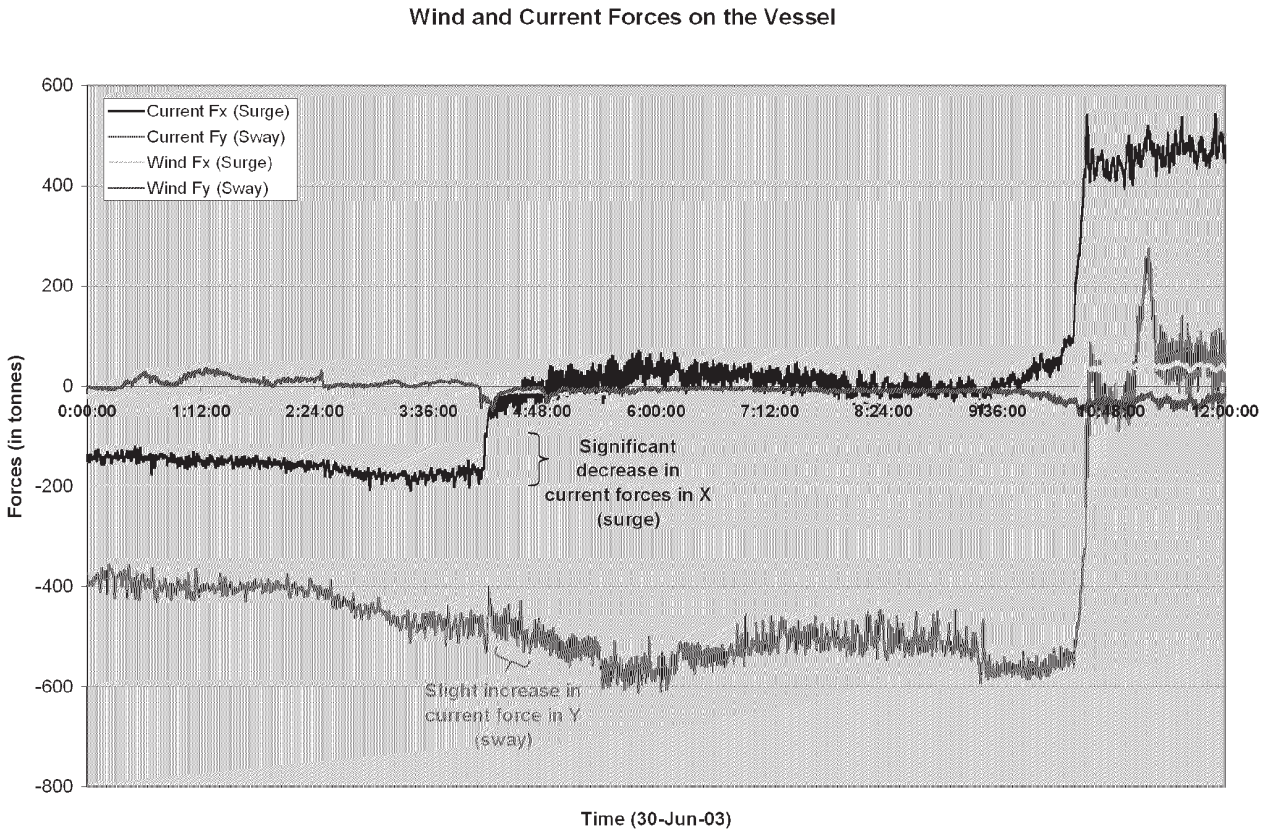


Please note on this graph that the System Preferred Heading (referred to as ***System Selected Heading*** by the SDP system) is different from the heading setpoint. This System Preferred Heading is calculated by the DP system and corresponds to the heading that requires the minimum power to maintain position in the current environmental conditions. It does change with prevailing environmental forces acting on the vessel and is constantly updated by the DP system. Please note that this System Selected Heading is available in a pull down menu, under Change Heading (as indicated below). It is not directly apparent on the DP screen.



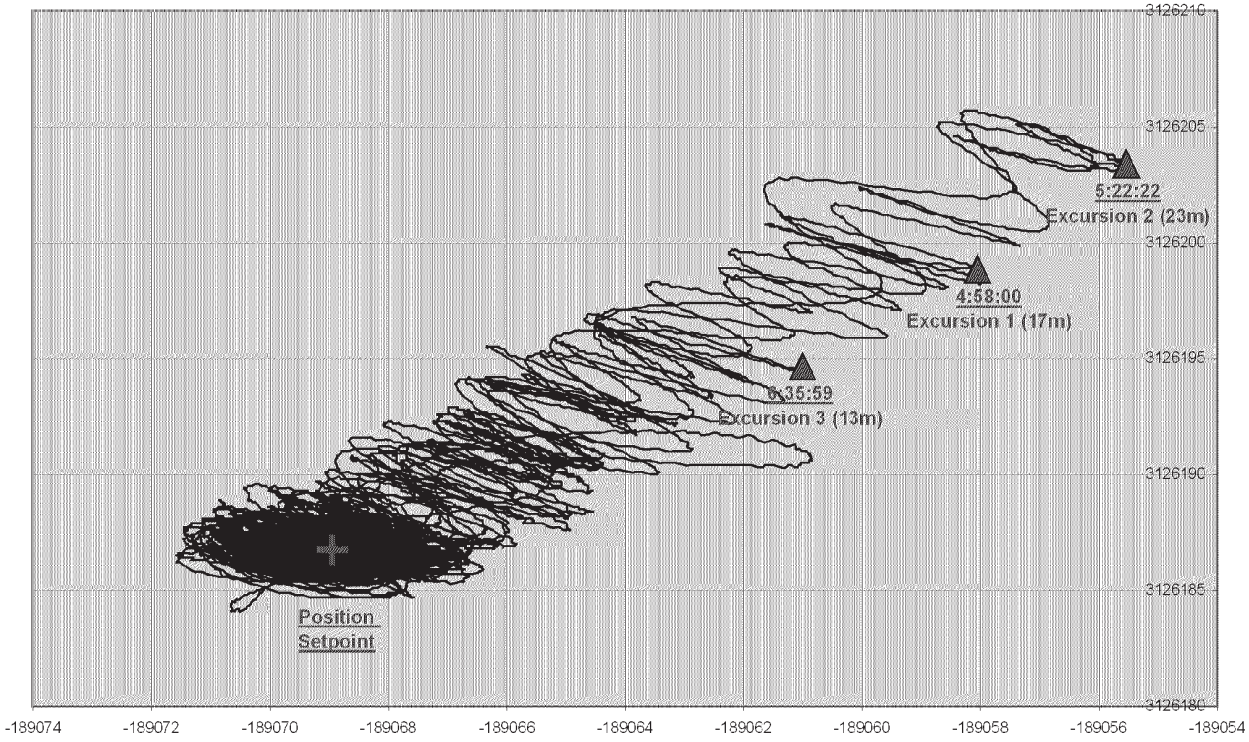
Indication of system preferred heading under Change Heading pull down menu

Looking at the forces acting on the vessel before and after the heading change, the consequence of the heading change was a significant decrease of "calculated current" forces in Surge and a slight increase of the "calculated current" forces in Sway. This is indicated on the graph below.



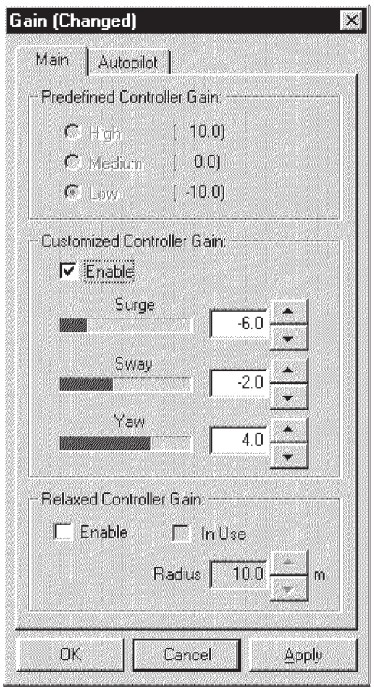
- **04:58:00 – 17m excursion from setpoint. Rig came back on setpoint.**
  05:22:22 – 23m excursion from setpoint. Rig came back on setpoint.
  06:35:59 – 13m excursion from setpoint. Rig came back on setpoint.

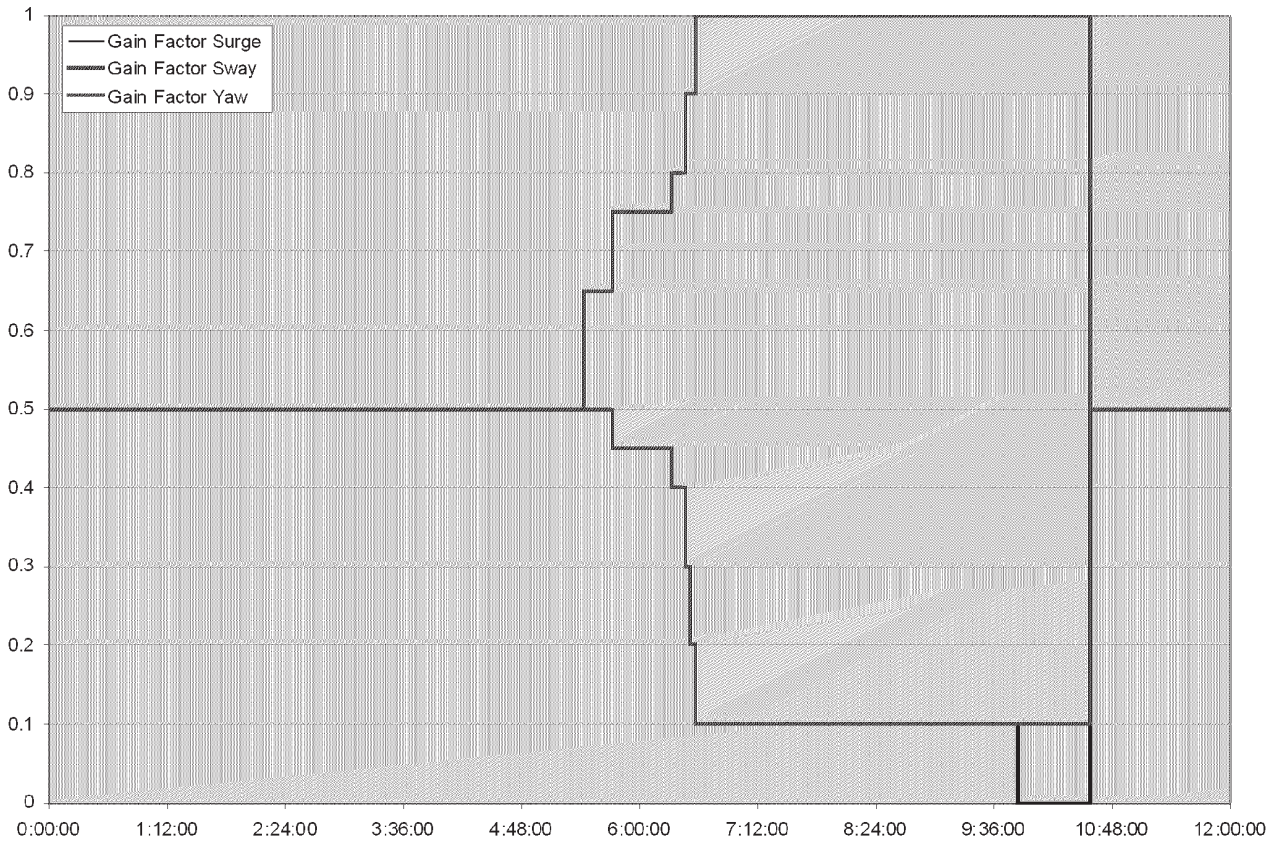
Snail Trail



- **05:28:00 – Started changing gains settings, increasing gain in SWAY and reducing gains in SURGE and YAW.**

  The SDP software release (3.0.7) installed on board the Deepwater horizon allows the operator to customize gain settings in each individual axis. The deviations in position and heading are multiplied by the selected gain factors to obtain the required force demand. High gain provides the quickest vessel response.



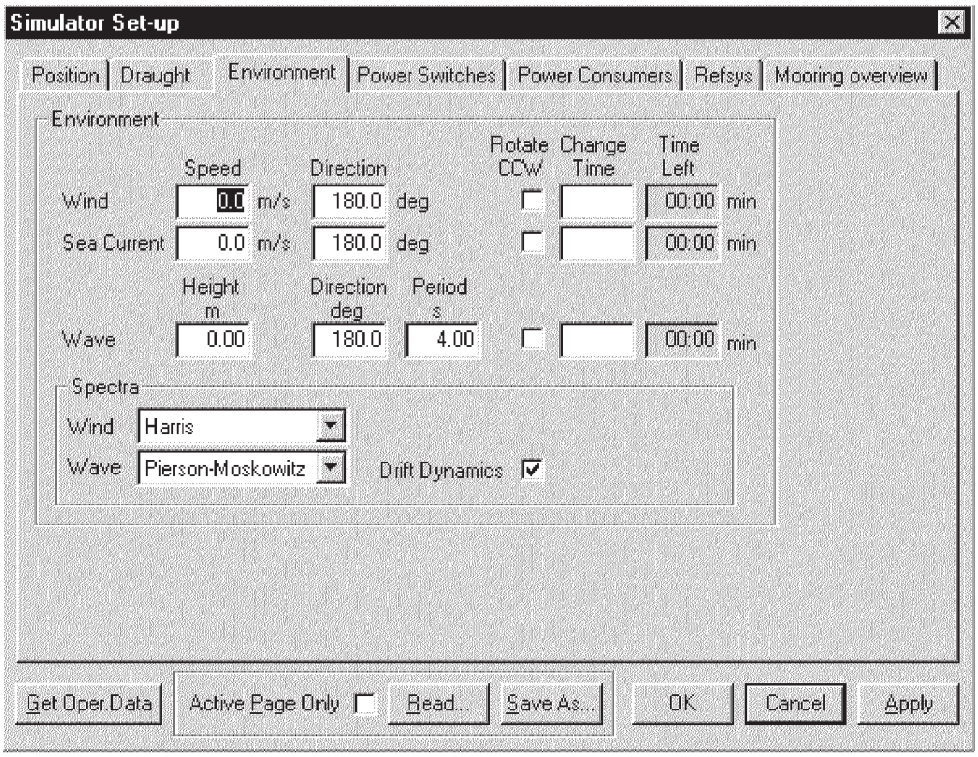


- **Around 06:00:00 – Crew ran simulation to determine if heading change could be made to the System Preferred Heading (215° - rig into current). The simulation indicated an excursion exceeding red limit (36m). Decision was made not to attempt the heading change.**

  The Simulator used on board the Horizon is an **offline simulator** provided by Kongsberg Simrad. All environmental data have to be entered manually. That includes:

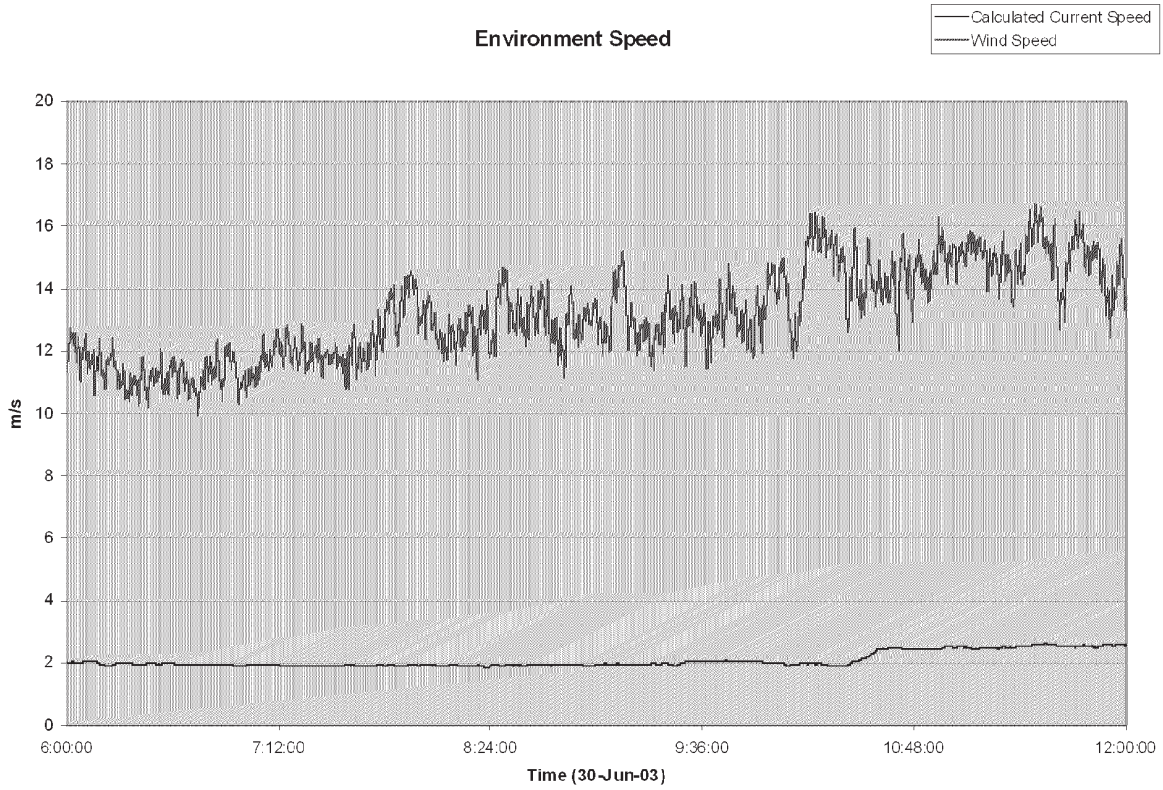
  - wind
  - wave
  - current (real current)
  - External Load (everything but thruster)

  The rate of turn used in the simulation was 5°/min.

