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To Generate and Analyse RISK INTENSITY MATRIX for Offshore data acquisition in ONGC in consideration with QHSE & Security aspects.

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Summary

Oil and Natural Gas Corporation LTD (ONGC) acquires Onland and Offshore seismic data through its own or contractual crews. The data acquisition involves operations of heavy machineries, power and transportation of explosives and imposes various kinds of risks to the operating crew. To offset these risks, ONGC practices various HSE and security measures. All E&P activities contribute to the risk posed to the environment and a full assessment of these risks is an essential part of environment impact assessment. This paper evaluates the effectiveness of these measures in offshore operational areas by recording the observations and interaction with the crew members of offshore seismic data acquisition. The observations were ranked on the scale of 1-4 and risk intensity matrix was generated. Based on the risk signals observed from the computed data of risk intensity matrix and various innovative approaches being practiced by petroleum companies world over, a suitable plan has been proffered for enhancing effectiveness in existing safety measures in vogue in practice in ONGC to more effectively control risk in offshore seismic data acquisition process.

Keywords: Incident Investigation, Process map development, Risk Intensity matrix, Bioremediation process.



Figure-1: Various activities in Oil Exploration

Introduction

ONGC is a Navaratana PSU engaged in seismic data acquisition both in offshore and on shore areas to pursue its exploration and exploitation activities. The ONGC's own offshore geophysical operations were started in 1975-76 through the seismic vessel ANVESHAK and then by SAGAR SANDHANI in 1986-87. The seismic exploration activities on-land started with 2D

seismic survey in 1967 followed by 3D in Balol field of Mehesana in Gujarat region in 1986-87.

The seismic data acquisition involves heterogeneous risks arising due to human error, equipment failure, miscreant activities, style of operating heavy vehicles/equipment's, handling explosives, and the place of operation. ONGC has its own Health Security, Safety and Environment management system to combat these risks. The existing HSE system of ONGC is efficient, effective, vibrant and as per industry standards of health, safety, security and the highest environment protection with minimized waste and pollution control.

Various new approaches have been evolved by the safety experts globally viz. Nakib Mohammed (2008) safety incidence investigation system in petroleum industry. Similarly, Alzaabi (2008), suggests development of HSE process maps for risk avoidance. Environmental Experts are also focusing on bioremediation process for pollution control to enhance Safety and Social Security.



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HSE security measures in ONGC seismic operations involve:

- Conserving biological diversity and maintaining ecological process and systems by plantation of mangroves for arresting coastal degradation



Figure-2: Mangrove Plantation with a production facility in the background

- Creating training and development programs such as sea survival training and mock drills as per ISO standards.
- Safety and security audit for personnel working in the offshore geophysical operations and environmental audit in the area of operation.
- Knowledge for continual growth of safe working practices among crew members and up gradation of HSE policy.
- Proactive management functioning style towards safety, health and environment protection, safety awareness with accountability for all employees and the contractors engaged in seismic data acquisition for performing the daily activities consistent with laid down HSE Policy and Integrate HSE proactive standards and the objectives as per global business plans in geophysical operations.
- Bioremediation process, Incidence investigation, and process map development are the main measures & innovative approaches for hazard assessment and risk control.



Figure-3: Application of Bioremediation



Figure-4: Before Bioremediation



Figure-5: After Bioremediation

- Cause-effect analysis of any near miss/oil spills or any casualty to control repetition /reoccurrence of accidents. Adequate resources to handle the oil spills and near miss in the operational areas with Fire suppression systems in offshore platforms and seismic vessels.
- Preserve the environment in which the geophysical operation is in progress by utilizing resources, responsibility and by reduction and elimination of waste materials.
- Regular Compliance report generation with all laws/rules and regulations in the geophysical operations.



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- To tackle Emergency and Disaster situation through Emergency Plan at the operational area level and Disaster Management Plan at the higher levels.
- Environmental protection by plantation of mangrove for balanced ecosystem and numerous species, which also serves as breeding place for marine organisms and to obtain environmental clearance for conducting geophysical operations (On land and Offshore). Bio-remediation technology has been used extensively and effectively in on land geophysical operations also.

