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Key Practices in HSEIA Study for Exploratory Well Drilling and Testing Operations: A case study from Middle East

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Abstract

Health Safety and Environmental Impact Assessment (HSEIA) Studies were carried out to identify the potential hazards/impacts and adequate control measures to ensure the successful completion of operations while minimizing the risks to As Low As Reasonably Practicable (ALARP) level. During the planning stage for Drilling and Testing Exploratory wells, data from offset wells suggested the presence of high H2S in target reservoirs. Along with HSEIA study, Social Impact Assessment (SIA) Study was carried to ensure the mapping of impacted receptors. Risk Assessment study aided in estimation of the Emergency Planning Zone (EPZ) and Emergency Awareness Zone (EAZ) areas to identify the potential stakeholders which need to be communicated/engaged during project implementation and to finalize the Emergency Response Plan (ERP) accordingly. The drilled exploratory wells are adjacent to some populated areas and existing infrastructure, such as residential settlements, highway, labor camps, schools and government facilities, environmental protected areas etc. An attempt has been made to identify hazards and impact of operations and develop the suitable mitigation measures to safely execute the Exploratory Drilling and Testing operations.

Introduction

The study area (Figure1) is situated in the petroleum prolific Rub Al Khali Basin in Middle East region. Approximately 90% of the block area is on land with 10% in a transition zone between land and offshore. Four exploratory wells were planned for drilling. The HSEIA and SIA studies were limited to area of influence of the proposed well locations. Well A is located in southern edge of study area and falls in uninhabited area. Nearest population zone is located approximately 17 Km Northwest. Well B is in small settlement area. This settlement includes residential areas, social infrastructure (including mosques, schools etc.), small scale retail shops, commercial establishments, farms etc. Well C is inside the protected wildlife sanctuary. This area was uninhabited and fenced. Well D is located inside the defense controlled area. Nearest housing society was at approximately 7km to the west. Furthermore, several labor accommodation camps and a prominent international highway were within the radius of 2 km.

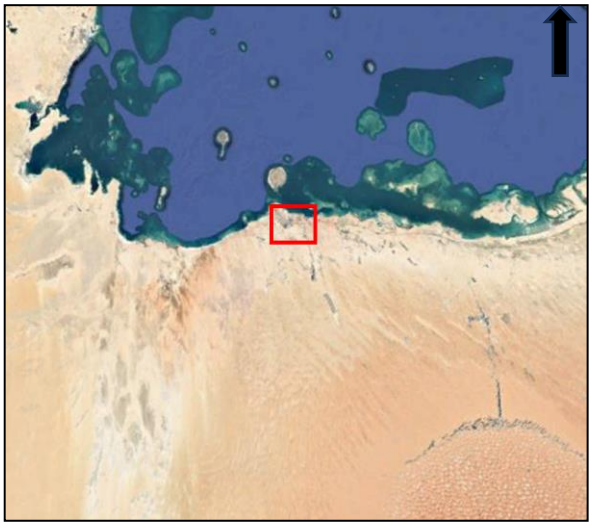

Figure 1: Location Map of study area

Studies and Procedure

Before starting the well drilling & testing activities, HSEIA study and SIA studies were carried out parallely. The following studies and procedure were adopted to ensure safe and environmentally sensitive operations for Exploration drilling and testing:

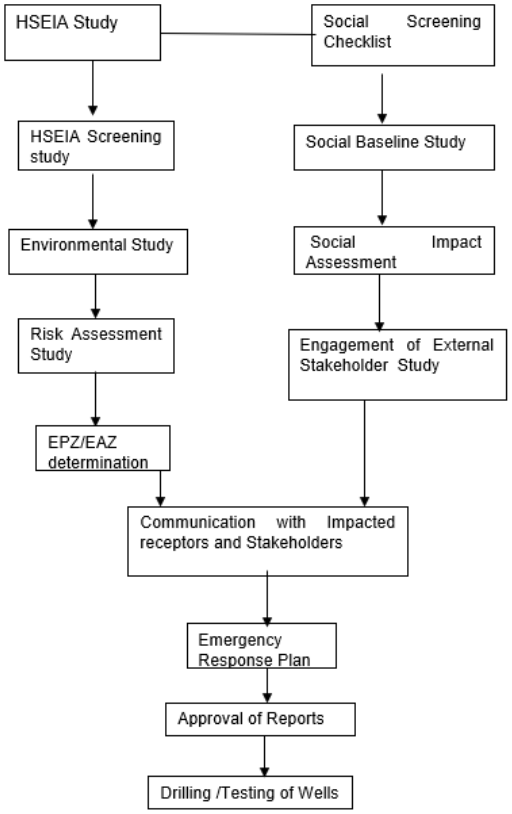

Figure 2: Process adopted for HSEIA study

HSEIA screening study

HSEIA Screening study was carried out to determine the relevant studies which need to be carried out as a part of project lifecycle. Various workshops were conducted viz. HAZID (Hazard Identification), ENVID (Environmental Identification), OHID (Occupational Health Identification), HAZOP (Hazard and Operability Study) etc. These workshops entail brainstorming sessions, guided by a typical checklist. These workshops involved thorough review of project operations, manpower, target reservoirs, expected reservoir fluid compositions, anticipated HSE risks and sensitivity to the surrounding environment. The main objective of these workshops was to systematically identify the Hazards, their cause and consequences, identify the preventive measures and assign risk to each hazard (before and after the preventive measures). These workshops were attended by experts of several domains which includes but not limited to Project Managers, Drilling Engineers, Geoscientists, Reservoir Engineers, HSE and Construction Engineers. Furthermore, all the stakeholders in the operation area were also invited to the workshops which were presumed to be impacted by the project activities. Involvement of all the potential stakeholder at the initial stage of study helped to identify the SIMOPS (Simultaneous Operations) in the area and ensure implementation of required safety measures. Major Hazards identified as an outcome of these workshops were Blowout and Toxic gases release during operations. One of the recommendations during workshop was to have close coordination with relevant Authorities for any additional support. Actions identified during these workshops were assigned to specific individuals or disciplines for resolution as part of the action tracking system. Further, comment resolution sheet (CRS) is provided to field HSE engineer and operation team to ensure all the open items are closed during the operation stage.

Environmental Study

Environmental Impact Assessment is a systematic procedure for the identification and assessment of environmental impacts associated with an activity, project or process, and subsequent determination of appropriate mitigation and monitoring practices. For establishment of environmental baselines conditions within the area of operations, a detailed environmental baseline survey has been undertaken. Ambient air quality monitoring data was collected at 10 locations. The monitoring was undertaken to measure Sulphur dioxide (SO2), Nitrogen dioxide (NO2), Ozone (O3), Carbon monoxide (CO). The ambient air quality monitoring results were compared

with relevant ambient air quality standards. The results of the monitoring showed that the average ambient air concentrations of the measured pollutants were within the relevant standards. The Meteorological Data which includes Wind speed and direction, temperature and relative humidity measured during the entire execution period. Overall impact was assessed low. To manage the waste (Hazardous and Non-Hazardous waste) generated during operations, a concrete Waste management Plan was prepared. A soil and Ground Water contamination assessment was undertaken at selected locations. Soil and Ground water samples within the proposed exploratory drilling locations were generally uncontaminated, and all of the target parameters were reasonably below the standard limits. Noise monitoring was conducted at 10 selected locations and results were found within the standard limits except at location D. High noise level at location D was attributed due to proximity of Highway (vehicle movement) and Camps etc. The results of the air dispersion modelling showed that the maximum concentrations will generally occur within the immediate vicinity of the well site and thus, it will not affect the nearest receptors (i.e. labour camp within the distances of 1.2km).

Quantitative Risk Assessment

Quantitative Risk Assessment (QRA) is a systematic approach of estimating the likelihood and consequences of hazardous events, and quantify the risks to people, the environment and assets. Risk is the product of the measure of the likelihood of occurrence of an undesired event and the potential adverse consequences. All potential Major Accident Hazards associated with the facility or operations were considered for QRA assessment. Major Hazards identified during HAZID and HAZOP workshops are Well Blowout and Well Release.