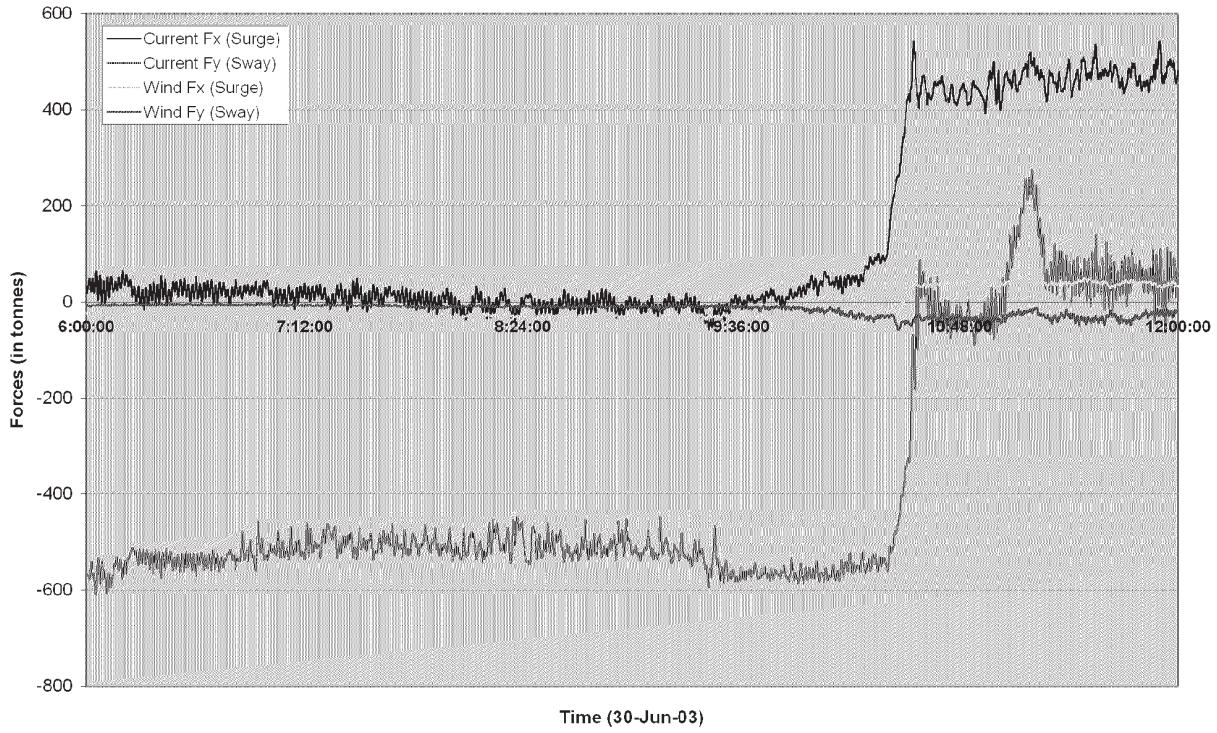


Please note that the Simulator version onboard allows entry of speed in knots. Environment data was entered correctly by the crew when they ran the simulation around 06:00 am on the day of the incident.

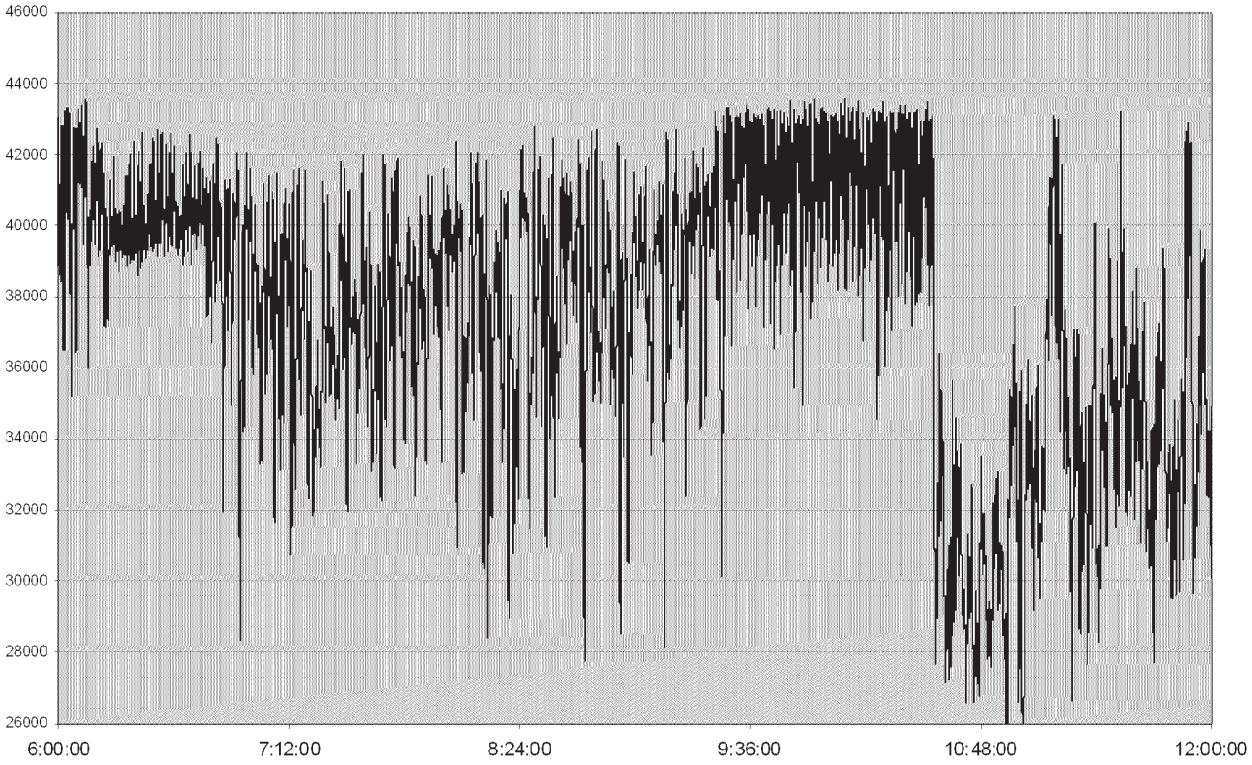
- **From 06:00:00 onwards – environment slowly picking up. As a result the forces acting on the vessel increased. Power limit (42MW) reached on numerous occasions.**



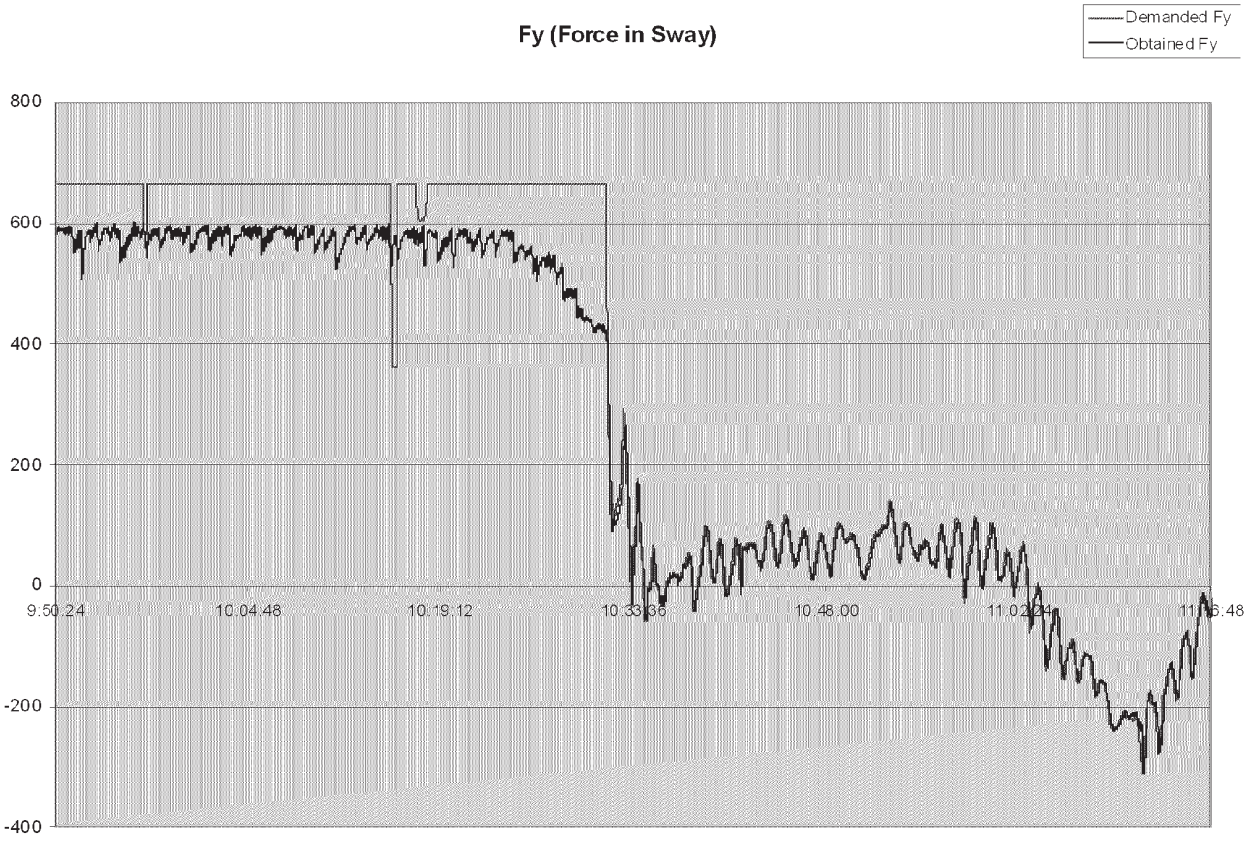
Wind and Current Forces on the Vessel



Bus Load

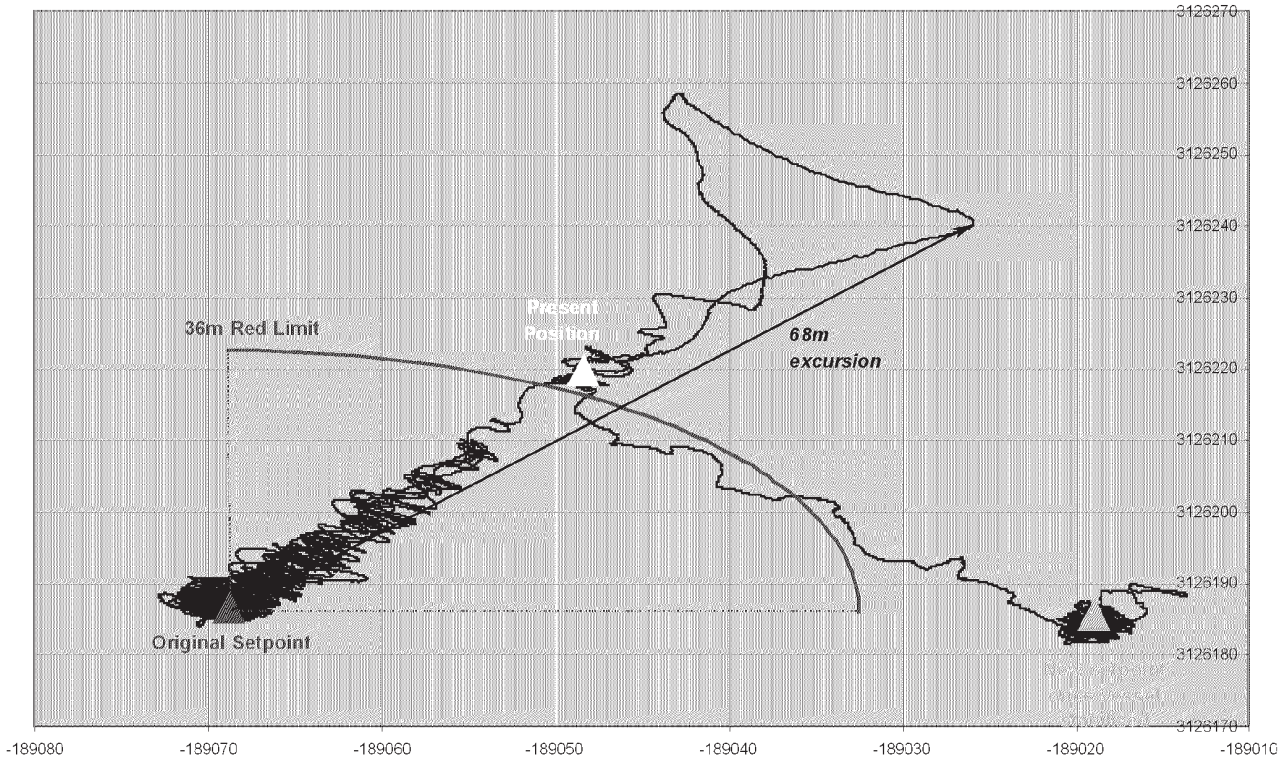


- **As a result the obtained forces (especially in SWAY) do not meet the demanded forces.**



- **As a result the rig drifts off location At 10:16:00, Emergency Disconnect (EDS#1) was initiated**

Snail Trail



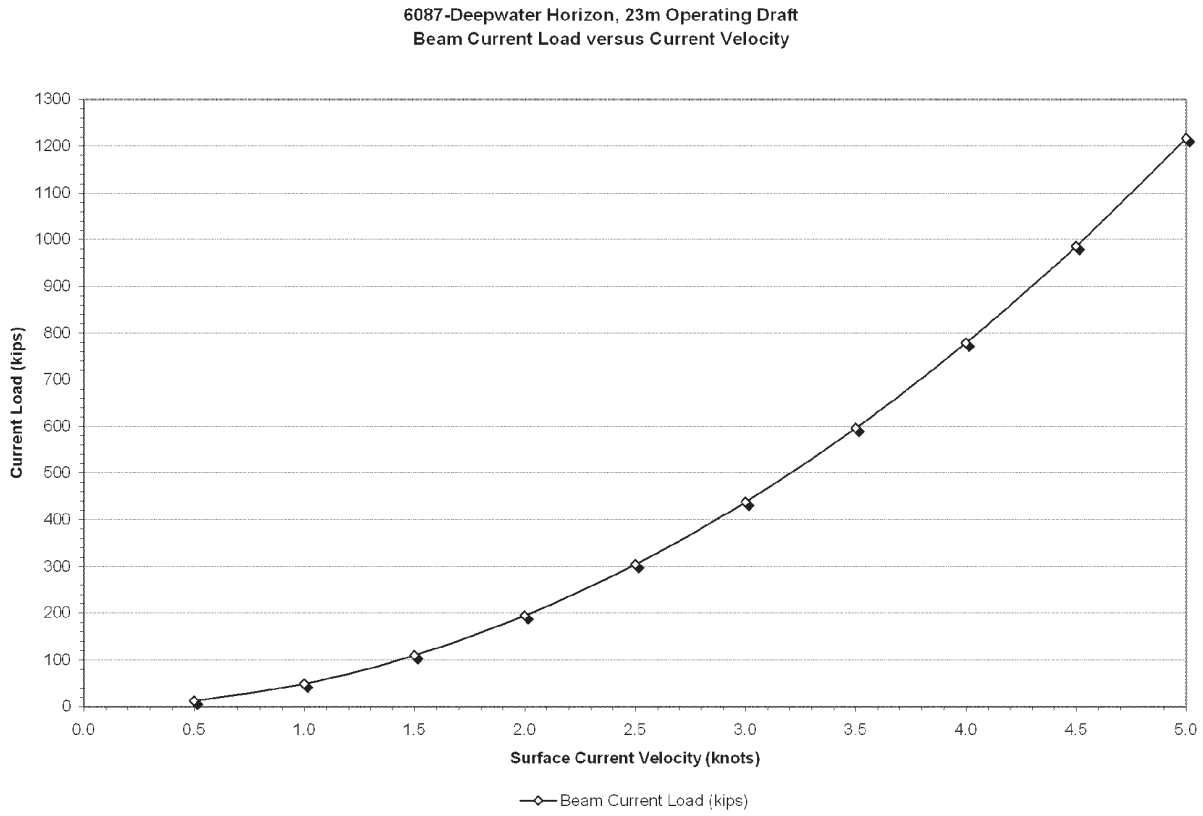
At the time of the disconnect the Kongsberg Simrad Calculated Current was 3.8 kts, coming from 218°. Wind speed was 30.7 kts coming from 145°.