Theory/Methodology

Review of practices followed by seismic crews of ONGC in off-shore areas and by physical observations and by interaction with about 20-25 geoscientists of ONGC, working in offshore areas as well as about 15-20 contractual vessels crew. Offshore crews personnel were asked questions related to HSE with in a span of 20-30 days. Interview was mainly focused on HSE, security issues pertaining to operations concerning men and material The responses were marked on a scale of 1-4 and tabulated severity factor. Rank Tables were prepared as per their impact and prevailing risk matrix was made for Offshore geophysical operations.(Table-4)

Consequences factors and Rank tables are categorized in four categories as given in Table-1 namely major, serious, minor, incidental depending on nature of injury and effect.

Likelihood factors/ Probability of occurrence of the incidence is presented in Table-2, under four categories as frequent, occasional, seldom, and unlikely depending upon periodicity of occurrence.

Likelihood factor/probability of occurrence Rating/score	Frequent	Occasional	Seldom	Unlikely
	4	3	2	1

Table.2: Risk Levels

The description of risk level and score is given in Table-3
EXTREME RISK- Cannot accept this risk. The score of 9-16 on the risk matrix indicates the extreme risk and it is not acceptable in any situation and which may have avoidable fatal and major permanent injury.

HIGH RISK-must implement extensive risk control The score of 06-08 on the risk matrix indicates the high risk and must implement extensive risk control causes to Semi permanent injuries /fatalities and serious damage.

MODERATE RISK-may require risk control, The score of 03-04 on the risk matrix indicated the moderate risk. It may require much risk control as it may cause to minor injury and damage.

LOW RISK-Some risk may still justified. The score of 01-02 on the risk matrix indicated the low risk and may require some risk control which may cause to minor injury and damage.

Score	Risk Level
9-16	EXTREME RISK
06-08	HIGH RISK
03-04	MODERATE RISK
01-02	LOW RISK

Table.3: Risk Measurement

Severity/ consequences factor	MAJOR Personnel(OHS)- Fatality or permanent injury Environmental- Significant release with serious off-site impact and more likely than not to cause immediate or long term health effect	SERIOUS Personnel(OHS)-One or more serious injury Environmental- Significant release with serious off-site impact	MINOR Personnel(OHS)-Single injury ,not severe Environmental-Release which results in agency notification or permit violation or onsite impact	INCIDENTAL Personnel(OHS)-Minor or no injury, possible down time Environmental- Environmentally recordable event with no agency notification or permit violation
SCORE/ RATING	4	3	2	1

Table.1: Consequences Factors and Rank Tables



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Location	List of activities	Hazards	Severity factor(S)	Likelihood factor (L)	RISK LEVEL S*L
Transformer/generator set	Overload /emergency condition handling	Explosion, fire and short circuiting /overloading	2	2	4
Electrical equipment/cables /accessories	Electrical supply to all electrical equipment's/seismic instruments	Damage to cable/junction box and short circuiting	2	2	4
In-sea repair and maintenance	Seismic operations/repair and maintenance	Water pollution, waste disposal ,environmental pollution/security lapse	2	2	4
Crew Health of On-Board and Medical care on-board	Seismic operations /maintenance / Rolling/Pitching /preventive maintenance Medical &clinical checkups and first aid	Sea sickness, Food induced sickness	2	2	4
		Deep freeze food for Long duration Improper diagnosis and lack of specialized medical aid	2	2	4
Environmental related activities	E.C clearance ,line laying and other related activities	Environment ,safety	2	2	4
Retrieval of air gun	Seismic operations/seismic cable laying,	Environment health and safety hazards, security hazards	2	2	4
Deployment of air gun	Seismic operations	Environment and safety hazards	2	2	4
Air Transport	Crew change/emergency	Mishaps due to bad weather	3	2	6
Security (marine)	Mock and safety drills	Insecurity and no safety	2	2	4
Stores	Loading/unloading Shifting of material	Lifting of heavy load/shifting and injury caused due to it	2	2	4
Survey and line operation	Seismic operations	Environment and safety hazards	2	2	4
Cranes/winch es	Maintenance/loading and unloading	Fall during lubricating due to wire and ropes snapping	2	3	6
Crew change at high sea	Seismic operations	Fatal accidents	3	2	6
Hazardous activities areas	Crew change	Bad weather and engine failure	3	2	6
Water Transport	Oil food seismic equipment with accessories etc	Rough sea, improper maintenance regular wear and tear	2	3	6
Marine seismic vessels	Seismic operations	Environment pollution: oil spills, near miss, and improper maintenance	3	2	6
Marine support vessel	Seismic operations	Environment ,oil spills ,near miss , and improper maintenance	3	2	6

