ENVIRONMENTAL IMPACT ASSESSMENT OF THE DRILLING ACTIVITIES

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Abstract: - "Algeria has an estimated 11.8 billion barrels of proven oil reserves" [1]. Sonatrach is striving to double its oil fields production within the 5 to 7 coming years, especially with recent increases in oil prices on the market. For this reason, a large scale drilling operation program has been launched. Particular attention must be given to the strict application of the environmental protection program during the drilling because of:

- The vulnerability of the natural environment.
- The proximity of built up areas to the drilling site.
- The nature of the activity.

Key words: Environmental Impact Assessment, Drilling activities.

1. INTRODUCTION

The importance of environmental issues is becoming essential to the drilling activities mainly because such activities are often proposed for remote areas which are important for wildlife. One single oil well and its associated infrastructure can occupy as much as 30,000 m² of land in addition to kilometres of roads. Furthermore, these facilities have the potential to increase adverse effect into the environment; hence, the necessity to perform environmental impact assessment studies.

The evaluation of the environmental impact of drilling activities is a hard exercise, requiring collection and assessment of a large amount of information, and providing suitable mitigation measures. Successful mitigation measures are those which prevent the occurrence of adverse impacts. If it is not possible to prevent their occurrences, they should at least reduce these impacts or provide compensatory action.

The benefits of conducting an Environmental Impact Assessment are as follows:

- Avoid severe and irreversible damage to the environment while protecting human health.
- "Assist in the selection of alternatives, including the selection of the best practicable and most environmentally friendly option" [2].
- Increase project acceptance by providing clear analysis on the effect and consequences of the project.
- Identify and assess key impacts and provide measures for mitigation.
- Improve project performance and reduce cost and time in project implementation.
- "Guide formal approval, including the establishment of terms and conditions of project implementation and follow-up" [2].
- "Serve as an adaptive, organisational learning process, in which the lessons of experience are fed back into policy, institutional and project design" [2].

2. IMPACT ASSESSMENT AND MITIGATION

2.1 Introduction

The study of the potential impact of the drilling activities, and their mitigation are key factors in undertaking an environmental impact assessment (EIA) report. Thus, the EIA will be usable by

the project team within the framework of the ongoing environmental management of the drilling activities, and it will describe the impact to the stakeholders involved in the project. The aim is to ensure that the potential impacts of the drilling activities are identified, assessed and suitable mitigation measures established for any negative impacts while ensuring at the same time that legislative or policy requirements regarding environmental impacts are met.

The approach used is risk-based assessment. It requires a systematic analysis of each individual phase of the activity, and consideration of potential impacts. "Assessment of impacts, for both frequency and severity results is ranked in terms of risk significance (high, medium or low)" [3]. The general principles are:

- Identify the project activities, products or services with potential impacts on environmental and socio-economic resources and receptors.
- Evaluate the significance of the impacts (severity and frequency).
- Determine mitigation measures to prevent negative environmental impacts.

2.2 Scoping and Impact Identification

Scoping is one of the main elements in a successful EIA. It identifies the potential impacts of the drilling activities, and focuses on the assessment and the range of issues to be considered. Once the potential impacts are identified, the next step is to establish temporary judgements on which impacts are potentially significant.

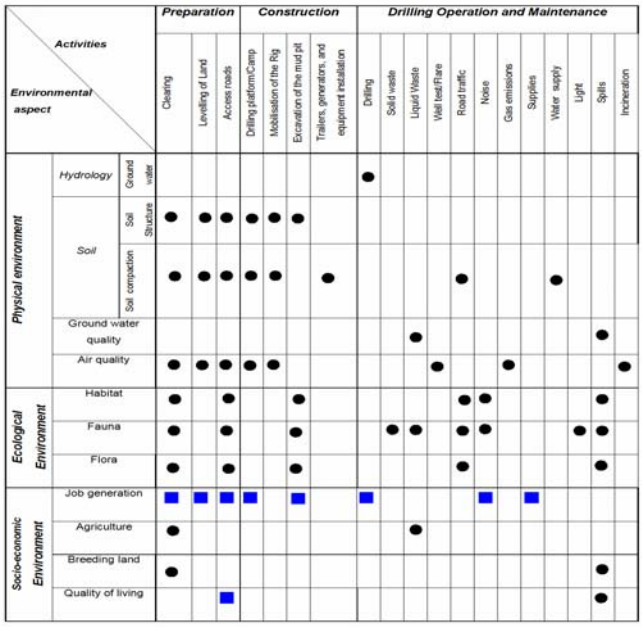

Table 1: Identified potential environmental impact

This Scoping matrix identifies the interactions between project activities and environmental receptors.