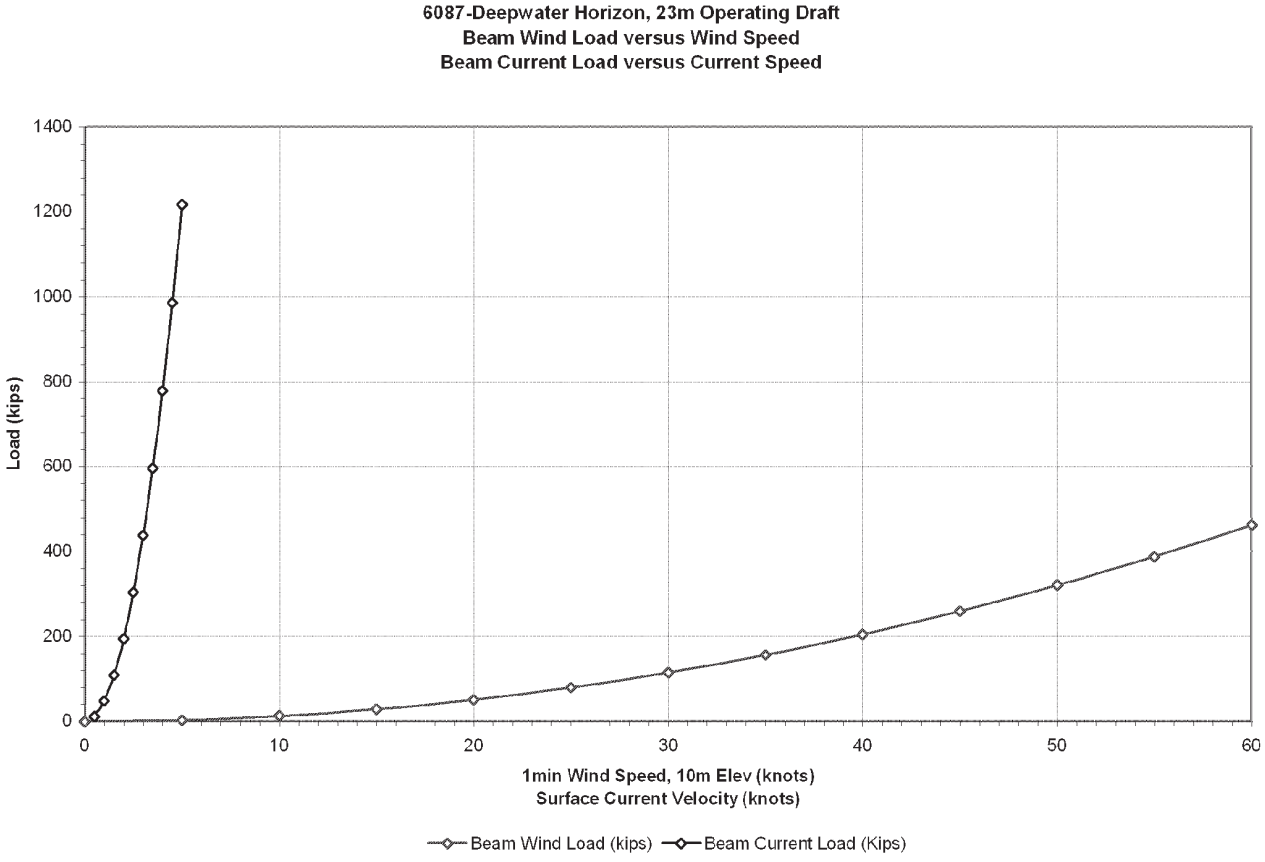
3. Conclusion

3.1. Root Cause: incorrect heading

The Deepwater Horizon was roughly beam into the current (Vessel heading 100° relative to current). The chosen heading was different from the System Selected Heading (preferred heading minimizing the forces acting on the vessel). Model calculations show that the load would have been reduced by roughly 192 kips heading into the current. As a result of this incorrect heading the forces of the vessel reached a point when the power plant capabilities were exceeded and the obtained forces to counteract the environment did not meet the demanded forces calculated by the DP system to maintain position.

The following graphs illustrate the Beam Current Load versus surface current speed. The second graph shows both the Beam Current Load and the Beam Wind Load (1 min wind speed 10m elevation). This second graph was just included to illustrate the effect of current compared to wind on the Rig.





3.2. Contributing Factors

3.2.1. Improper calculation of Hotel Load by Kongsberg Simrad SVC system

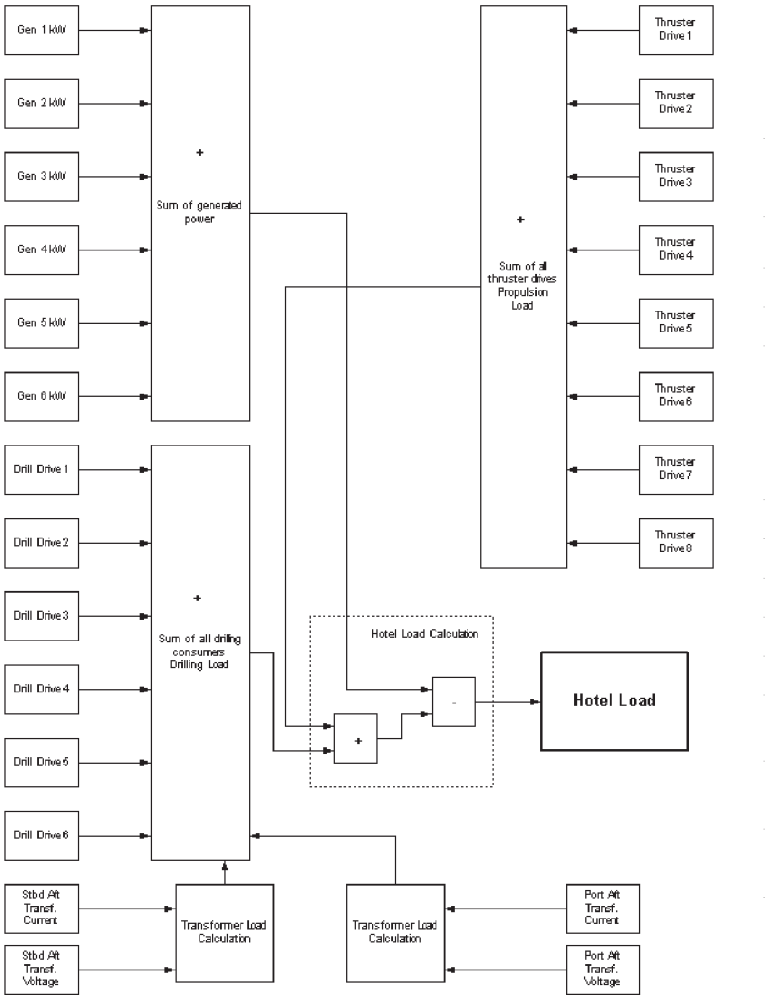
The Hotel load displayed on SVC screen was 6MW around the time of the incident. As a result the crew input 6MW constant hotel load in the simulator, thus reducing the power available for thrusters (drilling was already reduced). In post-event analysis a more correct value for Power for the simulation would have been 4MW. But the mis-calculation of the Hotel Load by SVC led the operator to believe that the hotel load was higher than it really was. And the result of the simulation (drift off of approximately 60m) led to the decision not to attempt the heading change around 06:00 am on the day of the incident.

Kongsberg Simrad investigation showed an error in the calculations for the Port Aft and Stbd Aft transformers. Both transformers loads are given by:

$$KW = \sqrt{3} * Current(A) * Voltage(kV) * PowerFactor$$

In the existing software the result of the calculation is 0 because one of the inputs is blank (returning a value of 0). As identified in the schematic below, the result of this error will be reflected in the Drilling Load displayed on SVC which will be lower than the "real" load. As a result the Hotel Load displayed on SVC will be higher than the "real" Hotel Load (Hotel Load = Total – Drilling – Propulsion). This results in an overall error of 2 to 3 MW.

Please note that investigation is ongoing on the SVC system at this point in time. The mis-calculated hotel load is what has been found so far.



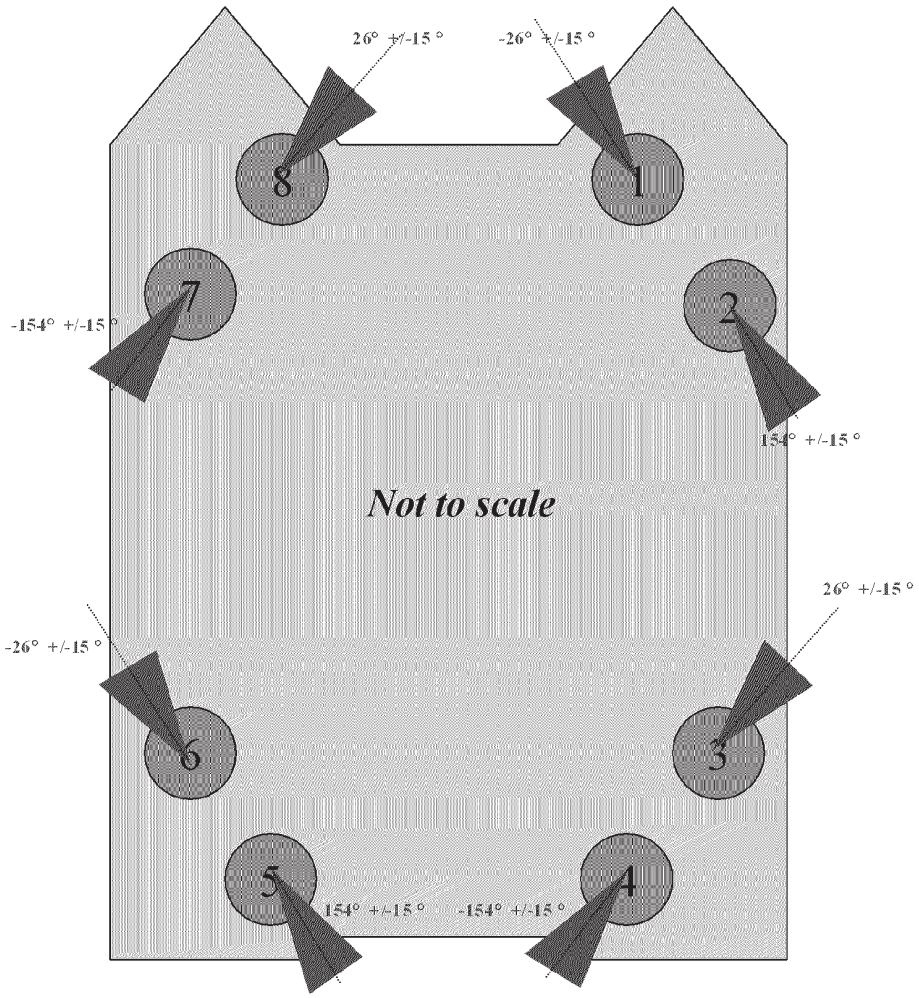
Hotel Load Calculation by Kongsberg Simrad (drawing produced by Jan Simonsen, Kongsberg Simrad)

Appendix A - Extra items for clarification

✓ **Blind sectors or forbidden zones implemented for the thrusters**

Each thruster on the Deepwater Horizon is fitted with one Azimuth Forbidden Zone designed to protect the closest thruster. Theses forbidden zones are only active in the software if that other thruster is in use. **Please note that these forbidden zones are the only ones active in the software**. For example, if Thruster 2 is in use, then the Azimuth Forbidden Zone for Thruster 1 will be active, and vice-versa. The Azimuth Forbidden Zones are indicated on the simplified schematic below.

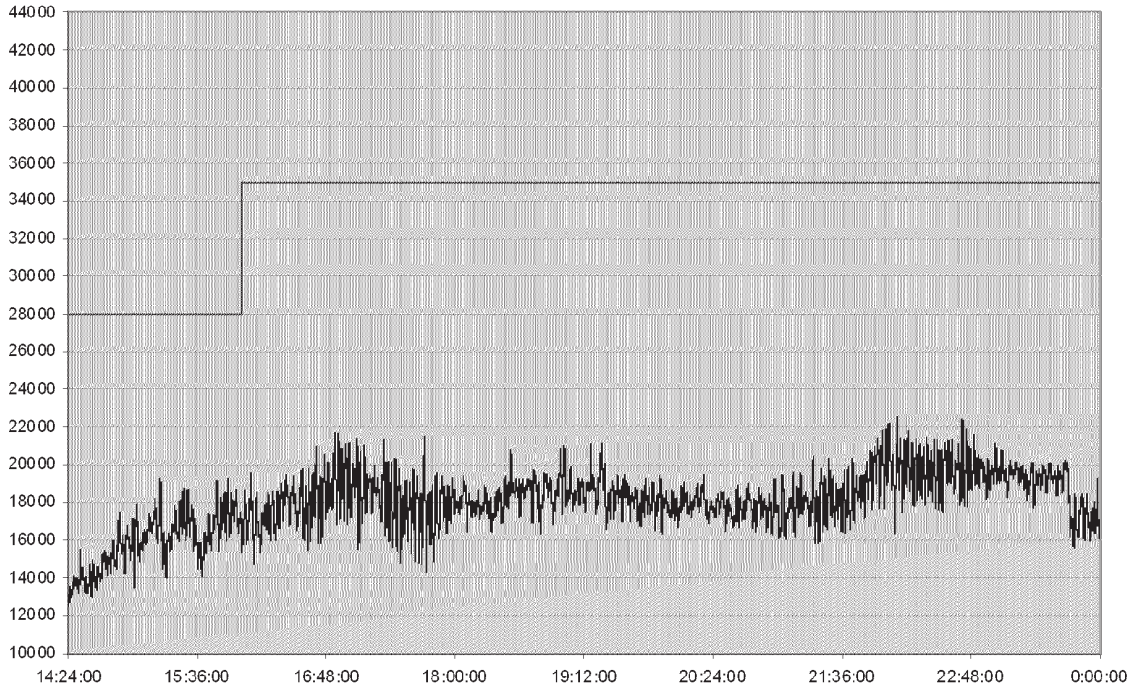
Thrusters interaction between Thrusters 2 & 3 and Thrusters 6 & 7 is considered negligible in view of their 38.7m (127') separation.