An important input to consequence calculations is the rate at which hazardous material reaches the environment and the receptors. For leaks from equipment, the leakage rate calculated is based on process parameters (pressure, temperature, composition). Another important aspect of the release rate calculation is its time dependence.

As part of the QRA the risks to personnel were studied for all worker's groups including onsite and offsite personnel's. The Location Specific Individual Risk (LSIR) was calculated for various locations of the project facilities i.e Rig Floor, Catwalk, Mud Tanks etc. The overall Individual Risk Per Annum (IRPA) was estimated for worker groups present at site during operations. IRPA represents the risk to personnel considering occupancy factor at that location. The risk contours for location D is shown in Figure 3. The maximum anticipated H2S for location D -was 4.75 % and surface pressure was 1500 psi. These contours were further inputs for generation of H2S zoning.

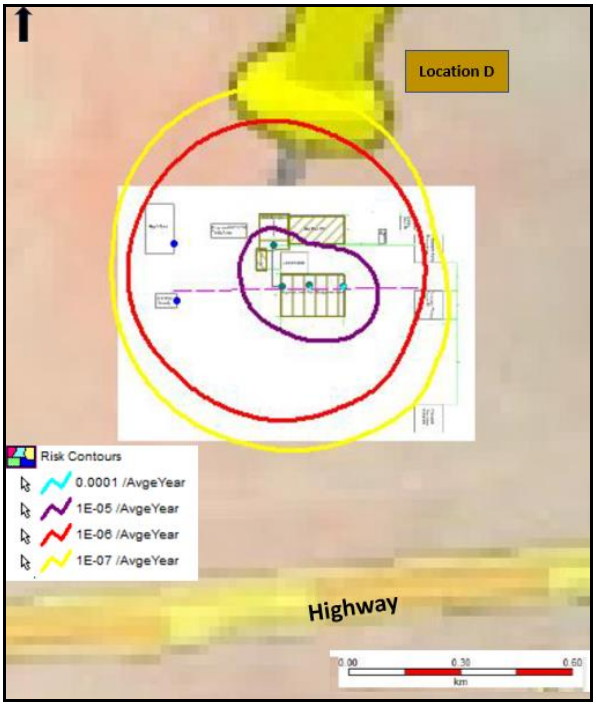

Figure3: Risk Contour for location D

H2S zoning

H2S classification Zones are defined for all facilities containing H2S more than 100 ppm in the stream. Based on critical nature of H2S hazard and associated risk, facilities are delineated in three Zones. Red Zone is considered to exist if there is high risk of H2S release which could be rapidly lethal. It is considered the limit at which personnel carrying an Emergency Escape Breathing Apparatus (EEBA) will have no time to don the mask before being overcome.

Red zone is defined where the toxic risk is greater than or equal to 1E-03 per year. No red zone is identified for drilling locations.
An Amber Zone is considered to exist outside the Red Zone where there is a tolerable risk of H2S release which could be rapidly lethal. In this zone, personnel carrying an EEBA or keeping it at hand's reach are considered to have time to don the mask before being overcome. The amber zone is the toxic risk greater than or equal to 1E-04 per year or the consequence result of 700ppm. Figure 4 is showing Amber zone generated for Location D.

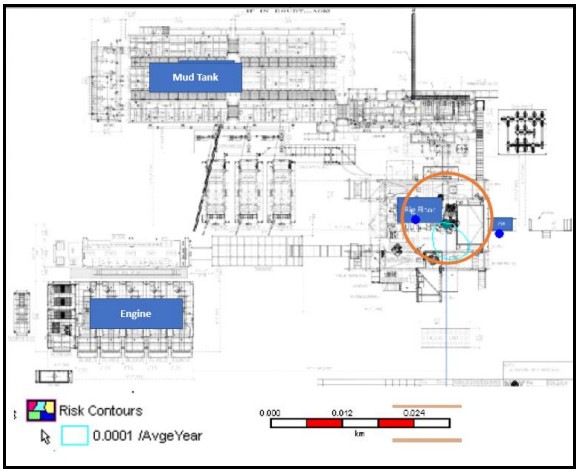

Figure 4: Amber Zone for location D

A Yellow Zone is considered to exist outside Amber Zone if there is a possibility of H2S release which could be lethal if present for prolonged period. In this zone, personnel are considered to have time to reach strategic locations of EEBA to don the mask before being overcome. The yellow zone is the toxic risk greater than or equal to 1E-05 per year or the consequence result of 100ppm. Figure5 is showing Yellow Zone generated for Location D. The modelling of various H2S zoning helped in planning the breathing apparatus at various locations at site.

