JNRC - Learning Opportunity Notification (LON) - 007

Incident Details		Incident Impact	
Incident	Ocean Ranger Semi-Submersible	People	84 dead (full crew)
Date of Incident	15-Feb-82	Environment	Minimal
Location/Country	Offshore Newfoundland, Hibernia Oil Field, Canada	Asset (adjusted claim at the time of loss)	USD $92.124 million (insured Loss)
Type of Incident	Capsize	Reputation	
Offshore/Onshore	Offshore		
Asset Type	Semi-Submersible		
Asset Status	Operational		
Immediate Cause	Inadequate Barriers		
Similar Root Cause Incidents	LON 003 & 004		
Date Updated	12-Jan-23		

Incident Description

Details of the loss draw heavily from the details of the Royal Commission Report (Ref1).

The Ocean Ranger was built as a semi-submersible drilling rig in 1976 in the Hiroshima, Japan yard of Mitsubishi Heavy Industries. At this time the vessel was the largest self-propelled unit of its type, designed by ODECO (the rig Operator) and a Norwegian company Fearnley & Eger. It was built and classed to the 1973 rules of the American Bureau of Shipping. The rig was of a similar design to other semi-submersible rigs at the time, comprising two pontoons, eight vertical columns, an upper hull and two decks, with a supporting framework of braces and trusses. The anchoring system comprised of 12 anchors – arranged in a 3 x 4 pattern. The ballast tanks were contained with the normally submerged pontoons, and the ballast control room located in one of the vertical columns, positioned 28' above the waterline. It had been approved by the classification society for 'unrestricted ocean operations'.

In its relatively short life, the vessel was drilling predominantly in the deeper, harsh environment waters for which the vessel had been designed, in North American waters and off the Irish coast. In February 1980 the vessel started a long-term drilling contract with Mobil offshore Newfoundland, Canada, and at the time of the loss was drilling in 260' of water.

On the day prior to the loss, the vessel was advised of a significant weather front moving from the Gulf of Mexico, and up the east coast of the USA and Canada. This was a severe storm with hurricane force winds greater than 100km/h and high waves in excess of 25metres. Two other rigs were drilling in relatively close proximity to the Ocean Ranger, being the Sedco 706 and the Zapata Ugland.

As the storm front reached the Ocean Ranger, and a wind speed 'trigger' was met, the Ocean Ranger ceased drilling and disconnected itself from the well. Whilst the Ocean Ranger had disconnected and hung-up successfully, it had been forced to shear the drilling string. There was a degree of confusion as when exactly the Ocean Ranger stopped drilling, and on whose authority (Ref1). There was confusion as to whether the wind trigger points for cession of drilling and moving to a storm draft were based on sustained or gust windspeeds. Regardless, after disconnecting, the Ocean Ranger did not move to a storm draft as per expected procedure, and that played a significant part in the following sequence of events.

At around 19h00 on the 14 February, the Sedco 706 reported damage. The Sedco706, unlike the Ocean Ranger, assumed storm draft. Both the Sedco 706 and Zapata Ugland reported waves washing over the helideck, but both ultimately rode out the storm without further significant damage.

Shortly after, the Ocean Ranger reported a smashed ballast portlight from wave action (one of four in total) in the ballast control room; this caused some flooding, but more crucially also caused water damage to the control panel, which began to malfunction. This caused the crew to isolate the panel and move to a manual function, noting that some of the ballast valves had reportedly begun "..opening by themselves..", although this more likely to have been an observation that panel lights were randomly flashing as a result of water ingress to the panel.

Communications between the Ocean Ranger and its stand-by vessel, the Seaforth Highlander (some 7 miles away on the evening of the 14 February) around the time of the breaking of the portlight and damage to the ballast panel, did not prompt a request for any assistance.

The portlights were necessary, as these were the only means of seeing the draft markings on the legs as there was no automated draft indication on the vessel. It was noted that deadlights were fitted over the portlights, to be lowered and secured to protect the glass in heavy seas, although there was no instruction or standing order when to use them in storm conditions

Overheard VHF radio transmissions on the Sedco 706 around 21h30 and 22h00 indicated that repairs to the control panel were in place.

Around 01h00 of the 15 February, a call was received onshore from the Ocean Ranger, advising the rig was listing to bow "..eight to ten feet.." and requested the Coast Guard be notified, it was also agreed to notify the helicopters under contract to Mobil. The Ocean Ranger also contacted the Seaforth Highlander and requested it come to close stand-by. Some minutes later a distress telex was received by a MARISAT operator in Connecticut – the list was advised at 10-15 deg. At 01h10 a Mayday request was sent on behalf of the Ocean Ranger – there is some conflict in evidence as to when the first Mayday call was sent.