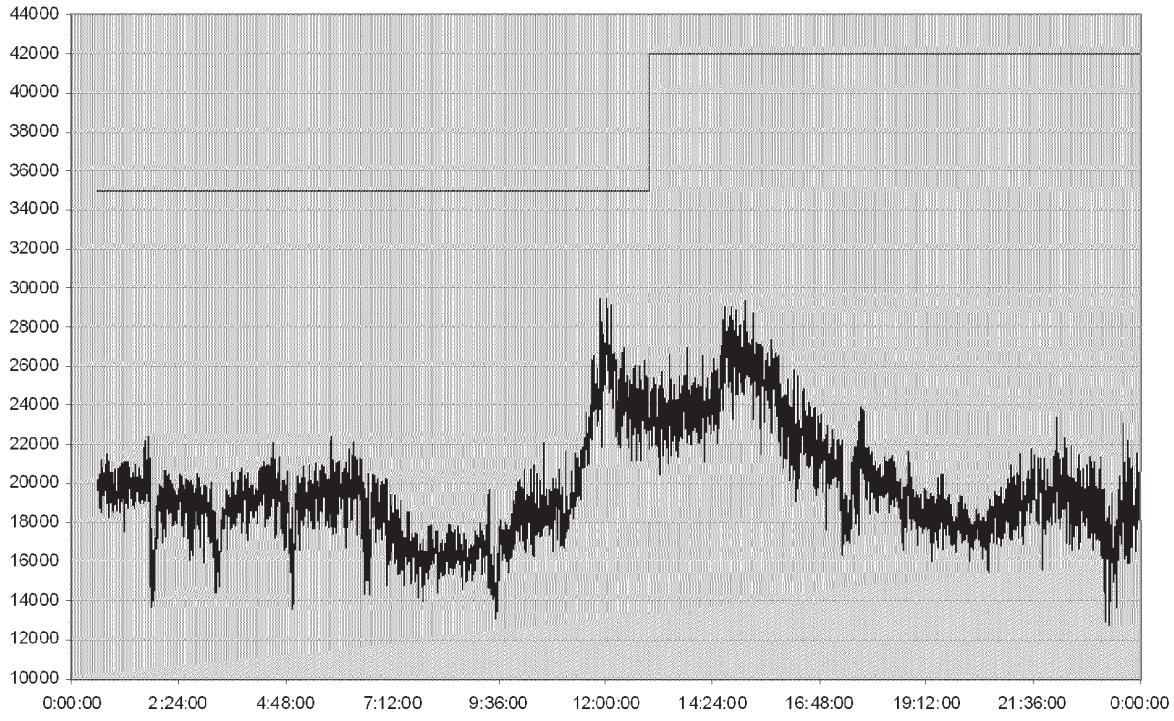
✓ **Power usage on the days prior to the event**

The following data is taken from the DP Logger and illustrate the total load on the bus compared to the bus capacity from Thursday 26-June to Sunday 29-June.

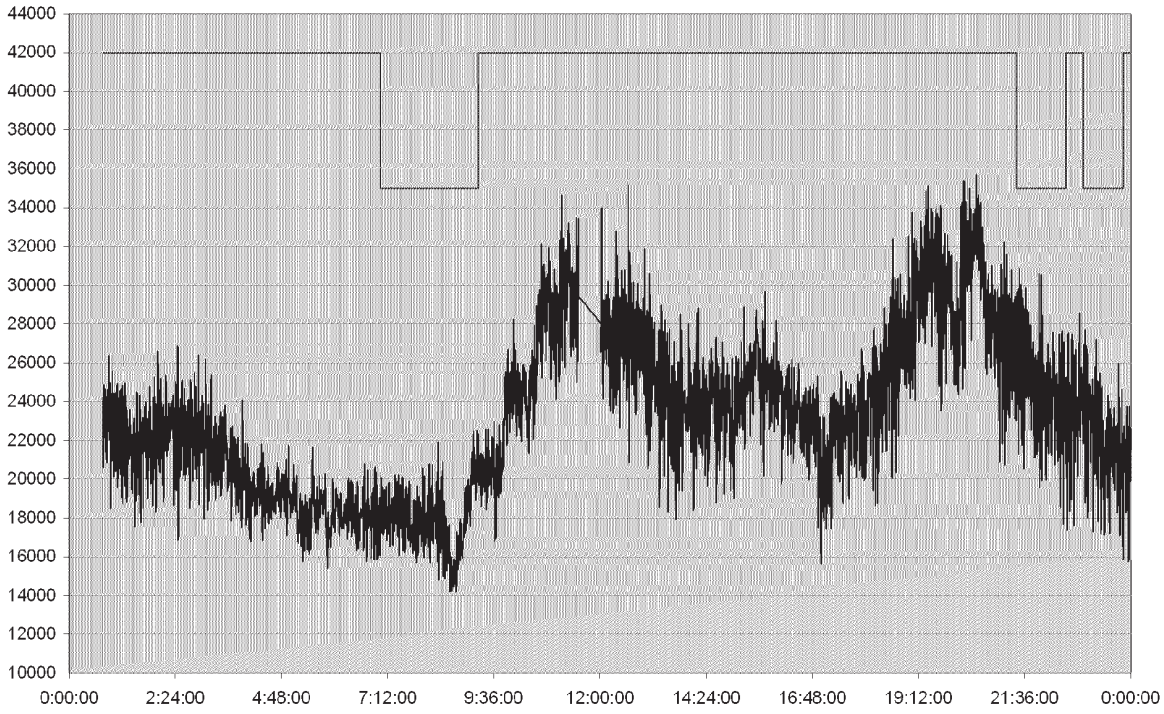
Bus Load and Bus Capacity - 26 June 2003



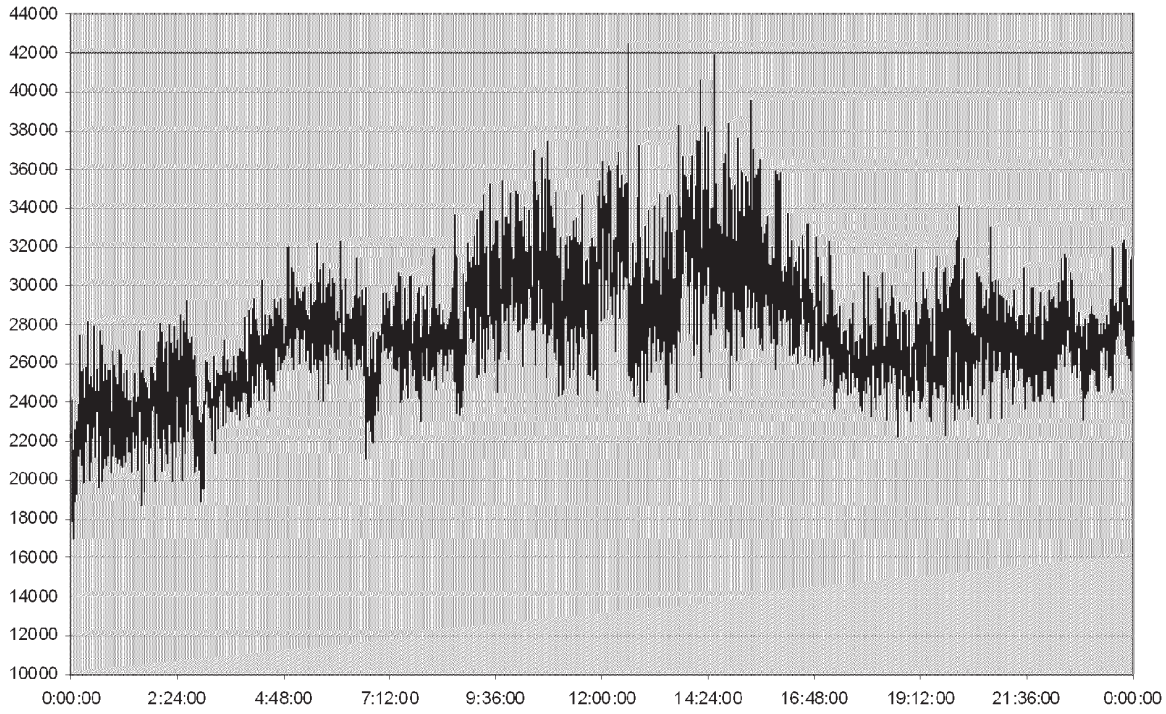
Bus Load and Bus Capacity - 27 June 2003



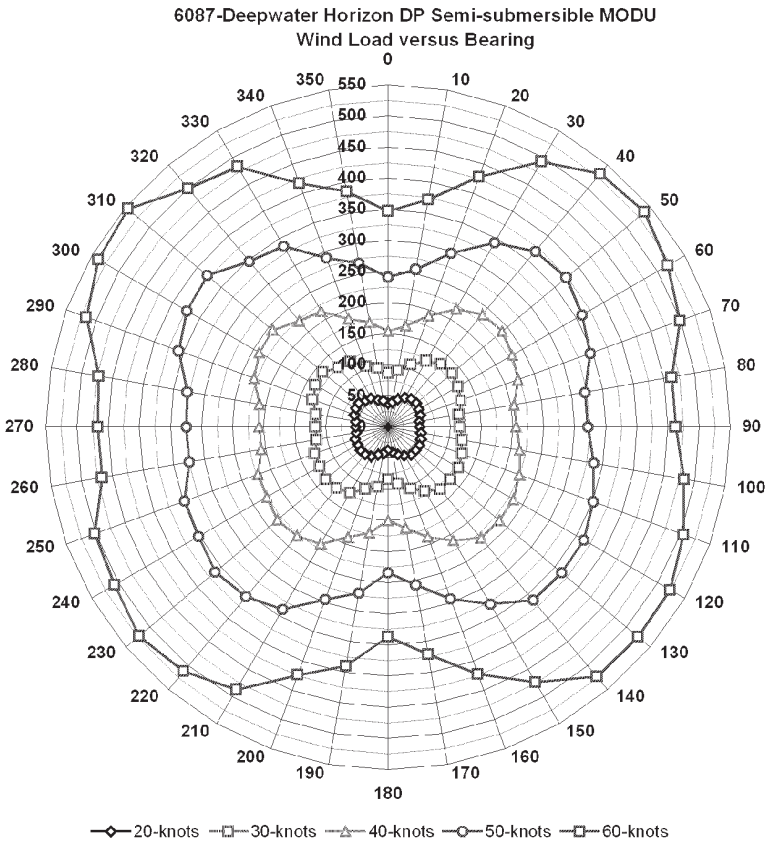
Bus Load and Bus Capacity - 28 June 2003

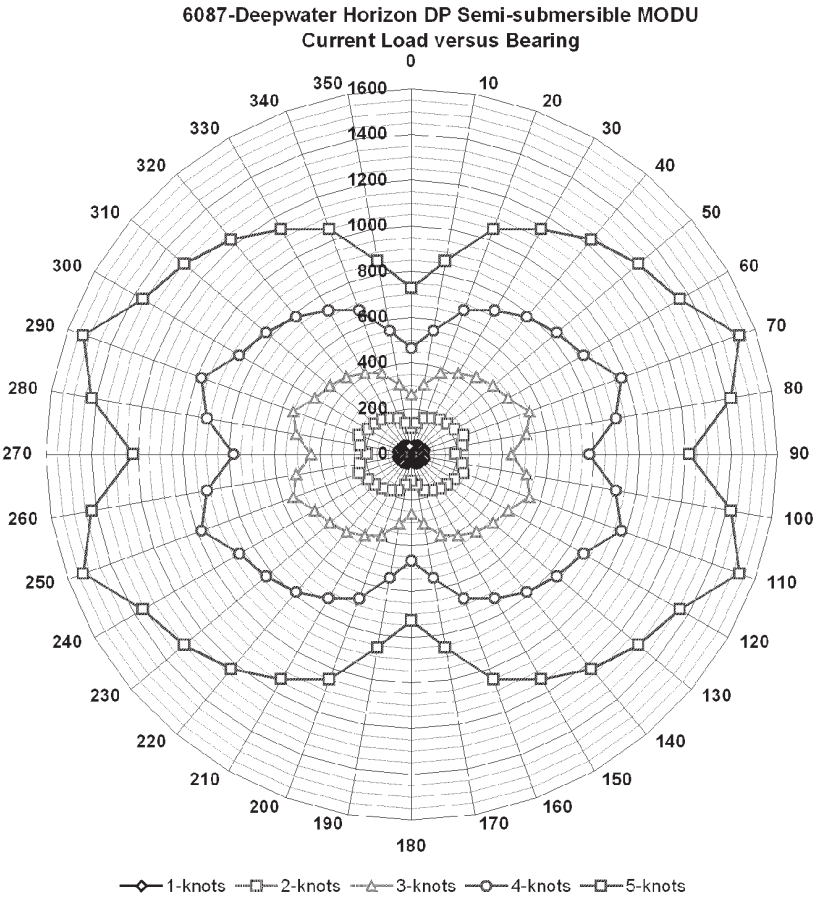


Bus Load and Bus Capacity - 29 June 2003



✓ **Wind and Current Load versus Bearing on Deepwater Horizon**





✓ **Results of various simulations**

First of all the drift off scenario experienced by the vessel was re-created on our simulator with the same environment as experienced by the vessel at the time of the incident. Drift off of the vessel (with heading 125°) is confirmed by simulation. Power Limit (42MW) reached in these conditions with the rig beam to the current.

Case 0 - DP Incident

Simulation Configuration	
Wind (Harris Spectra)	
Wind Speed	16 m/s (29kts)
Wind Direction (coming from)	140-150
Sea Current	
Sea Current Speed	2.0 m/s (3.8kts)
Sea Current Direction (coming from)	215-220
Wave (Pierson-Moskovitz spectra)	
Wave Height	6 m
Wave Period	4 s
Wave Direction (coming from)	125
Power	
External Load	4 MW
Number of Engines online (max = 6)	6
Thursters	
Number of Thrusters used (max = 8)	8
Heading	
Rig Heading	125
DP Controller Gain	
Gain (Surge, Sway and Yaw)	High (in Sway), Low in Surge and Yaw

Results	
Holding position and heading	NO
Total Power used (max = 42MW)	42 MW
Thruster 1 % used	75%
Thruster 2 % used	75%
Thruster 3 % used	75%
Thruster 4 % used	75%
Thruster 5 % used	75%
Thruster 6 % used	75%
Thruster 7 % used	75%
Thruster 8 % used	75%

The simulations presented below have all been run with rig pointing head into the current and with the external environment collinear. All cases were run with 4MW of external load (external load being defined as everything but thrusters).

In the first three simulations the wind speed is gradually increased from 35kts (case 1) to 50.5kts (case 3). Current is set at 4.5kts. The important parameter to check during these simulations is the Total Power used. The closer this total power used is from the Maximum limit (42MW) the smaller the margin for DP capability. In the first case for example, there is plenty of power left (7MW). The last case shows only 1MW of power left.

The fourth and last case corresponds to the design criteria for the rig, with one engine down and one thruster down.