Emergency Planning Zone (EPZ)

An EPZ is an area surrounding wells, production facilities, pipelines or any other process facilities that handles sour fluid. Only operation related personnel (essential) may be present in the area. This zone corresponds to extent of H2S gas cloud corresponding to 76 ppm of H2S from reasonably worst-case representative scenarios. The facilities areas are within the Emergency Planning Zone (EPZ). The goal of emergency planning, preparedness and response is to reduce the potential exposure of non-essential personnel to H2S. Only operation related personnel (essential) may be present in the area. There were no sensitive receptors presents in EPZ zones. Figure 6 is showing the EPZ modelled for Location D.

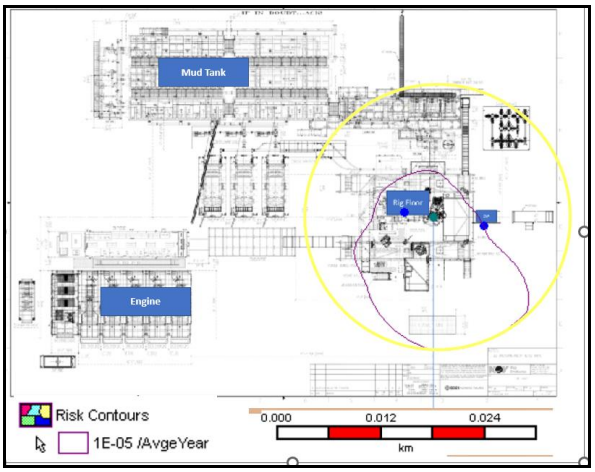

Figure 5: Yellow Zone for location D

Emergency Awareness Zone (EAZ)

EAZ corresponds to the zone where the non-essential personnel shall be located at large and should be informed about the consequences of a toxic release (H2S). This zone goes beyond the EPZ to the extent where the H2S concentration will reach 10 ppm for reasonably worst-case scenarios. The reasonably leak scenarios for 10ppm H2S Concentration engulf the entire facilities and it is considered as Emergency Awareness Zone (EAZ). The EAZ for location D includes Highway, labor Camps and offices. Figure 7 is showing the EAZ modelled for Location D.