At 01h30, the last radio communication from the Ocean Ranger was that they were going to lifeboat stations with an increasing list, now > 15 deg.

The Royal Commission investigation placed much focus on what happened onboard between the breaking of the portlight and the call to advise the vessel was listing to bow, and whether at any time power was restored to the ballast panel. What was clear that a sudden list to bow was caused by crew action. Brass manual control rods were found inserted in the ballast solenoid valves. These had been used during the rig commissioning and were not part of the normal operation of the ballast valves. Used correctly they could operate the ballast valves in the event of electrical fault/failure to the panel, but their use in this manner was not officially recognised, nor documented. Contrary to crew belief, when inserted, the ballast valves would open, and not close. Evidence also suggests that electricity and air was restored to the panel around 01h00, which is also considered to have contributed to the initial list.

Based on available evidence it was concluded that sea water was inadvertently introduced into the port ballast, causing a list which compromised the vessel in heavy seas, and recovery actions taken only worsened the situation. With such an increasing list, sea water would have then entered the open anchor chain lockers, which had neither alarms or means to dewater, and accelerated the list. With such a list, escalation resulted as water damage occurred to deck structures and fittings, leading to water ingress to lower deck areas, and lower hull tanks through vent lines now underwater.

When the Seaforth Highlander reached the Ocean Ranger, it was fully lit. A distress flare was sighted off the starboard quarter, although there was confusion as to the exact time it was seen. What was clear however was that in spite of a severe list a lifeboat had been launched, albeit damaged and riding low in the water, with some 30 persons onboard. In spite of efforts to secure a line between the stand-by vessel and lifeboat, the poor physical condition of the lifeboat and heavy seas caused it to capsize with the loss of all onboard.

The rate of flooding or damage relative to the time of decision to abandon is unknown, but the increased flooding would have caused an increasingly unstable situation and the Ocean Ranger, assisted by wave motion, capsized and sank at approximately 03h15 on 15th February. At 03h38, the stand-by vessel Norderator reported the Ocean Ranger had disappeared from radar.

None of the 84 crew were recovered alive from the water, and in total only 22 bodies were found.

The MV Mekhanik Tarasov, a Soviet Union flagged cargo ship, was also a victim of this same storm, with loss of 32 of the 37 crew, sinking on the 16 February, after shifting cargo had punctured a ballast tank.

It is understood that in the aftermath of moving the Ocean Ranger to deeper waters, to avoid it being a shipping hazard, 3 divers lost their lives in 2 separate incidents.

It is noted that loss of the Ocean Ranger came just 2 years after the loss of the Alexander L. Kielland in the Norwegian sector of the North Sea – see also JNRC LON-003.

Incident Analysis and Findings (including Causal Factors)

The following list of causal or contributing factors that led to the loss of the Ocean Ranger are based on those given in Chapter 7 of the Royal Commission report (Ref1):

1. Design decision to locate the ballast control room in the third starboard column below the lower deck, in part driven by having only manual draft verification needing physical line of sight of draft marking measurement lines on a leg.

2. Failure to assess the potential design wave loading on the portlight, and to specify material of sufficient strength – albeit noting of course that the use of the portlight and location of the control was necessitated by the absence of remote draft measurement.

3. Failure in the design to protect the ballast control panel and its internal components in an environment where sea water ingress was possible.

4. Failure of the crew to close the deadlight in the ballast control room when confronted with the severe storm – albeit closure was of course reliant on an understanding of the vulnerability of the portlight, and written instruction to close, which was absent.

5. Lack of ballast crew understanding of the operation of the ballast control panel, particularly in view of the vulnerability of the panel to water damage. In an emergency use of either one of an electrical supply or air supply separately would have allowed safe operation of the panel whilst repairs were undertaken. The restoration of both air and electricity at the same time was considered largely responsible for the initial list when water entered the forward ballast tanks. This in turn was exacerbated when in attempting to pump out the forward ballast tanks they failed to realise that possibility that one or more aft ballast values were open and increased the forward list by unintentionally pumping out the aft tanks. It is noted the senior marine staff's poor knowledge of the ballast system had been illustrated a few weeks before the loss when incorrect use of the ballast controls resulted in a 6 deg list, which was corrected. Other than a severe verbal reprimand of the person involved, no action was taken as a result of this incident.

6. Interconnection between the control and monitoring circuits of the ballast system that caused problems for the operator.