Case 1 - 35kts wind with 4.5kts current

Simulation Configuration	
Wind (Harris Spectra)	
Wind Speed	18 m/s (35kts)
Wind Direction (coming from)	140
Sea Current	
Sea Current Speed	2.3 m/s (4.5kts)
Sea Current Direction (coming from)	140
Wave (Pierson-Moskovitz spectra)	
Wave Height	6 m
Wave Period	11 s
Wave Direction (coming from)	140
Power	
External Load	4 MW
Number of Engines online (max = 6)	6
Thursters	
Number of Thrusters used (max = 8)	8
Heading	
Rig Heading	140
DP Controller Gain	
Gain (Surge, Sway and Yaw)	High

Results	
Holding position and heading	YES
Total Power used (max = 42MW)	35 MW *
Thruster 1 % used	70%
Thruster 2 % used	70%
Thruster 3 % used	60%
Thruster 4 % used	60%
Thruster 5 % used	60%
Thruster 6 % used	60%
Thruster 7 % used	70%
Thruster 8 % used	70%

** fluctuates around 35MW, but goes up to 42 MW temporarily*

Case 2 - 41kts wind with 4.5kts current

Simulation Configuration	
Wind (Harris Spectra)	
Wind Speed	21 m/s (41kts)
Wind Direction (coming from)	140
Sea Current	
Sea Current Speed	2.3 m/s (4.5kts)
Sea Current Direction (coming from)	140
Wave (Pierson-Moskovitz spectra)	
Wave Height	6 m
Wave Period	11 s
Wave Direction (coming from)	140
Power	
External Load	4 MW
Number of Engines online (max = 6)	6
Thursters	
Number of Thrusters used (max = 8)	8
Heading	
Rig Heading	140
DP Controller Gain	
Gain (Surge, Sway and Yaw)	High

Results	
Holding position and heading	YES
Total Power used (max = 42MW)	37 MW
Thruster 1 % used	75%
Thruster 2 % used	75%
Thruster 3 % used	60%
Thruster 4 % used	60%
Thruster 5 % used	60%
Thruster 6 % used	60%
Thruster 7 % used	75%
Thruster 8 % used	75%

** fluctuates around 37MW, but goes up to 42 MW temporarily*

Case 3 - 50.5kts wind with 4.5kts current

Simulation Configuration	
Wind (Harris Spectra)	
Wind Speed	26 m/s (50.5kts)
Wind Direction (coming from)	140
Sea Current	
Sea Current Speed	2.3 m/s (4.5kts)
Sea Current Direction (coming from)	140
Wave (Pierson-Moskovitz spectra)	
Wave Height	6 m
Wave Period	11 s
Wave Direction (coming from)	140
Power	
External Load	4 MW
Number of Engines online (max = 6)	6
Thursters	
Number of Thrusters used (max = 8)	8
Heading	
Rig Heading	140
DP Controller Gain	
Gain (Surge, Sway and Yaw)	High

Results	
Holding position and heading	YES
Total Power used (max = 42MW)	41 MW
Thruster 1 % used	80%
Thruster 2 % used	80%
Thruster 3 % used	65%
Thruster 4 % used	65%
Thruster 5 % used	65%
Thruster 6 % used	65%
Thruster 7 % used	80%
Thruster 8 % used	80%

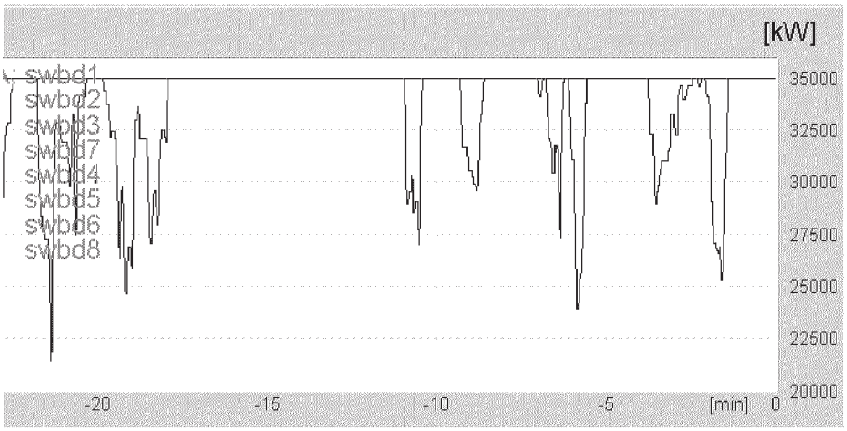
** fluctuates around 41MW, but goes up to 42 MW temporarily*

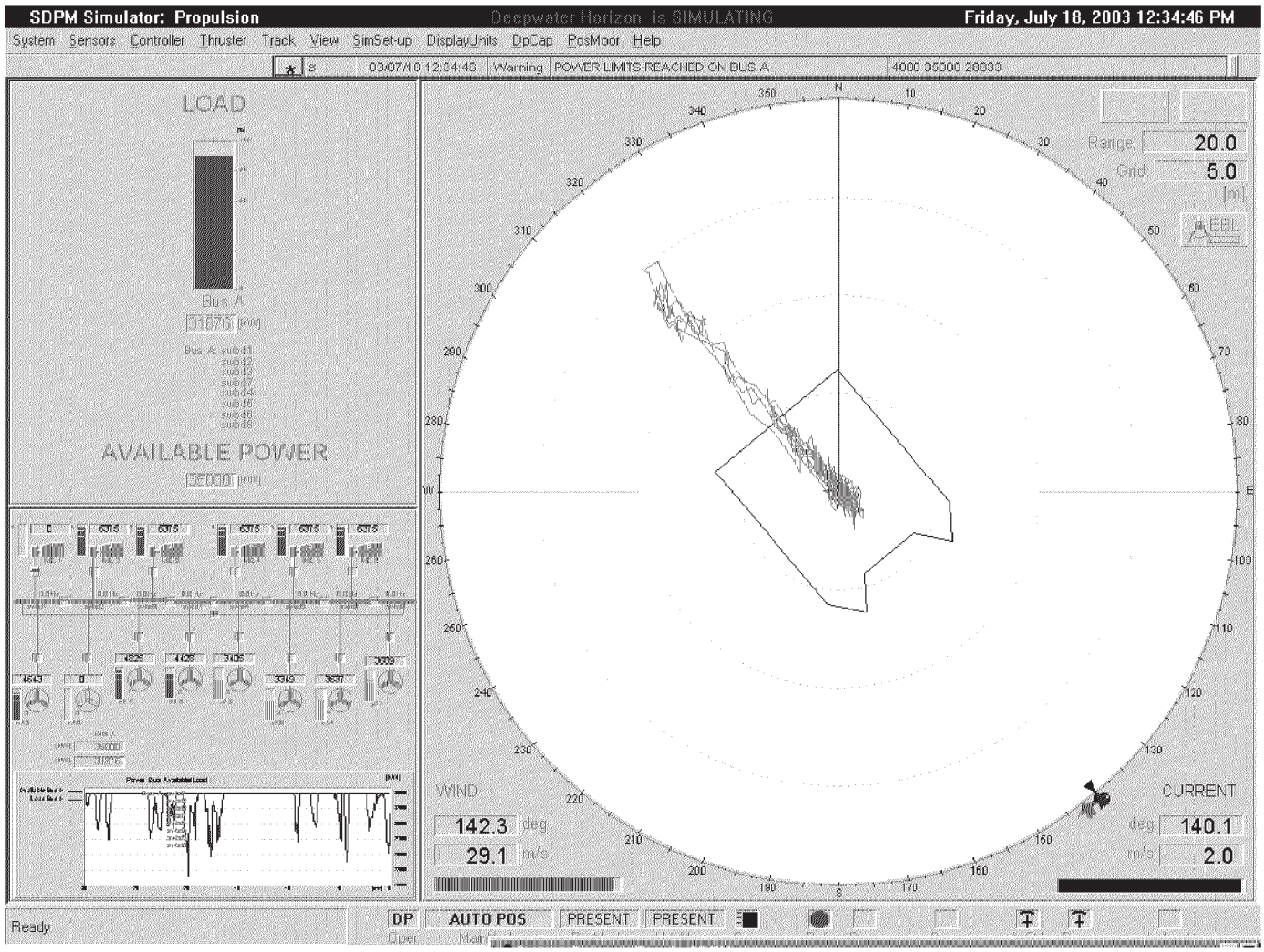
Case 4 - Design Capability

Simulation Configuration	
Wind (Harris Spectra)	
Wind Speed	30.9 m/s (60kts)
Wind Direction (coming from)	140
Sea Current	
Sea Current Speed	1.8 m/s (3.5kts)
Sea Current Direction (coming from)	140
Wave (Pierson-Moskovitz spectra)	
Wave Height	7.9 m
Wave Period	11 s
Wave Direction (coming from)	140
Power	
External Load	4 MW
Number of Engines online (max = 6)	5
Thursters	
Number of Thrusters used (max = 8)	7 (T6 out)
Heading	
Rig Heading	140
DP Controller Gain	
Gain (Surge, Sway and Yaw)	High

Results	
Holding position and heading	Within 15m
Total Power used (max = 35MW)	25-35 MW *
Thruster 1 % used	85%
Thruster 2 % used	85%
Thruster 3 % used	70%
Thruster 4 % used	70%
Thruster 5 % used	70%
Thruster 6 % used	-
Thruster 7 % used	85%
Thruster 8 % used	85%

** See graph below*





Case 4 – 30min trace

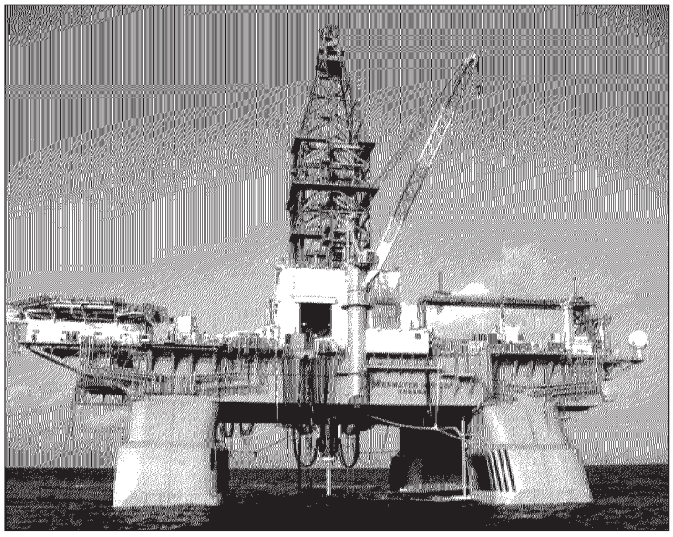
Appendix D Transocean Riser and Watch Circle Assessment

(Following pages)

Transocean

Transocean Offshore Deepwater Drilling, Inc.
Engineering & Construction Department
Marine and Structual Engineering

Deepwater Horizon
Dynamically Positioned Semisubmersible



Riser & Watch Circle Assessment
For Gulf of Mexico Operations
in
4361 ft of Water at MC 725 Tubular Bells

Prepared for
bp

Rig No.	Group	Subgroup	REA / Project		
6087	AA	422	6087-005-H004		
1	First Issue		07 Oct 2002	B. Ambrose	
0	Internal Review and Comment		04 Oct 2002	B. Ambrose	
Rev No.	**Description**		**Date**	**Author**	**Check By**

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1. EXECUTIVE SUMMARY

This report documents the riser and watch circle assessment for the Deepwater Horizon (DWH) dynamically positioned semisubmersible operating in 4361-ft water depth at the BP Tubular Bell well. The following sections of this report will outline:

- Riser spaceout
- API Tension versus Mud Weight
- Riser stroke out and flex joint angles
- Wellhead and casing bending loads
- DP capability, watch circle limit guidance, and reaction times

Parameters of the study include:

- Water depth: 4361-ft
- Operating Region: GOMEX
- Mud Weight: 16 ppg
- Environments: 10-yr Winter Storm, 10-yr Loop Current
- Well head: FMC w/ Vetco HDH4 profile, 5200 ft-kip rating at 67% yield
- Casing: 38" x 2.25" x60, 36" x 1.50" wall x56, 36" x 1.0" wall x56

Conclusions from the riser and drift off assessment work are as follows:

1) Maximum allowed mud weight for the well is greater than 20 ppg, significantly exceeding the required 16 ppg.

2) For normal operating conditions up to the 10-yr winter storm or 10-yr loop current events, the DWH will be able to maintain adequate riser angles for limited drilling operations. Rig position management up current can reduce lower flex joint angles, however, upper riser angle may begin to limit operations for surface offsets greater than 2% WD up-current.

3) Up to the point of riser stroke out (~9% WD) the well head (FMC), BOP, and riser angles are within normal maximum allowed connected limits during the 10-yr winter storm and 10-yr loop current.

4) Watch circle guidance is provided in Table 4.4 for two EDS sequences and three environmental conditions. Normal set point locations over or near well center should be adequate for 10-yr winter storm or loop current events to allow safe reaction and disconnect times. The drift off and watch circle program on board can be used with the point of disconnect (POD) limits provided in Section 4.4 to obtain watch circles appropriate for prevailing environments.

2. DESIGN PREMISE

2.1. Metocean Criteria

Metocean criteria from the Crazy Horse field data are summarized in Table 2.1 and Table 2.2. This report will document performance in the 10-yr winter storm and 10-yr loop current conditions.

Table 2.1 Crazy Horse Environmental Criteria

Storm	*10-yr Loop Current*	*10-yr Winter Storm*
Wind Speed, 1-min mean	33.4 kts	47.5 kts
Sea Hs	11.5 ft	18.0 ft
Sea Tp	9.5 sec	10.1 sec
Surface Current	3.30 kts	0.95 kts

Table 2.2 Current Profiles

Depth from Surface	*10-yr Loop Current*	*10-yr Winter Storm*
0 ft	3.30 kts	0.98 kts
100 ft		0.74 kts
196 ft		0.35 kts
295 ft		0.20 kts*
328 ft	3.10 kts	
656 ft	1.98 kts	
984 ft	0.93 kts	
1312 ft	0.70 kts	
1640 ft	0.43 kts	
1968 ft	0.20 kts	
4452 ft	0.20 kts	0.20 kts*

*Metocean data shows 0 knots below 295 ft, for conservatism analysis assumes 0.2 knots

2.2. Site & Well Program Information

Soil properties assumed are as follows:

Depth (ft)	Su (ksf)	E50	Sub Unit Wt. (pcf)
0	0.3	1.5%	40 pcf
100	1.6	1.5%	40 pcf

These values are provided as preliminary estimates. They are used to calculate p-y soil curves for 38-in and 36-in piles. In final analysis work, the p-y stiffness was increase by 20% to conservatively predict well head bending loads as this is the component of interest for this location. Softer soils will generate higher casing bending loads than estimated in this report.

Structural casing is assumed to be 38" OD x 2.25" wall x60 and 36" OD x 1.50 x56 below the mud line. The maximum allowed bending moment is reduced to 95% yield of the tube to account for the weaker threaded coupling connection and variances in soil properties. Internal casing strings are

included by increasing the stiffness of the region. A well head stick up of 15 ft is modeled. The FMC well head is assumed to have the following bending capacities at 4 ksi differential pressure:

5200 kip-ft @ 67% yield
6500 @ 83% yield
7800 @ 100% yield

These values are lower than the bending moment capacity of the SHD H4 connector with 27" mandrel inserts for the HD H4 profile.

2.3. Riser Analysis Criteria

Table 2.3 gives the riser analysis criteria and the calculation of required riser tension based on API RP-16Q.

Table 2.3 API RP-16Q Drilling Riser Maximum Design and Operating Guidelines

Design Parameter	Connected Drilling	Connected Not Drilling	Riser Disconnected
Mean Flex-joint Angle (upper & lower)	2.0°	NA	NA
Max Flex-joint Angle (upper & lower)	4.0°	90% Available(1)	90% Available
Stress Criteria(2)	$0.67\sigma_y$(3)	$0.67\sigma_y$	$0.67\sigma_y$
Significant Dynamic Stress Range			
@ SAF ≤ 1.5	10 ksi	NA	NA
@ SAF > 1.5	15 / SAF	NA	NA
Minimum Top Tension	T_{min}(4)	T_{min}	NA
Dynamic Tension Limit	DTL	DTL	NA
Max Tension Setting	90% DTL	90% DTL	NA

Note: 1) reduce further with drill pipe in hole 2) Method B for Deepwater Analyses 3) σ_y = yield strength of material 4) $T_{min} = T_{SRmin} \times N / [R_f (N-n)]$

3. METHOD OF ANALYSIS

3.1. Riser Dynamic Analysis for the Connected Mode

The riser dynamic response during the connected mode was computed in a time-domain analysis using the STARIS program developed by Starmark Offshore. The analysis procedure is as follows:

(1) Represent the riser by a finite element model with appropriate properties: mass, weight, buoyancy, added mass (C_m = 2.0), drag coefficients (C_D ~ 0.7-1.2), top tension, flex-joint stiffness, etc.

(2) Specify the metocean and motion parameters:

- Wave height, spectral mean period, and wave energy spectrum (ISSC).
- Vessel offset (mean plus low frequency).
- Vessel motion response amplitude operators (RAOs) and phase angles.

The specified vessel offset must reflect the actual DP system responses under the maximum operating and design conditions.

(3) Perform static and dynamic analyses to determine the riser maximum lateral displacements, bending moments, and maximum stresses.

It should be noted that the riser analysis program used here is adequate up to the point where the riser tensioners stroke out. Past this offset, the results are in error since the non-linear increase in tension associated with stroke out is not explicitly modeled.

4. ANALYSIS RESULTS

4.1. Riser Space-out and Tension Stability Calculation

A riser spaceout is provided in Table 4.2 and the associated tension versus mud weight curve in Table 4.3. Assumptions used to determine tension requirements are:

1) 1 tensioner down
2) Friction and fleet losses = 4%
3) Riser wet weight factor = 1.02, Buoyancy Reduction Factor = 0.98 (riser weights well known)
4) Max 70% DTL (3350 kips) so that the coupling rating of 3500 kips is not exceeded during stroke-out or heave fluctuations
5) Recoil lift-off overpull included

4.2. Riser Drilling Operability Performance & DP Stationkeeping Footprint

Riser operability performance was studied for a 16-ppg mud weight in various storm and current environments. A composite plot of flex joint angle (upper and lower) and stroke as a function of offset are provided in Figure 4.1 and Figure 4.2 for each environment. For drilling operations, Table 4.1 provides allowed excursions versus estimated DP station keeping performance. The results indicate extremely good riser operability for the typical 10-yr return winter storm and loop events.

