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Mumbai High North Platform Disaster

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ABSTRACT

The Mumbai High oil field is located in the Arabian Sea, 160km west of the coast of Mumbai, India. The field is operated by Indian operator Oil and Natural Gas Corporation (ONGC) and is the largest oil field in India. Located in the field's northern block was a production complex, 100km from shore, consisting of four bridge-linked platforms. The Mumbai High North (MHN) platform was constructed in 1981 and outfitted for production of 80,000 barrels of crude oil per day.

In July 2005, a multipurpose support vessel (MSV) was completing a diving campaign at MHN when a crewmember was injured. Upon recovery of the diving bells, the MSV requested the injured employee to be transferred to the platform. Weather conditions were unfavourable the day of the event, with monsoon rains and high winds, prohibiting the use of the MHN's helicopter. The leeward crane of MHN was out of commission at this time, so the vessel began to approach the platform on its windward side. During the approach, the master had noted that the starboard thrusters pitch was slow moving. After the injured crewmember was successfully transferred to the platform, the MSV experience a heave from ongoing ocean swells and struck several marine risers. The resulting gas leak ignited rapidly and spread to adjacent risers with no fire protection. Fluid flow in the risers was not contained by emergency shutdown valves due to their overall length. Rescue operations were unsuccessful in recovering 22 lives that day.

At the time of this incident, no regulatory body or organization for the governance of offshore safety in oil and gas existed in India. Serious issues concerning the platform and it's export risers, as well as lack of risk mitigation aboard the MSV, were discovered. Shortly after the incident, U.S. governing bodies signed an MOU with the Indian petroleum directorate to share common knowledge and develop comprehensive rules and regulations.

1 INTRODUCTION

The Mumbai High oil field (formally Bombay High) is located in the Arabian Sea, 160km west of the coast of Mumbai, India. Upon discovery in 1967 by Russian and Indian seismic exploration vessels, the Mumbai High Field had an estimated 1,659 million tons of total reserves consisting mainly of crude oil. The field covers a surface area of approximately 115,000 km^2 in an average of 200m water depth [1]. The field is operated by Indian operator Oil and Natural Gas Corporation (ONGC) [2] and is the largest oil field in India. This particular field remains to be the largest producer of oil in India.

Located in the field's northern block was a production complex, 100km from shore, consisting of four bridge-linked platforms, as indicated in [1]:

- NA; Wellhead Process Platform (built 1976)
- MHF; Residential Platform (built 1978)
- MHN; Production Platform (built 1981)
- MHW; Additional Process Platform – Gas compressor, water injection

Figure 1: Mumbai HIgh Field Complex [5]

The MHN (Mumbai High North) Platform possessed crude oil production capabilities of 80,000 plus barrels per day. Other topsides activity on the platform included gas processing for gas-lift production methods, which is the main means of oil recovery in the Arabian Sea [1]. MHN was a 7-story steel structure housing 10 fluid import risers and 5 gas-injection risers ranging from 12 to 16 inches at 1200 psi. Oil was exported to shore-based facilities via subsea pipelines. The structure was supported by an eight-legged steel jacket and was 65m and 25m wide [3].

2 DISASTER EVENTS

On July 27th 2005, the Samundra Suraksha, a multipurpose support vessel, was working in the Mumbai High field completing a diving support campaign. Refer to Figure 2 below for the location of the MHN platform. Although owned by ONGC, the 100m long vessel was operated by the Shipping Company of India (SCI) [5]. At approximately 1400hrs, a cook in the galley of the Samundra Suraksha cut off the tips of two if his fingers. The vessel's master then ordered the recovery of its diving bell and divers. At roughly 1445hr [1], the OIM (Offshore Installation Manager) received a request from Samundra Suraksha in the MHN radio room to transfer the injured crew member.

Weather conditions on the day of the event were unfavourable. Monsoon rains, high winds (25 knots) and accompanying high seas (4-5m swell), had grounded the helicopters servicing the offshore platforms in the Mumbai High field. The MI-172 helicopter was parked on the MHN helideck, but flight and landing aboard the Samundra Suraksha to retrieve the injured personnel was prohibited due to deteriorating weather conditions. The MSV captain then sent a request to MHN for a basket transfer of the injured crew member via crane transfer. When their call went unanswered, the vessel requested the assistance of medical professionals and attention from several other platforms and jack-ups operating in the field. Requests were denied due to POB (personnel on board) and doctor unavailability. When the vessel reached MHN on a second occasion via radio, the situation was discussed between the platform's OIM and the vessels master. It was agreed upon that the injured person would be transferred in a basket via the platform's south crane [3].

Figure 2: Mumbai High Field Location [1]

The leeward crane of MHN was out of commission at this time, so the vessel began to approach the platform on its windward side. The Samundra Suraksha was a DP (Dynamically Positioned) class vessel with multiple thruster control options, as outlined below [5]:

- DP: computer controlled thrusters based on dynamic positioning.
- Manual: the maneuvering of individual thrusters via lever control.
- Emergency: the bypassing of lever controls and directly maneuvering thrusters with push buttons.