7. Lack of understanding of the alternative method of operating the ballast valves from the ballast control room. The brass manual control rods, if used correctly, did provide an alternative means of control in event of an electrical failure, but their use was not officially documented or controlled. Their insertion resulted in up to 15 ballast valves being opened, allowing ballast water to gravitate forward, accelerating the list to port.

8. A lack of appreciation of the extent to which ballast water could transfer or gravitate from one tank to another. The use of the brass control rods had an opposite effect to that anticipated by the crew and accelerated the bow list.

9. Absence of secondary communications between the ballast control room and pump room. With loss of the public address system, this could have provided a means of co-ordinating the manual operation of the ballast system from the pump room.

10. Lack of appreciation that a forward list would increase if one or more of the aft tanks were open while pumping form a forward tank was attempted.

11. Lack of protection for the chain lockers against ingress of sea water, together with lack of alarm or dewatering capability.

12. Failure of the watertight integrity of the upper hull by reason of the vents and the light structure of the accommodation area.

Absent from the above list is the fact the Ocean Ranger did not assume a storm draft after cession of drilling and disconnect from the well.

All the above, contributed to what became an inevitable 'slide' to a position were capsize was inevitable, with the vessel too low in the water, listing and taking water to the topsides. The loss of all onboard was made inevitable by a combination of:

• poor command and control under normal operations – the Royal Commission report noted a command structure reflected a "…predominant interest in an efficient industrial endeavour…" – this being a reference to the tool pusher being the senior function offshore, to which the marine function (who ensured rig stability and safety) was sub-ordinate.

• poor command and control under emergency operations.

• an underestimation of the seriousness of the situation on-board the Ocean Ranger.

• absence of clear authority offshore and continued recourse to onshore staff for decision making, who were absent a clear picture of the situation.

• delays in the communication of the Mayday situation.

• absence of survival suits - this presents as incredulous given the climatic conditions and sea temperatures offshore Newfoundland, those in the water would have experienced near instant onset of debilitating hypothermia. The Canadian offshore safety regulator had recommended their use to operating companies working off the east coast and in Arctic waters some 8 months previously but had not moved quickly enough with operators to enforce.

• absence of alternative means of escape – use of conventional davit style lifeboat is extremely challenging with a listing structure, dependent on the lifeboat location, they were either extremely vulnerable to damage whilst being lowered (stern), or already submerged (bow). It is further noted the vessel had inadequate life-rafts and lifeboats at the time of loss.

• relative remote location (8 miles away) of the stand-by vessel as the event escalated and likely need of abandonment in heavy seas and storm condition. It was noted that role of the Seaforth Highlander as a rescue vessel was not mentioned in its contract with Mobil, and likewise there were no written instructions as to the distance of the stand-by vessel from the drilling rig, although of common practice of 2 miles (weather permitting) was practised in the industry.

• inadequate design and presence of emergency equipment on the stand-by vessel and rescue helicopters to rapidly intervene to assist with lifeboats or men in the water – the rescue and recover equipment on the stand-by vessels would not have looked out of place in vessels from the 19th century and fell short of regulation at the time of the loss.

• absence of rigorous and tested emergency response procedures.

• communication issues between all responders, with lack of a central control having a clear and up to date assessment of the situation at any one time.

• lessons learned (locally) – see 5. above.

• lessons learned (from others) – the loss of the Alexander L. Kielland two years earlier in storm conditions, whilst having some major differences in the causal factors had highlighted the need for adequate emergency equipment and training for offshore crew, few of the lessons had been heeded by the Ocean Ranger at the time of the loss.

Root Causes									
Equipment Failure				**Human Performance**				**Other**	
Repeat Failure		Unexpected Failure		Human Engineering		Training	X	Sabotage	
Preventive/Predictive Maintenance				Procedures	X	Management System	X	Natural Peril	Wind Storm
Design	X			Communications	X	Quality Control		Other	
Equipment/Parts Defective				Immediate Supervision	X				

Lessons Learned

Reading the Royal Commission report some 40 years later, it is useful to reflect on how far the industry has 'travelled' since the loss, notwithstanding that some of the fundamental weakness in critical risk controls that resulted in the loss of 84 lives and vessel are ever prevalent.

Reference should be made to the Royal Commission Report, Chapter 10 for the published list of Recommendations, and also to the United States Coast Guard (USCG) Report, who conducted a parallel and supporting investigation given the Ocean Ranger was registered in the United States.

The Norwegian Maritime Directorate (NMD) conducted a study of the Risk Assessment of Buoyancy Loss (RABL) looking at both the Alexander Kielland and Ocean Ranger losses, reporting in 1988. The UK HSE subsequently published a document, RR143 Review of the RABL Project, in 2003 which discussed the key findings of the Norwegian project.