Table 4.1 Riser Operating Offset Limits and Estimated DP Stationkeeping Footprints

Environment / Mud Weight / Tension	1-deg Mean Angle Limits	2-deg Mean Angle Limits	Estimated DP Station Keeping in 10-yr WS[1]
10-yr Winter Storm 16 ppg 1685 kips (vertical)	-0.8 to 0.7% WD (-35 to 30 ft)	-2.0 to 1.8% WD (-87 to 78 ft)	0.2% WD (10 ft)
10-yr Loop Current 16 ppg 1800 kips (vertical)	Not possible	-1.1 to 1.7% WD (-48 to 74 ft)	0.2% WD (10 ft)

Note: 1) from prior time-domain DP simulations and similar environmental conditions, max excursion ~3 m.

Table 4.2 Riser Spaceout, 4361-ft WD

Well Information (Items in **BLUE** need to be updated for each new well)

Region of Operation	GOMEX (GOMEX, Brazil, West Africa, North Sea, etc.)
Well Name/Number	MC 725, Tubular Bells
Operator	bp
Spud Date	1-Dec-02
Required Max Mud Weight	16.0 ppg

RKB to Datum Measurements with Stretch Correction & Required Number of Joints

Drillpipe used for RKB measurement OD = 5.500 in ID = 4.000 in Weight/ft Dry = 38.00 lb/ft

RKB to Seabead Measurement	4435.4 ft	1351.8 m	Corrected RKB to ML Length:	4436.4 ft	1352.1 m
RKB to Wellhead Measurement	4420.4 ft	1347.3 m	**Corrected RKB to WH Length:**	**4421.5 ft**	**1347.6 m**
Overpull during Measurement	10 kips		WH Stickup	14.9 ft	4.5 m
Estimated Drillpipe Stretch	1.1 ft		Estimated Riser Stretch	1.8 ft	0.6 m
			Number of Joints Required:		
Vessel Draft (at time of measurement)	75.5 ft	23.0 m	Rig Constants	253.7 ft	77.3 m
Estimated Water Depth	**4361.0 ft**	**1329.2 m**	Required No. of Full Joints	46.0	
			Required Length of Pups & Stretch	27.9 ft	8.5 m
Wellhead Connector (1 = Cameron DWHC, 2 = Vetco SHD H4)	2				

Recommended and Actual Riser Spaceouts

Joint Type	Description	Recomm. Spaceout	Actual Spaceout	Section Length [ft]	Depth to Top of Section [ft]	Component Weights In Air [lb]	Component Weights In Water [lb]	Section Weights In Air [kips]	Section Weights In Water [kips]	Wet to Dry Weight Ratio LMRP Only 30.2%	Wet to Dry Weight Ratio BOP 37.0%
	Wellhead			14.9	4346						
	BOP	1	1	22.0	4324	335315	291724	335.3	291.7		
	LMRP	1	1	21.5	4303	290000	252300	290.0	252.3		
	Riser Adapter	1	1	6.0	4297						
Type A	Slick 21.5 in x 1 in	11	11	990.0	3307	39920	34730	439.1	382.0	87.0%	87.0%
Type B	Slick 21.25 in x 0.875 in										
Type K	8500 ft 21.25 in x 0.875 in										
Type J	8000 ft 21.25 in x 0.875 in										
Type I	7000 ft 21.25 in x 0.875 in										
Type H	6000 ft 21.5 in x 1 in	4	4	360.0	2947	62629	3926	250.5	15.7	66.4%	71.6%
Type G	5000 ft 21.5 in x 1 in	11	11	990.0	1957	62158	3440	683.7	37.8	41.4%	49.0%
Type F	4000 ft 21.5 in x 1 in	11	11	990.0	967	60069	1351	660.8	14.9	30.2%	37.4%
Type E	3000 ft 21.25 in x 0.875 in										
Type D	2000 ft 21.25 in x 0.875 in										
Type C	1000 ft 21.5 in x 1 in	9	9	810.0	157	47206	16332	424.9	147.0	30.9%	37.0%
Type A	Slick 21.5 in x 1 in										
Type B	Slick 21.25 in x 0.875 in										
Type K	8500 ft 21.25 in x 0.875 in										
Type J	8000 ft 21.25 in x 0.875 in										
Type I	7000 ft 21.25 in x 0.875 in										
Type H	6000 ft 21.5 in x 1 in										
Type G	5000 ft 21.5 in x 1 in										
Type F	4000 ft 21.5 in x 1 in										
Type E	3000 ft 21.25 in x 0.875 in										
Type D	2000 ft 21.25 in x 0.875 in										
Type C	1000 ft 21.5 in x 1 in										
Type A	Slick 21.5 in x 1 in										
Type B	Slick 21.25 in x 0.875 in										
Type E	3000 ft 21.25 in x 0.875 in										
Type D	2000 ft 21.25 in x 0.875 in										
Type C	1000 ft 21.5 in x 1 in										
Pup											
Pup											
Pup	21.5in x 1in x 45ft										
Pup	21.5in x 1in x 37.5ft										
Pup	21.5in x 1in x 30ft	1	1	30.0	127	15980	13903	16.0	13.9	31.2%	37.3%
Pup	21.5in x 1in x 22.5ft										
Pup	21.5in x 1in x 15ft										
	Termination Joint	1	1	80.0	47	49165	26282	49.2	26.3	31.6%	37.5%
	Gas Handler										
	Estimated Riser Stretch	1	1	1.8	45						
	TJ OB & Tension Ring	1	1	80.2	-35	216223	188114	216.2	188.1	35.6%	40.7%
	TJ Stroke (IB)	1	1	21.0	-56	15139	13171	15.1	13.2	35.8%	40.9%
	Diverter FJ	1	1	4.31	-61	11990	10431	12.0	10.4		
	Diverter FJ to RKB	1	1	14.63	-75						

Table 4.3 API & Lift-off Required Tension versus Mud Weight

API 16Q Minimum Tension Requirements (including recoil tension requirements for DP vessels) & Riser Torque

Riser Mud Volume (incl. aux lines)		10430 ft³	1858 bbl	DP (1) or Moored (2):	1

Riser Weights, API Factors, and Tension Margins

TJ OB to LFJ Steel Wet Weight	1647 kips	API Weight Factor	1.02	API Factored Steel Weight	1686 kips
Buoyancy Net Lift	-974 kips	API Buoyancy Factor	0.98	API Factored Buoyancy Lift	-951 kips
Total Nominal Riser only Wet Wt.	672 kips	API Weight Margin	63 kips	Total API Factored Wet Weight	735 kips
TJ OB, Riser, and LMRP Nominal Wet Weight		934 kips		Reserve Tension After Failure	70 kips
TJ OB, Riser, and BOP Nominal Wet Weight		1225 kips		Tension Margin for Lift-off	variable kips

Tensioner System Capacity	**System 1**			**Total**
No. of Tensioners [N] Online	**6**	BE Press., 0ft stroke	**420.0**	6
No. of Tensioners Subject to Failure [n]	**1**	BE Press., mid stroke	**17.6**	1.00
DTL Tension Limit	800 kips	BE Area [in²]	381.7	4800 kips
Max %DTL	70%	RS Area [in²]	317.4	70%
Friction & Fleet Losses [Rf]	4%	BE Vol., 0ft [gal]	31.4	4%
Max Usable Tension	559 kips	BE Vol., mid strk. [gal]	409.0	3356 kips
Max Operating Pressure (%DTL x Max Press)	1784 psi			

Well Head System Torque Capacity (for DP vessels)

Is the allowed wellhead torque a function of set-down weight? (1=no, 2=yes)		1	
If no, what is torque resistance provided by operator/manufacturer?		200 kip-ft (To be specified by operator or WH manufacturer)	
If yes, wellhead characteristics: a) Coeff. of friction (0.12 - 0.15)	0.15	b) Mean shoulder diameter	30.0 in
c) Shoulder angle [deg]	30 deg		

Applied Tension, Wellhead Loads, and Torque versus Mud Weight

Maximum Mud Weight: 30.9 ppg **Required Mud Weight:** 16.0 ppg

				Tensioner Settings & Output		LMRP, Wellhead, & Lower Flex Joint Loads					Tension Ring vs. WH Torque		
Mud Density [ppg]	Total Mud Weight [kips]	T_{SRmin} Buckling [kips]	T_{min} Required [kips]	Pressure [psi]	Vert. Ten. [kips]	LMRP Con. Ten. [kips]	Wellhead Tension [kips]	LFJ Tension Actual [kips]	LFJ Tension Effective [kips]	LFJ Pressure [psi]	Breakout Torque [kip-ft]	Breakout Heading [deg]	% WH Torq. Cap.
8.6	3	809	1528	824	1301	367	76	620	704	28	25	17	13%
9.0	38	843	1546	833	1319	385	93	637	698	128	25	17	13%
9.2	53	859	1554	837	1326	392	101	645	696	173	25	17	13%
9.4	69	874	1562	842	1334	400	108	653	693	218	25	17	13%
9.6	84	890	1571	846	1343	409	117	661	692	264	25	17	13%
9.8	100	905	1579	850	1350	416	125	669	689	309	25	17	13%
10.0	116	921	1588	855	1359	425	133	677	687	354	25	17	13%
10.2	131	937	1596	859	1366	432	141	685	684	400	25	17	13%
10.4	147	952	1604	864	1374	440	148	692	682	445	25	17	13%
10.6	162	968	1613	868	1383	449	157	701	680	490	25	17	13%
10.8	178	984	1621	872	1390	456	165	709	677	536	25	17	13%
11.0	194	999	1629	877	1398	464	172	716	675	581	25	17	13%
11.2	209	1015	1638	881	1406	473	181	725	673	626	27	18	14%
11.4	225	1030	1643	884	1412	478	186	730	668	672	27	18	14%
11.6	240	1046	1649	887	1417	484	192	736	664	717	27	18	14%
11.8	256	1062	1654	890	1422	489	197	741	658	762	27	18	14%
12.0	272	1077	1660	893	1428	494	202	746	653	808	27	18	14%
12.2	287	1093	1666	896	1433	500	208	752	649	853	27	18	14%
12.4	303	1108	1671	899	1438	505	213	757	644	898	27	18	14%
12.6	318	1124	1676	902	1444	510	218	762	639	944	27	18	14%
12.8	334	1140	1682	905	1449	516	224	768	634	989	27	18	14%
13.0	350	1155	1688	908	1454	521	229	773	629	1034	27	18	14%
13.2	365	1171	1694	911	1460	527	235	779	624	1080	27	18	14%
13.4	381	1186	1699	914	1465	532	240	784	619	1125	27	18	14%
13.6	396	1202	1705	916	1471	537	245	789	614	1170	27	18	14%
13.8	412	1218	1711	920	1476	543	251	795	610	1216	27	18	14%
14.0	428	1233	1716	922	1481	548	256	800	605	1261	27	18	14%
14.2	443	1249	1727	928	1492	558	266	810	605	1306	27	18	14%
14.4	459	1264	1746	938	1511	577	285	829	613	1352	29	19	15%
14.6	475	1280	1766	949	1529	596	304	848	622	1397	29	19	15%
14.8	490	1296	1785	959	1548	614	323	867	630	1442	29	19	15%
15.0	506	1311	1805	969	1567	633	341	885	639	1488	29	19	15%
15.2	521	1327	1824	979	1586	652	360	904	647	1533	29	19	15%
15.4	537	1342	1844	990	1604	670	379	923	655	1578	31	20	16%
15.6	553	1358	1863	1000	1623	689	397	942	664	1624	31	20	16%
15.8	568	1374	1883	1010	1642	708	416	960	672	1669	31	20	16%
16.0	584	1389	1902	1020	1660	727	435	979	681	1714	31	20	16%
16.2	599	1405	1922	1030	1679	745	454	998	689	1760	31	20	16%
16.4	615	1420	1941	1041	1698	764	472	1016	698	1805	31	20	16%
16.6	631	1436	1961	1051	1717	783	491	1035	706	1850	33	21	17%
16.8	646	1452	1980	1061	1735	802	510	1054	715	1896	33	21	17%
17.0	662	1467	2000	1071	1754	820	529	1073	723	1941	33	21	17%
17.2	677	1483	2019	1082	1773	839	547	1091	732	1986	33	21	17%
17.4	693	1498	2039	1092	1792	858	566	1110	740	2032	33	21	17%
17.6	709	1514	2058	1102	1810	876	585	1129	748	2077	35	22	18%
17.8	724	1530	2078	1112	1829	895	603	1147	757	2122	35	22	18%
18.0	740	1545	2097	1123	1848	914	622	1166	765	2168	35	22	18%

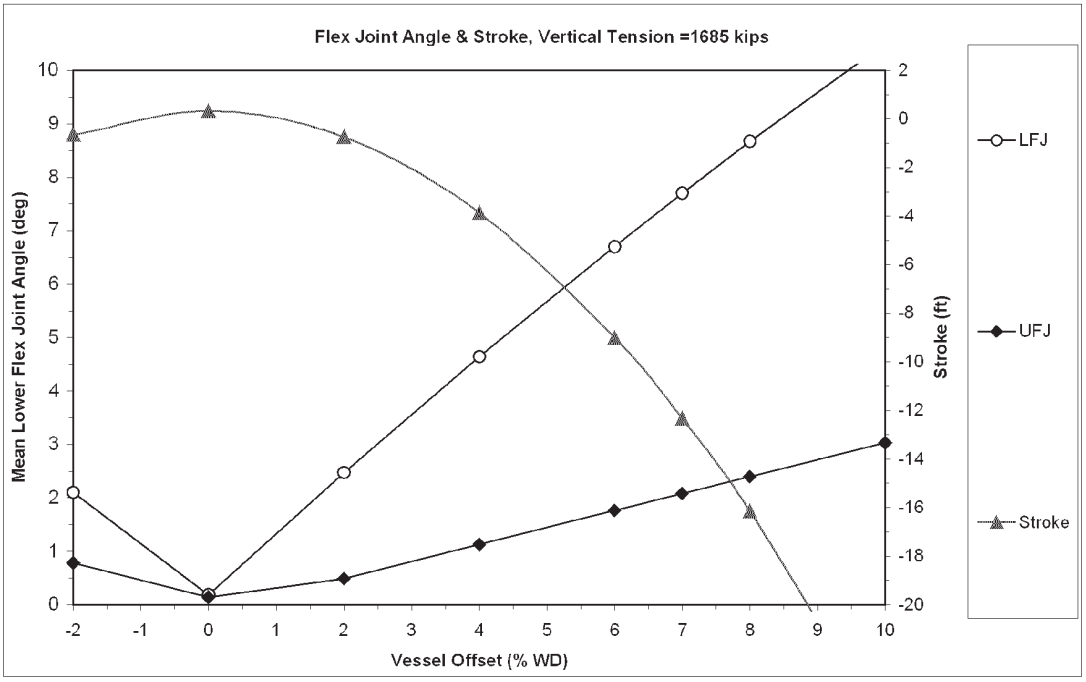


Figure 4.1 Riser Operability – 10-yr Winter Storm, 16 ppg Mud 1685-kips Vertical Tension