Table.4: Responses for hazard identification, risk assessment and control in geophysical operation (off-shore)



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As per the analysis from table-4 the Risk Level(S*L) lies in between 4-6 which are within the range from high risk and moderate risk and description is as under:-

High risk (Score=6) : High risk at the key locations namely Stores, Survey and line operation, Cranes/winches, Crew change at high sea, Hazardous activities areas, security of men material and machine, Water Transport, marine seismic vessels, Marine support vessel and Operational activities areas. The activities at these locations are major causes of high risk and generate irreparable damage. The damages emerge in the form of environmental pollution such as water pollution due to oil spills and waste disposal endanger marine life. Similarly and more seriously, it damages to the health of personnel on-board and environment. As per the analysis from table -5 it gives a picture about the product of severity and the likelihood factor ie Risk Level(S*L)

Moderate risk: (Score=4) Moderate risk at the key locations namely Transformer, Electrical equipment/cables/accessories. On-sea repair and maintenance, On-Board crew health, medical care on board, road transport, environment related activities, deployment and retrieval of air gun and streamers, air transport and security of men and material. The activities at these locations are major cause of moderate risk and require risk control measures to reduce the risk. The local management should analyze the Severity of the incident and the situation to monitor the trends and identify the factors associated to grade it by Periodical reviews. If continuous monitoring is done for risk control, then these factors associated to grade it by Periodical reviews. If continuous monitoring is done for risk control, then these problems will overcome the damage which occur for health, safety environment and security related activities.

Table: 5 Risk Matrix Analysis (Offshore data acquisition)

	4	04	08	12	16
serious	3	03	06	09	12
moderate	2	02	04	06	08
incidental	1	01	02	03	04
Severity factor	0	1	2	3	4
	Likelihood factor	unlikely	Occasional	seldom	frequent

Top Four Bright and Grey areas in ONGC HSE Management system are :-

Bright Areas:

- 1 Electrical equipment/cables and accessories are world Class and imbibe negligible risk.
- 2 On-sea repair and maintenance system.
- 3 Environmental related activities.
- 4 Deployment and retrieval of air gun.

Grey Areas:

- 1 Preventive repair and maintenance of seismic vessels.
- 2 Streamer layout.
- 3 Repair and maintenance of cranes winches and accessories at the area of operations.
- 4 Areas such as stores where loading shifting unloading and other activities are in the progress.

Conclusions

From the description and results of Risk Matrix Analysis of the risk level measurement, it is evident that the activities in top bright area in ONGC HSE Management system are being performed under the highest safety control environment. However, it is suggested that meticulous process map should be evolved and strictly followed. The incidence reporting system has to be further refined to the level of micro details to avoid near miss.

Similarly, the activities in top grey areas in ONGC HSE Management system are under the moderate to high risk zone. The operations falling under these categories should be performed with more care, technical knowhow and



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caution. The mandatory items of uniforms and safety kit must be used on operational sites. The electrical diagrams and operational flow charts should be displayed with miniscule detailing in front of the operating personnel. In the location where the electrical equipments and accessories are handled there should be proper preventive maintenance, to avoid short circuiting insulation tapes should be used, use of electrical safety shoes, proper earthing facilities, properly insulated tools. Pollution should be minimum so that it does not harm the flora and fauna and proper reconnaissance of the area should be conducted before the operations start.

Fresh food should be supplied in place of deep freeze processed food items. Books of first aid should be available for guidance on use of first aid medicines and medical activities to facilitate self medication and proper preventive first aid effort by the crew. Special air lift facility on demand for medical help shall also be available for offshore seismic crew.

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