A generational change in design of semi-sub MODUs resulted from the Ocean Ranger loss – the IMO code for the construction and equipment of Mobile Offshore Drilling Units (IMO MODU code) was revised and updated in 1989.

The following is a more general reflection of the failed risk controls that were significant to this incident, and serves to illustrate how adverse and upset operating conditions will 'find' the latent weakness in these controls.

Design (Inherently Safe) – the location of the ballast control room at a low elevation in the 3rd starboard column was a fundamental design weakness, which was not acknowledged within the design of the equipment in the room, nor the provision of sufficiently strong portlights, themselves necessitated by a reliance on manual draft measurement, in spite of the availability of remote measurement capability that time. An inherently safe design should always be a preferred solution; any deviation from this will inevitably lead to compromise and further barriers needed to protect the inherent flaw.

Design (Process Hazard Analysis) – the control of the ballast system presented as an unnecessarily complication, and whilst a critical operational station keeping system and process, this had not been subject to a systematic tool such a HazOp (hazard and operability study). Absence of critical challenge and analysis of any design will leave it vulnerable to being compromised in normal and emergency operation.

Design (Safety Critical Elements) – flawed approach to the location of the ballast control room and design of the ballast system, together with the example of the chain lockers as designed being vulnerable to taking in 'green water' resulting in down flooding, with no weather or watertight covers, and lacked the means to be pumped out, are all illustrative of the ballast system and wider station keeping system simply not being the given the Safety Critical Element status it deserved. The Enquiry report emphasised that the ballast pumps should be designed to pump at an adequate rate to restore the rig level up to and including the down flooding angle or the angle reached in the worst case damage stability case whichever is greater. The ballast pumps' inability to perform as the rig inclined by the bow contributed to the loss.

Design (Inherent Design for Intact and Static Stability) – review the assumptions made for the MODU intact and static stability and in particular the use of the static down flooding angle to calculate the righting moment unless the point of down flooding is adequately weather-proofed.

Procedures – the lack of key procedures or lack of procedural discipline was centre-stage in this loss. Not taking the vessel to storm draft and failure to close the deadlight on the portlights are but two examples of safety critical procedures not being followed. Procedures are there for good reason and compliance should be mandated and audited. Where design features are included to mitigate loss, their presence should be acknowledged in procedures, and clear guidance given as to their need and use.

Functional Training – notwithstanding the damaged portlight, and the resulting disabling of the ballast control panel, the incident would not have escalated to a capsize had the crew been fully competent in the use and function of the control panel. The view of the investigation was that had the crew shut the panel down and retired for the evening the vessel would have likely survived the storm. Their good intentioned intervention, without a proper understanding of the panel functionality, led to ballast being introduced to port, whilst taken away from aft which resulted in a list from which the vessel did not recover. Comprehensive functional training is a necessity of any role, with a demonstration that a required level of competence has been reached, particularly for safety critical roles, such as training and competence which should be routinely re-demonstrated.

Emergency Response – the cause of death for all the bodies recovered was drowning whilst in a hypothermic condition. Suitable equipment was available to the offshore industry in the form of survival suits, not yet available on board, and would have appreciably lengthened the time of survival in the water. The fact that those on board were in the water was as a result of inadequate means of escape. Primary, secondary, and tertiary means of escape should be provided as a matter of course, to cater for a range of emergency evacuation scenarios. Emergency equipment on rescue vessels and helicopters should be available to rapidly pull persons from the sea or lifeboats/life craft

Emergency Training – delays in escalating and responding to the incident diminished the already slim chances of survival for those on the night of the loss. Training and routine realistic scenario testing should be mandated to individuals offshore in respect to survival, and likewise those with key offshore and onshore emergency response roles, with absolute clarity in regard to the command structure

Role of the Regulator – a number of Canadian and USA regulatory bodies came under criticism for both the regulation gaps, and enforcement of regulation already in place. Such a situation is not unusual and has been a criticism of many offshore incidents with large loss of life. Whilst regulators will typically make changes in direct response to individual losses, these can take many years to pass into legislation, and remain ultimately only as strong as the level of compliance and enforcement. There remains a fine balance and disagreement globally across regulators as to the use of prescriptive and enabling models, although arguably the most appropriate model is a combination of both. As was the case in other major offshore incidents such as Alexander L. Kielland, Piper Alpha and Deepwater Horizon, major regulatory overhaul followed this incident.

References

1) Report of the Royal Commission, https://publications.gc.ca/site/eng/9.818922/publication.html.

2) USGC Marine Casualty Report.

3) Willis Loss Database.

4) Marsh 100 Largest Losses in the Hydrocarbon Industry (March 2020).