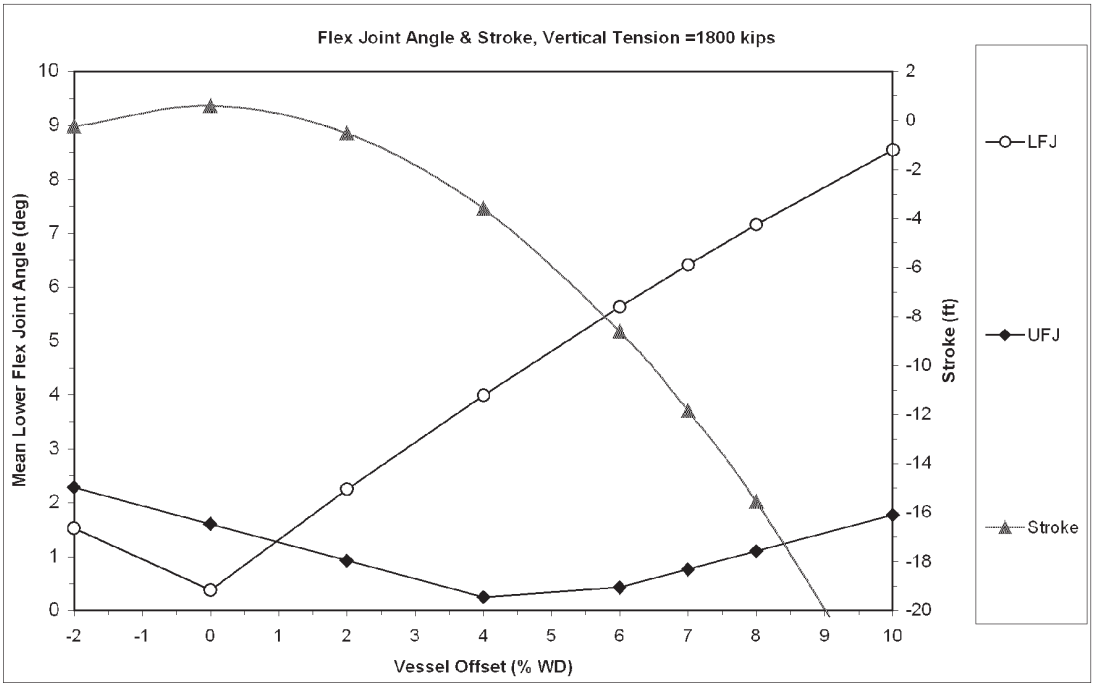


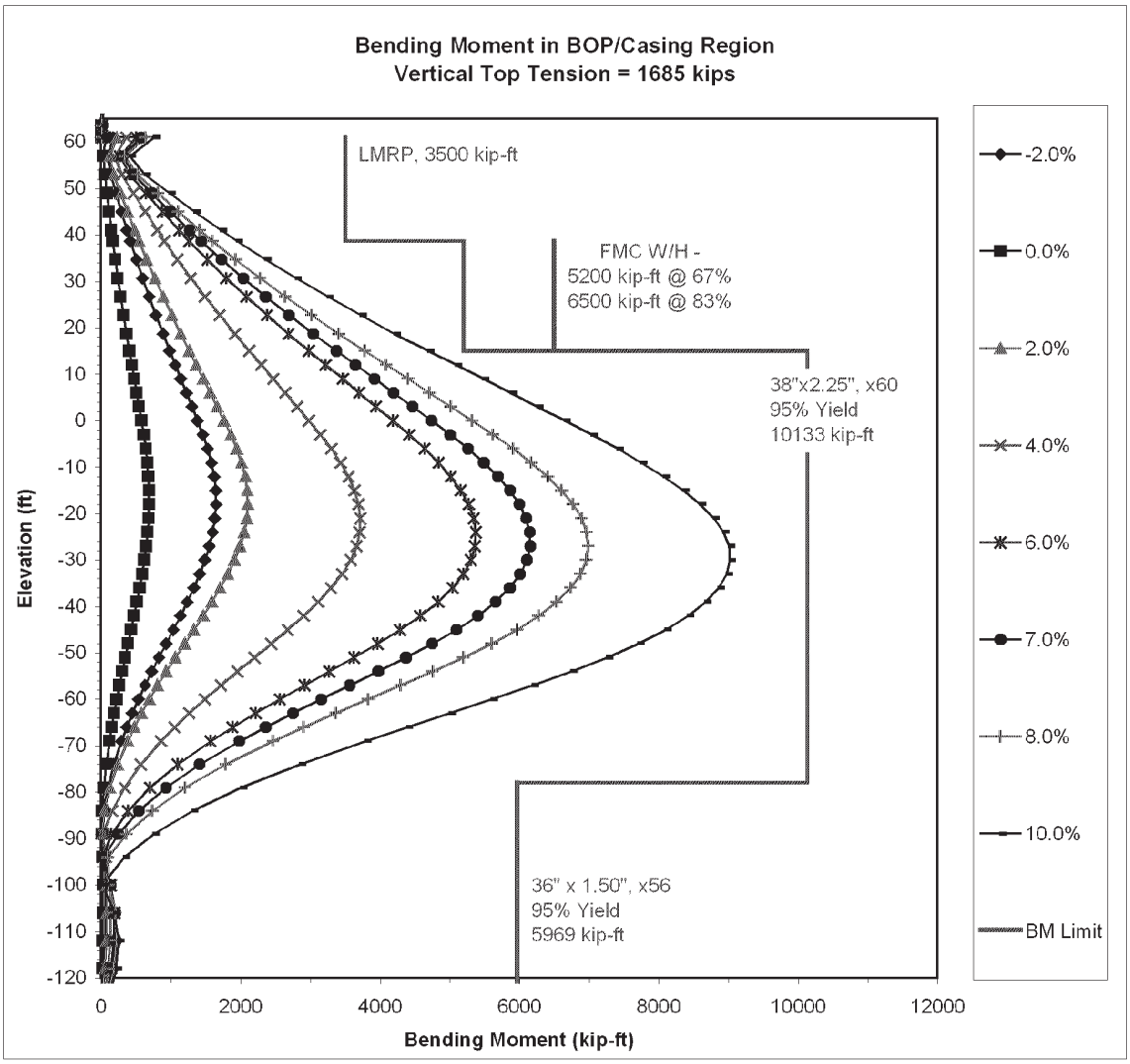
Figure 4.2 Riser Operability – 10-yr Loop Current, 16 ppg Mud 1800-kips Vertical Tension

4.3. Wellhead and Casing Loads

The riser model used in this assessment accounts for soil interactions with 38" OD x 2.25" wall and 36" OD x 1.50" wall structural casing down to 130 ft below the mud line. A clay soil model was used as outlined previously. More accurate soil profiles for the specific site could change the values reported herein (i.e. softer profiles will generate higher casing bending moments and stiffer profiles higher well head moments).

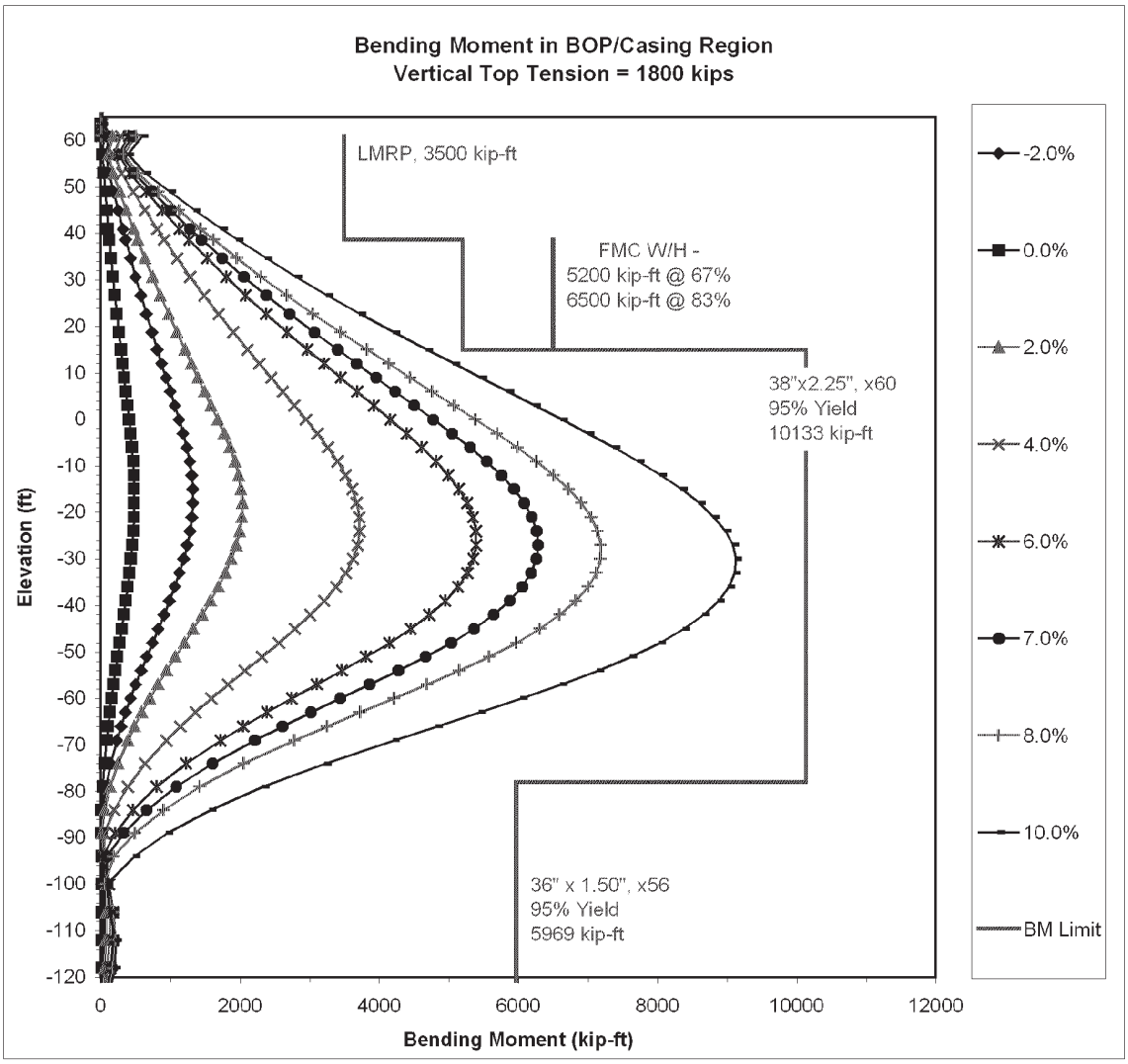
Figure 4.3 and Figure 4.4 provide bending moment profiles in the casing and stack regions for the 10-yr winter storm and loop current environments. Results are presented for various vessel offsets with 16-ppg mud. On each figure, the limiting bending moment is shown as a vertical line for each the LMRP, BOP, and casing regions.

For offsets out to the point of stroke out (~9% offset) the 10-yr winter storm and loop current events generate bending moments that are within the allowed values for both the wellhead and casing components. First yield of the casing should not be exceeded until beyond 10% of water depth.



16 ppg Mud / 1685 kips Tension at Outer Barrel

Figure 4.3 Casing Bending Moment vs. Offset – 10-yr Winter Storm



16 ppg Mud / 1685 kips Tension at Outer Barrel

Figure 4.4 Casing Bending Moment vs. Offset – 10-yr Loop Current (0.2 knot at bottom)

4.4. Dynamic Positioning Watch Circle Guidance

Dynamic positioning watch circles should be set to make certain the LMRP can disconnect (lift off) from the well prior to exceeding any mechanical limit of the riser system. The maximum allowed offset, denoted as the point of disconnect (POD), is the minimum offset to exceed any one of the following limits:

- Riser angles
- Well head bending limits
- Riser stroke/tensioner stroke limits
- Casing bending limits

Allowed mean riser stroke out is estimated based on the following heave and tide margins:

- Initial Tensioner stroke setting — 25 ft out (25 ft remaining)
- Error in stroke position — +/- 2.5 ft SA
- Max heave (max in 1000 waves) — +/- 2.4 ft (10-yr Storm)
- Usable Mean stroke out — 20 ft (mean stroke)

For the two mud weights considered, the following point of disconnect (POD) offsets are determined from riser analysis work:

Criteria	*Limiting Value*	*10-yr WS*	*10-yr Loop*
1) Lower FJ Angle	6 deg	5.4% WD*	6.5% WD
2) Upper FJ Angle	9 deg	>10%	>10%
3) Riser Stroke	20 ft	9.0%	8.9%
4) LMRP Bending Mom.	3500 kip-ft	>10%	>10%
5) W/H Bending Mom.	5200 kip-ft	>10%	>10%
6) 38" x 2.25", x60 casing	10133 kip-ft	>10%	>10%
Limiting POD offset:		***5.4% WD***	***6.5% WD***

* 5.4% offset for a 1685 kip vertical tension, if tension is increase to 1800 kips vertical, allowed offset will match 10-yr loop condition 6.5%

To determine the red watch circle and reaction times, two vessel drift off calculations were completed for the 10yr winter storm and 10yr Loop Current events. All drift off rates assume an optimum vessel heading into the environments. The EDS times for blind rams (35 seconds) and super shears (64 seconds) were compared to the drift rates to ensure ample time is available to react to a situation and conduct a EDS in case of a blackout.

Table 4.4 outlines the calculated maximum offset to set red watch circle limits (point where EDS is started; note the red circle is centered about the set point, not well center) and the associated reaction time (drift time from blackout to red circle). These values are presented as indicative red watch circle limits. Actual watch circles can be set on the bridge with the drift off and watch circle program for the prevailing environmental conditions.

Table 4.4 Red Watch Circle Maximum Offset Settings and Reaction Times

	10-yr Winter Storm	**10-yr Loop Current**
DP Set Point	Well center	Well center
POD from well center	5.4% WD	6.5% WD
Drift Distance (set point to POD)	5.4% WD	6.5% WD
Drift Time to POD	93 sec	96 sec
EDS 1		
Duration	35 sec	35 sec
Reaction time to Red	58 sec	61 sec
Red Watch Circle (from set point)	2.7% WD (118 ft)	3.0% WD (130 ft)
EDS 2		
Duration	64 sec	64 sec
Reaction time to Red	29 sec	32 sec
Red Watch Circle (from set point)	0.7% WD (30 ft)	0.9% WD (39 ft)

Appendix E BP Daily Operations Reports

OCS-G 22898 /MC 725/ #1 ST00
TUBULAR BELLS - TRANSOCEAN DEEPWATER HORIZON

OPERATIONS SUMMARY - June 26 - July 1, 2003

Report Date	From Time	To Time	Hours (hr)	Phase	Task	Activity	Code	NPT	NPT Detail	Operation
6/26/2003	0:00	4:30	4.5	PROD1	DRILL	RIH	N	DFAL	LMWD	RIH WITH 9 5/8" DRILLING ASSY FROM 7,627' MD TO 13,460' MD AT 2 MINUTES PER STAND. NOTE: FILLED UP THE DRILL PIPE EVERY 10 STANDS. BROKE CIRCULATION DOWN BOOST FOR 5 MINUTES AND THEN DOWN THE DRILL PIPE FOR 5 MINUTES TO BREAK GELS AT 10,941' MD.
6/26/2003	4:30	5:00	0.5	PROD1	DRILL	PU	N	DFAL	LMWD	PICKED UP TO THE HANG OFF POSITION DUE TO BARGE STRIKING THE PORT AFT COLUMN.
6/26/2003	5:00	14:00	9	PROD1	DRILL	RIH	N	DFAL	LMWD	RIH FROM 13,460' MD TO 24,202' MD AT 2 MINUTES PER STAND. NOTE: FILLED UP THE DRILL PIPE EVERY 10 STANDS. BROKE CIRCULATION DOWN BOOST FOR 5 MINUTES AT 90 SPM, THEN DOWN THE DRILL PIPE FOR 5 MINUTES AT 40 SPM & 700 psi AT TOP OF THE LINER (17,538' MD).
6/26/2003	14:00	15:30	1.5	PROD1	DRILL	RIH	N	DFAL	LMWD	CONTINUED TO RIH FROM 24,202' MD TO 24,378' MD. SHEARED RHINO REAMER ARMS PULL TESTED AT THE SHOE (15K OVERPULL). CONTINUED TO RIH FROM 24,378' MD TO 24,440' MD. NOTE: TAGGED UP AT 24,440' MD WITH 30K.
6/26/2003	15:30	16:30	1	PROD1	DRILL	REAM	N	DFAL	LMWD	WASHED AND REAMED FROM 24,440' MD TO 24,545' MD, STALLED OUT AT 24,545' MD WITH 32K FT/LBS. PICK UP TO 880K. PIPE FREE. WELL OBSERVED TO BE FLOWING. NOTE: FLOW HAD ALMOST STOPPED, THEN INCREASED TO A MAJOR FLOW BACK. TOOK A 20 - 23 BBL. GAIN AFTER THE FLOW INCREASED.
6/26/2003	16:30	18:30	2	PROD1	DRILL	WELCON	N	DPRB	WCON	SHUT WELL IN ON LOWER ANNULAR. MONITOR PRESSURE ON CHOKE WHILE WEIGHTING UP PITS TO 15.1 PPG (SICP-320, SIDPP-260).
6/26/2003	18:30	19:30	1	PROD1	DRILL	DISPL	N	DPRB	WCON	BEGAN DISPLACING RISER WITH 15.1 PPG AT 140 SPM, 2,250 PSI. NOTE: DETERMINED THE WELL WAS LIKELY SHUT IT ON TRAPPED PRESSURE RESULTING FROM PARTIAL PACKOFF.