As the vessel continued to approach the platform at approximately 1530hrs, it was observed by the master that the starboard azimuth thruster pitch was sluggish. He promptly decided to continue approaching MHN's windward side, as a lot of time had already been lost in search of medical attention for the vessel's injured crew member. For the approach, the operating mode of the thrusters was switched from DP to emergency mode [5].

The injured person was successfully transferred to the platform. As the Samundra Suraksha moved away from the platform, it experienced a large heave from ongoing ocean swells and the thrusters were unable to compensate. The helideck of the vessel struck one or more of the export gas-lift risers in the SW region of MHN at approximately 1605hrs [5]. The resulting gas leak ignited and flames spread rapidly to adjacent risers with no fire protection. Emergency shutdown valves did not contain the flow of hydrocarbons in several of the longer risers, some of which reached 12km in length. Explosions occurred and the fire escalated extremely quickly. The duration of the immensely destructive fire was just under two hours and it engulfed the entirety of MHN and MHF, as illustrated in Figure 3 below. Nearby platforms and jack-ups working in the area were severely affected by heat radiation.

Figure 3: MHN Platform Engulfed in Flames (July 25th 2005) [5]

3 RESCUE OPERATIONS

The rapid spread of the flames also hindered rescue operations, as only a small portion of lifeboats and rafts could be launched. Over a 15-hour period, 362 of the 384 POB that day were rescued, along with 11 pronounced dead and 11 lost at sea [1]. Rescue operations were also severely affected by weather conditions, as the monsoon had grounded all helicopters in the area for several days. The Samundra Suraksha MSV caught fire due to several explosions. Flames were extinguished and the vessel was towed off-site, only to sink on August 1st 2005. 36 hours after the initial impact, an emergency response vessel rescued 6 divers in a saturation diving bell [1].

4 ISSUES & FINDINGS

At the time of this incident, no regulatory body or organization for the governance of offshore safety in oil and gas existed in India. Another factor influencing the disastrous series of events was the lack of procedures and measures for risk mitigation, which is predominantly at fault of the operator.

4.1 Samundra Suraksha, MSV

The Samundra Suraksha was a DP class vessel. DP control of the thrusters would have allowed for appropriate thruster output and in turn, vessel position with reference to the platform and surroundings, even in unfavourable sea states. Instead, in manual or emergency thruster operation mode, the vessel’s position is entirely under human control. When the inadequacy of DP control was discovered, an all-stop on the injured crew member transfer should have been called. This command was likely in the hands of the MSV captain, who should have assessed the weather conditions and required proximity of the vessel and platform. In any case, this would have been a difficult judgment call by the captain when one of his fellow crew required medical attention and all other avenues had been exhausted. This may also have been a case of competency and training in the captain and crew and poses the question: was someone not doing their job correctly, or were they improperly instructed on how to do so in the first place?

Prior to leaving for field, pre-qualification checks and required maintenance is generally performed on offshore vessels as a measure of risk mitigation. The DP control issue may have been discovered at port if it had been present at the period prior to departure.

Another issue with the MSV in this compilation of events was the diving bell evacuation procedure. Saturation diving (diving at depths greater than 50m) campaigns are risky undertakings and proper procedures should be present to ensure diver safety in emergency situations. The recovery of the diving bell was extremely delayed. Since the divers were subsea in the diving bell for an extensive period of time, appropriate decompression methods would be required to ensure the health of the divers.

Figure 4: MSV Samundra Suraksha post-collision with MHN [1]

4.2 MHN Export Risers

MHN's gas export risers should have been considered a principal hazard of production operations, as there are high volumes of extremely flammable fluids flowing through them at all times. Emergency shutdown valves capable of controlling the entirety of the risers content should have been in place. Isolation valves could have also been in place on the subsea end of the risers to control fluid flow in the event of failure. A proper risk management scheme would have identified the hazard at hand and the radical consequences may have been prevented.

The export risers also lacked proper protection from impact and environmental loading. Sleeves on the risers would have added protection against external forces. Alternatively, the risers could have been places in J-tubes, which are tubular j-shaped columns that completely enclose spools which travel from topsides to subsea. The overall positioning of the risers was an issue in itself, as several risers were installed on the prevailing weather side of the platform, making them more susceptible to damage and failure. The risers were also located within close proximity to a transfer crane, or in general, a loading/offloading zone. This poor design scheme dramatically increases the risk of impacting the export risers and subjecting other components and personnel to consequences upon rupture.