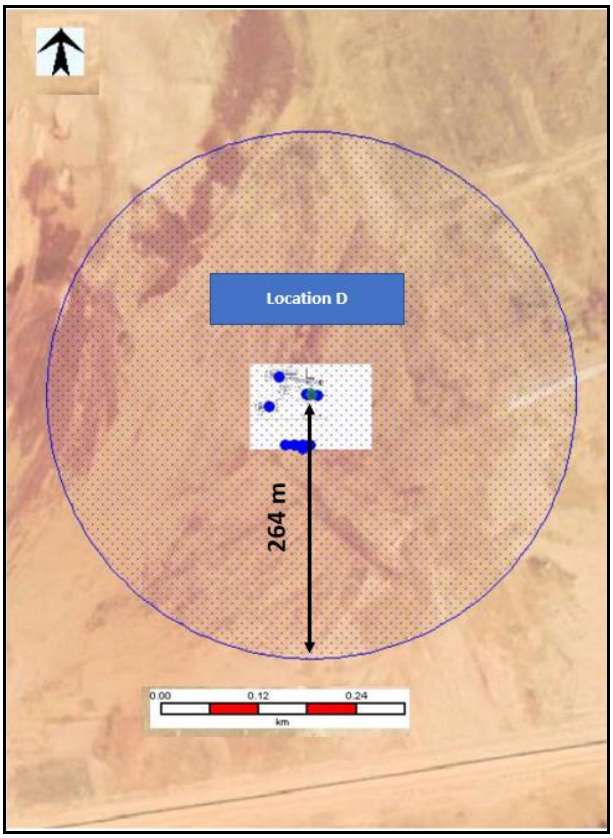

Figure 6: EPZ (264 m) for Location D

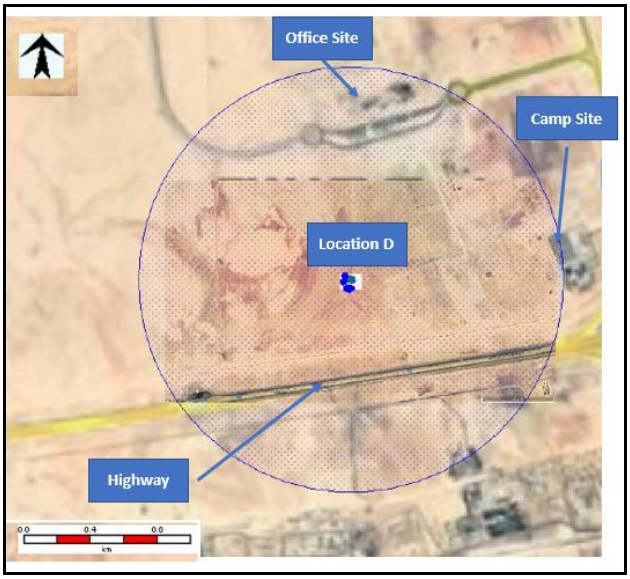

Figure7: EAZ (1182m) for Location D

Social Impact Assessment (SIA) Study

Social Impact Assessment study deals with the impact of Drilling and Testing Operations on nearby stakeholders and prepare suitable plans for stakeholder engagement during operation and ensure proper mitigation measures are in place before the commencement of operations. As the inter-well distances were large, individual well wise area of influence was considered for the study. Area of influence is the area outside the operational boundary of the facility that is occupied by the civilian population and potentially be affected (directly or indirectly) by the operation of a proposed Project. The area of influence in each site may extend to a radius of about 5 to 10 kilometers (or more). The actual impacts could vary from disturbance of routine activities within surrounding areas of a proposed well site, blockage of access roads used by public, and general public nuisance (due to vehicular movement, presence of facilities and workforce, etc.). This was particular concern for Location B and Location D, which were located in the vicinity of Residential areas. Detailed mapping of receptors was carried out and the mitigation measures were adopted in consultation with concerned authorities.

Potential stakeholders and government authorities were informed about the Project activities and their concerns were taken into consideration. Stakeholder engagement included both direct communication and communication through local government authorities (through project Brochures and public meetings). Community liaisoning officer (CLO) was in continuous communication with all government authorities and local communities during the entire period of project execution.

Conclusions

Various workshops conducted during commencement of study aided in anticipating HSE risks and sensitivity to the surrounding environment. Involvement of nearby stakeholder at the initial stage of study helped in understanding the SIMOPS (Simultaneous Operations) and requirement of necessary measures. Well specific HSEIA study and Social Impact Assessment (SIA) Study ensured the critical mapping of Environmental and Social

impacts and coordination with respective stakeholders before and during project execution. Strict procedures and processes were developed, agreed, and implemented as part of mitigation measures which includes multiple gas detection monitors at various locations on the rig, around the wellsite and perimeter fencing, within the EPZ and and beyond the EPZ area, H2S scavengers during drilling, H2S monitoring at regular time intervals during well testing, Autoignition system was installed, sufficient breathing apparatus were provided at site, Use of these equipment has been backed up with comprehensive site training, and safety drills and exercises to ensure individual understanding of the equipment. Muster points were identified for onsite and offsite personnel's. Public awareness meetings, Community Awareness Brochure have been utilized to assure stakeholders awareness of operations and suitable emergency response. Well Specific detailed study and close coordination with stakeholders helped in successful completion of drilling and testing activities.

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