Report Date	From Time	To Time	Hours (hr)	Phase	Task	Activity	Code	NPT	NPT Detail	Operation
6/26/2003	19:30	20:00	0.5	PROD1	DRILL	WELCON	N	DPRB	WCON	OPEN CHOKE, BLEED TO T.T. RECOVER 8.6 BBLS IN 24 MINUTES. (SICP-60, SIDPP-70). SHUT IN & MONITORED PRESSURE. SICP BUILT UP TO 150 psi, SIDPP 70 psi.
6/26/2003	20:00	21:00	1	PROD1	DRILL	WELCON	N	DPRB	WCON	BLEED BACK 0.8 BBLS. OPENED ANNULAR. MONITORED WELL ON T.T (WELL STATIC) WHILE CUTTING MUD WEIGHT IN THE PITS TO 14.9 PPG.
6/26/2003	21:00	0:00	3	PROD1	DRILL	REAM	N	DFAL	LMWD	STAGED UP PUMPS TO 114 SPM, 4,550 PSI. WASHED AND REAMED FROM 24,479' MD TO 24,607 WITH 140 SPM ON BOOST, 3-5K WOB, 14K-19K FT/LBS TORQUE. NOTE: MAX GAS 656 UNITS, MAX GAS CUT 14.9 PPG TO 13.8 PPG.
6/27/2003	0:00	12:00	12	PROD1	DRILL	REAM	N	DFAL	LMWD	REAMED FROM 24,607' MD TO 24,770' MD. ATTEMPT TO WASH FROM 24,770' MD TO 24,808' MD, TOOK 15K DOWN. CONTINUED TO REAM FROM 24,808' MD TO 25,366' MD. NOTE: FROM 25,247' MD TO 25,366' MD IT TOOK EXCESSIVE TORQUE 21-35K, STALLING THE TOP DRIVE WAS A PROBLEM ALSO.
6/27/2003	12:00	14:30	2.5	PROD1	DRILL	WOW	N	WAIT	WTHR	SUSPEND DRILLING DUE TO LOOP CURENT EXCEEDING OPERATIONAL LIMITS (3.2 KNOTS SURFACE CURRENT).
6/27/2003	14:30	19:00	4.5	PROD1	DRILL	REAM	N	DFAL	LMWD	CONTINUED TO REAM FROM 25,366' MD TO 25,467' MD. NOTE: STILL HAVING HIGH TORQUE AND STALLING PROBLEMS.
6/27/2003	19:00	19:30	0.5	PROD1	DRILL	WRKPIP	N	DFAL	LMWD	STALLED OUT AT 25,467' MD, RELEASED TORQUE (DRILL STRING WAS STUCK). JAR UP ONCE WITH 40K OVER PULL (PIPE CAME FREE). RE-ESTABLISHED ROTATION.
6/27/2003	19:30	0:00	4.5	PROD1	DRILL	REAM	N	DFAL	LMWD	CONTINUED TO WASH AND REAM FROM 25,467' MD TO 25,570' MD. NOTE: STILL HAVING HIGH TORQUE AND STALLING PROBLEMS.
6/28/2003	0:00	3:30	3.5	PROD1	DRILL	REAM	N	DFAL	LMWD	REAMED FROM 25,570' MD TO 25,656' MD. NOTE: STILL FIGHTING STALLING AND HIGH TORQUE.
6/28/2003	3:30	9:30	6	PROD1	DRILL	RIGREP	N	RREP	TDRV	AT 25,656' MD STALLED OUT AT 36,000 FT/LBS OF TORQUE. PIKED UP AND FREED THE DRILL PIPE. NOTE: UNABLE TO ESTABLISH ROTATION WITH THE TOP DRIVE. TROUBLE SHOOTING THE TOP DRIVE FOR ROTATION PROBLEMS.

Report Date	From Time	To Time	Hours (hr)	Phase	Task	Activity	Code	NPT	NPT Detail	Operation
6/28/2003	9:30	11:00	1.5	PROD1	DRILL	RIGREP	N	RREP	TDRV	SWAPPED DRIVE TO AUX. DRAW WORKS DRIVE. ABLE TO ROTATE, BUT HAD INCORRECT TORQUE READINGS.
6/28/2003	11:00	13:30	2.5	PROD1	DRILL	WAIT	N	WAIT	CURR	RESUMED TROUBLE SHOOTING ON ROTATION PROBLEMS. HAD TO SHUTDOWN 3 MUD PUMPS AND CIRCULATED WITH ONLY 1 MUD PUMP DUE TO 3.4 KNOT SURFACE CURRENT. AT 12:00 HRS THE CURRENT WAS AT 3.6 KNOTS.
6/28/2003	13:30	16:30	3	PROD1	DRILL	WASH	N	DFAL	LMWD	WASHED AND REAMED FROM 25,656' MD TO 25,702' MD. NOTE: STILL FIGHTING HIGH TORQUE AND STALLING OF THE DRILL STRING.
6/28/2003	16:30	20:30	4	PROD1	DRILL	DRL	P			DRILLED FROM 25,702' MD TO 25,861' MD. DRILLED SAND AT 25,810' MD. FLOW CHECK- NO FLOW.
6/28/2003	20:30	23:30	3	PROD1	DRILL	WAIT	N	WAIT	CURR	POOH FROM 25,861' MD TO 25,765' MD AND SUSPEND DRILLING OPERATIONS DUE TO LOOP CURRENT EXCEEDING OPERATIONAL LIMITS 3.5 KNOTS.
6/28/2003	23:30	0:00	0.5	PROD1	DRILL	RIH	P			TIH FROM 25,765' MD TO 25,861' MD. TOOK SCR'S AT 25,861' MD WITH 14.9 PPG MUD WEIGHT.
6/29/2003	0:00	11:00	11	PROD1	DRILL	DRL	P			DRILLED FROM 25,861' MD TO 26,259' MD.
6/29/2003	11:00	12:00	1	PROD1	DRILL	SAFETY	P			TOOK SURVEY AT KELLY DOWN, TOOK SCR'S. HELD FIRE & ABANDONMENT DRILL & WEEKLY WELL CONTROL DRILL.
6/29/2003	12:00	12:30	0.5	PROD1	DRILL	DRL	P			DRILLED FROM 26,259' MD TO 26,290' MD.
6/29/2003	12:30	14:30	2	PROD1	DRILL	WAIT	N	WAIT	CURR	SUSPEND DRILLING OPERATIONS DUE TO LOOP CURRENT EXCEEDING OPERATIONAL LIMITS. SURFACE CURRENT 3.4 KNOTS.
6/29/2003	14:30	19:30	5	PROD1	DRILL	REAMBK	N	WAIT	WTHR	BACKREAMED & PUMPED OUT OF HOLE FROM 26,290' MD TO 24,571' MD.
6/29/2003	19:30	22:30	3	PROD1	DRILL	CIR	N	WAIT	WTHR	CIRCUALTED BOTTOMS UP TO THE WELLHEAD FROM 24,571' MD AT 57, 57 SPM, 4,380 PSI.
6/29/2003	22:30	23:30	1	PROD1	DRILL	POH	N	WAIT	WTHR	HELD WEEKLY BP SANCTIONED WELL CONTROL DRILL WITH CREW THEN POOH 4 STDS FROM 24,571' MD TO 24,020' MD. 25K OVER PULL WHEN REAMER CAME INTO THE SHOE. WELL TAKING PROPER DISPLACEMENT.

Report Date	From Time	To Time	Hours (hr)	Phase	Task	Activity	Code	NPT	NPT Detail	Operation
6/29/2003	23:30	0:00	0.5	PROD1	DRILL	CIR	N	WAIT	WTHR	CIRCULATE BOTTOMS UP FROM THE WELLHEAD WITH BOOST PUMPS AT 70 SPM, 70 SPM, 2,200 PSI. NOTE: TIGHT SPOTS ON TRIP OUT OF HOLE 26,098' MD- 30K UP, 35K FT/LBS TORQUE 26,054' MD- 35K UP, 35K FT/LBS TORQUE 25,982' MD- 50K UP, 35K FT/LBS TORQUE
6/30/2003	0:00	2:00	2	PROD1	DRILL	WAIT	N	WAIT	WTHR	CIRCULATED BOTTOMS UP FROM THE WELLHEAD WHILE WAITING ON WEATHER.
6/30/2003	2:00	4:00	2	PROD1	DRILL	WAIT	N	WAIT	WTHR	MONITORED WELL ON THE TRIP TANK WHILE AT HANG OFF POSITION. NOTE: NO GAIN OR LOSS.
6/30/2003	4:00	10:00	6	PROD1	DRILL	WAIT	N	WAIT	WTHR	AT 04:05 DUE TO APPROACHING MAX POWER USAGE, HUNG OFF ON UPPER PIPE RAMS. NOTE: WELL WAS SHUT-IN FROM 04:00 TO 10:00 HOURS, CHOKE LINE PRESSURE AT 10:00 HOURS WAS 20 PSI.
6/30/2003	10:00	11:00	1	PROD1	DRILL	WAIT	N	WAIT	WTHR	AT 10:14 HRS RIG WAS 36 METERS OFF LOCATION, CONTINUING TO DRIFT, AND UNABLE TO STABILIZE OR RE-GAIN POSITION DUE TO INSUFFICIENT THRUST. EDS 1 SEQUENCE INITIATED FROM RIG FLOOR AND LMRP DISCONNECTED. RIG CONTINUED DRIFTING UNTIL 67 METERS OFF LOCATION BEFORE POSITION STABILIZED. AT TIME OF DISCONNECT THE CURRENT WAS 3.8 KNOTS NNE, SEAS WERE 13' TO 15' SE AND WIND AT 44 KNOTS SE.
6/30/2003	11:00	12:00	1	PROD1	DRILL		N	WAIT	WTHR	RIG MAINTAINING POSTION 50 METERS EAST OF LOCATION. POWERED UP SYSTEMS TAKEN DOWN TO CONSERVE POWER AND PREPARED TO POOH. INSPECTED THE MOONPOOL AREA. AT 1200 HRS THE CURRENT REACHED 5.1 KNOTS NNE WITH SEAS AT 14' TO 16' SSW & WIND AT 39 SSW.
6/30/2003	12:00	0:00	12	PROD1	DRILL		N	WAIT	WTHR	WAITING ON WIND AND SEA CONDITIONS TO SUBSIDE FROM TROPICAL STORM BILL TO INSPECT ADD RE-ESTABLISH LMRP AND BOP CONNECTIONS WITH THE HELP OF THE ROV. WHILE WAITING ON WEATHER POOH WITH DRILL PIPE FROM 4,375' MD. NOTE: AFTER EMERGENCY DISCONNECT, INITIAL MUD LOSS FROM THE RISER WAS CALCULATED AT 777 BBLS.

Report Date	From Time	To Time	Hours (hr)	Phase	Task	Activity	Code	NPT	NPT Detail	Operation
7/1/2003	0:00	12:00	12	PROD1	DRILL	WAIT	N	WAIT	WTHR	WAITING ON WEATHER TO SUBSIDE FROM TROPICAL STORM BILL TO INSPECT & RE-ESTABLISH LMRP & BOP CONNECTIONS. WHILE WOW PERFORMED PM'S ON TD'S & MUD PUMP #2 - MONITORED RISER TENSIONER PRESSURES. TIME WIND DIREC. CURRENT DIREC. SEA'S 03:00 35 S 3 NE 14 06:00 35 SSW 3.3 NNE 12 09:00 27 SSW 3.6 NNE 12 12:00 31 SW 3.8 NNE 8
7/1/2003	12:00	0:00	12	PROD1	DRILL	WAIT	N	WAIT	WTHR	WHILE W.O.W. SLIPPED AND CUT 40' DRILL LINE. CROW / FLOOR SAVER WAS FUNCTION AND RE-SET. RE-CALIBRATED BLOCK. CHANGED OUT TOP DRIVE SAVER SUBS AND PERFORMED PM'S WHILE MONITORING RISER TENSIONER PRESSURE. TIME WIND DIREC. CURRENT DIREC. SEA'S 12:00 31 SW 3.8 NNE 5 18:00 6 NW 3.5 NE 5 00:00 16 SSW 3.0 NE 5

Appendix F BP Incident Report (2003-1R-553533)

bp

Incident Report: 2003-IR-553533

Personal Information not available in downloaded report

Responsible Organisation Information

Stream: Upstream
Site: Not Applicable
Business Unit: North America Exploration - Deepwater CoreX PU
Organisation Level 1: Drilling
Organisation Level 2: Deepwater Horizon

Location Information

Stream: Upstream
Site: Not Applicable
Business Unit: North America Exploration - Deepwater CoreX PU
Location 1: Offshore
Location 2: Deepwater Horizon

General Information 1

Date Occurred (DD/MM/YYYY)*: 30/06/2003 10:16
Reported By: Darrell Boudreaux
Reported To: Bryan Cook
Contact Number: 281-366-0455
Job Title: Drilling Team Leader
Date Reported (DD/MM/YYYY): 30/06/2003 10:20
Short Description: Emergency Riser Disconnect Caused SMB Release
Event Description: Emergency disconnect of LMRP due to high current (3.8 knots on surface) and high winds (44 knots) occured when the rig reached 36 meters off locations. Total volume of mud in riser, drill string, choke line, kill line, and boost lines was 1817bbls. Total initial discharge of 777 bbls. of synthetic base mud (52% SBM, 30% Solids, and 18% Water).

Capital Project Related: N

Golden Rule	Golden Rule Details
None	None

General Information 2

Primary Company Involved: BP

Shift: - Needs Data -

Immediate Action Taken: Moved off location after disconnect and notified BP and Transocean offices.

General Information 3

Weather Condition: Windy

Regulatory Authorities Notified: NRC

Type of Report	Report Number
Spill	649475 / Ms. Jones

Drug & Alcohol Test Mandatory?: N

General Information 4

HIPO (To be completed by H

Work in Progress Drilling

Standdown Conducted No

Golden Rules of Safety Involved None

Regulatroy Authorities Notified: NRC

Type of Report Spill

Severity

ACTUAL: Environment 2

POTENTIAL: Environment 2 L

Material Release Information

Release Type: Spill

Specific Location: Sea Floor Release at the Subsea Wellhead for Mississippi Canyon 725 #1. Release water depth of 4395'

Secondary Containment Breached?: Y

Barometric Pressure: 29.92 Inch(es)

Material Released	Material Type	Quantity Released	Quantity Recovered
Synthetic Mud	Synthetic Based Mud	16968.05 Gallon(US)	0 Gallon(US)

Release To: Sea

Duration (minutes): 2

Clean Up Action: None

Riser Disconnect MC 725 #1

Material Release Responsibility:	BP
Notifiable Release:	Y
Surface Area:	0 Square Feet
Environmental Impact:	Total volume of mud in riser, drill string, choke line, kill line, and boost lines was 1817bbls. Total initial discharge of 777 bbls. of synthetic base mud (52% SBM, 30% Solids, and 18% Water).
Source of Release:	Lower marine riser package following emergency disconnect.
Additional Comments or Information	NRC Contact: Ms. Jones MMS Contact: Suzanne Moore USCG Contact: Petty Officer Barron / Morgan City
Enter any Fines Assessed $	
Penalties or Violations Assessed (To be completed by HSE)	None
Causes	Natural Disaster/Weather
Material Released	Synthetic Base Mud (SBM)
Reportable Quantity Exceeded	Yes

Comprehensive List of Causes

Originator/Approver Information

Originator:	Cullum, Tyson
Origination Date (DD/MM/YYYY):	30/06/2003
Approver:	Cook, Bryan
Approval Date (DD/MM/YYYY):	02/07/2003
Last Modified By:	Cook, Bryan
Last Modified Date (DD/MM/YYYY):	02/07/2003 08:56