4.3 MHN Platform

Though a suitable risk management plan was lacking, the OIM aboard the platform should have foreseen the risk involved in an approaching vessel during adverse weather conditions. There should always be pre-entry checks before a vessel advances a fixed platform. The OIM should have denied the MSV's request for a basket transfer, as conditions and placement of equipment put the personnel of both the platform and vessel at increased risk. The decision to allow the vessel to approach the vessel was a subjective one, and made under emotional considerations as the employee of the MSV was injured and could not attain medical attention elsewhere. This may also be an issue of crew competency and proper training in emergency/safety events.

If it was the case that the crane placement was not flexible, proper fenders should have been placed in the loading zone to mitigate the risk of impact on the platform and it's utilities. It is obvious that collision risk management was not a deciding factor in the installation of the platform. The installation arrangement and lack of protection left the platform and it's appendages vulnerable.

The total cost of damages of the Mumbai High North platform fire was upwards of $200 million (USD). In 2005, India produced 50% of it's crude domestically [3]. This disaster left the Indian government in search of product from surrounding countries, as the MHN complex produced the majority of oil extracted in the country.

5 LESSONS LEARNED & WAY FORWARD

As mentioned, at the time of the MHN platform fire, India lacked a governing body for offshore oil and gas operations. There were no standards and regulations other than those set by ONGC, the platform's operator. Established in the 1950's, ONGC is India's largest, most profitable company [3]. However, the company did not have a set of offshore rules and regulations until 2008 [4].

This offshore disaster led India's offshore industry, as well as other industries globally, to rethink and reinforce their need for a suitable and thorough risk management plan. The UK's Health and Safety Executive (HSE) conducted a review of the MHN platform disaster and deduced upon several key findings. India's lack of offshore regulations was compared to those of the United Kingdom's. A risk management scheme would have immediately picked up on the fact that export risers are a major hazard due to their high volumes of explosive hydrocarbons.

> "Hydrocarbon risers on UK offshore installations generally are considered safety-critical elements and, therefore, are subject to independent verification of assessment." [5]

There was a complete failure in risk mitigation on the MHN platform with regards to the export risers. Risk management and collision avoidance measures would also have provided guidance on the issue of approaching vessels. A moving vessel within certain limits of a fixed platform should always be seen as a threat, as the platform does not have the ability to move out of harms way. A safer design of the platform itself may have avoided the events that quickly escalated to disaster in July of 2005.

The Indian Ministry of Petroleum and Natural Gas is responsible for all exploration, production and export/import of petroleum and natural gas in India. In 2000, the Ministry formed the Indian Oil Industry Safety Directorate (OISD) who would be responsible for governing oil and gas operations and setting forth safety objectives. A Memorandum of Understanding (MOU) between the U.S. department of the Interior's Bureau of Ocean Energy Management, Regulation and Enforcement (BOEMRE, formally Mineral Management Service, MMS) and OISD was instated. This MOU outlined that the United States and India would share common offshore oil and gas regulatory knowledge over the next several years. The MHN platform disaster created urgency for cooperation between both parties and the MOU was signed on July 21st 2006. In 2008, 174 new rules and regulations were added to OSID's drafted offshore rules [1].

> "In November 2008, BOEMRE experts and management travelled to New Delhi to perform a needs assessment as for future training and cooperative efforts. In February 2009, the first activity after this assessment was two, 2-week on-the-job training/shadowing stints of OISD engineers and inspectors at both the BOEMRE's Gulf of Mexico Region and the Pacific Region. This was followed up in November 2009 by a small team of BOEMRE inspectors and engineers travelling to both the Eastern and Western Indian offshore to conduct joint audit/inspections of Indian facilities utilizing the new 174 safety rules." [1]

When BOEMRE auditors looked at facilities in the Mumbai High South field, gaps in consistency of the rules and regulations were found, but overall the goal of engaging Indian operators in safety and regulatory initiatives in the offshore was achieved. However, in such an innovative and ever-changing industry, safety rules and regulations need to continuously be amended and built upon. In 2010, BOEMRE and OISD held a joint industry/regulator workshop in New Delhi that focused on deepwater technology and industry regulation compliance. In February of this 2011, the two bodies held a second workshop focusing on integrity concerns of aging facilities offshore India. Some clauses relevant to the outcome of this disaster include (among others): Guidelines on Safety Management System in Petroleum Industry (OISD-GDN-206), Inspection of pipelines Offshore (OISD-GDN-139), and Emergency Requirements and Evacuation (OISD-GDN-227).

6 CONCLUSION

Production was restored in just 5 weeks, as lines were diverted to Mumbai High South facilities. In 2006, ONGC spent $280 million USD to rebuild the platform and it's extensions in the Mumbai High field. As a result of the disastrous events in 2005, India eventually created a much-needed offshore regulatory body to monitor and govern offshore oil and gas activities. Though this body will not solve and prevent all safety issues, it will drastically decrease the risk associated with operations in India's offshore. If a set of rules and regulations had been instilled prior to 2005, it is likely that the collision and its disastrous consequences would not have occurred.

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