Common key issues and impacts include the impacts of drilling and support operations, generation of solid and liquid waste, use of explosives, ground disturbance, effects on the local community and noise and air emissions.

2.3 Risk Assessment Matrix

Having identified the potentially most significant impacts of the project, the next step is to examine these impacts in detail using an environmental risk assessment matrix.

Environmental risk assessment forms an essential component of an environmental impact study. It is the process that evaluates the frequency and the severity of adverse environmental impacts occurring during the project activities. It allows potential adverse environmental impact to be considered on the basis of the level of potential risk to the environment; prioritising thus the effort required to ensure environmentally safe operations.

The matrix produced a useful numeric score that quantified the magnitude of the risk: It also allows the user to determine the magnitude (significance of the impact) of a risk (by scoring the frequency of each important failure mode and the severity of its consequences, so the intersection of the two values falls on a square within the matrix), and whether action is required to mitigate that risk. It would define responsibility for responding to or dealing with specific situations.

This matrix contains five possible levels of severity and frequency. It is divided into three zones to indicate the magnitude of the risk and what level of response is required.

Table 2: Environmental Assessment Matrix

Risk Assessment Matrix (Risk = Frequency x Severity)					
Frequency					
Very Frequent	5	10	15	20	25
Frequent	4	8	12	16	20
Occasional	3	6	9	12	15
Remote	2	4	6	8	10
Improbable	1	2	3	4	5
Severity	*Minor*	*Moderate*	*Severe*	*Major*	*Catastrophic*

2.4 Impact and mitigation

The drilling activities are described as a series of activities commencing with site preparation, construction and the drilling process itself as they are described in the Table 1.

The assessment of each activity has been carried out by examining the possible hazards and their potential effects.

These effects are ranked as high, medium, or low depending on their frequency and severity. For example, clearing activities are expected to be on a monthly basis, thus the ranking will be 4 on the frequency table. One of the potential impacts relates to the damage caused to ecological habitat and species. This impact will be temporarily and will be ranked 2. The product of the severity and frequency will be 8, then the item being assessed is categorised as a medium risk.

Potential significant impacts and measures for their mitigation have been grouped and discussed under the following subject areas:

2.4.1 Soil Impact

The project activities considered likely to have a significant impact on soils include clearing, levelling, and excavation of the pit, road construction, traffic road and rig mobilisation.

These activities cause the compaction and disturbance of the soil surface leading to increased soil erosion, soil contamination from various pollutants used in the drilling process and loss of topsoil.

The overall impact is likely to be temporarily as soil recovers in a reasonable time, thus it may be considered as medium. The following mitigation measures will minimise this impact:

- Drilling sites and camps should not be located in areas where soils may be sensitive to disturbance.
- Off-road driving should be avoided whenever possible and the building of new roads should be avoided unless absolutely required.
- During excavation activities, dust suppression will be achieved by watering the soils.
- Minimise the use of bulldozers.

2.4.2 Water Supply Impact

The drilling sites will be supplied with water by tankers in case there is no nearby drain crossing the areas. In addition to domestic consumption, it will be used for drilling mud preparation, rig cleaning, location and road maintenance, cementation and others.

Water consumption is estimated as of 150 l/person/day on average. Therefore, for an average staff of 50 people, estimated water consumption is about 7.5 m^3/day for about 40 days (average assumption for drilling a well), so a total of approximately 300 m^3 per well. The amount of water consumed in drilling operation ranges from "6,000 to 8,500m^3"[3] for a drilled well depending on the well profile and its total depth. Based on this, the total water consumption in a drilling site will be estimated at about 6,500 to 9,000m^3. This volume of water corresponds to the daily consumption of the whole Hassi Messaoud city. In fact, it is relatively high and should be reduced. Nevertheless, it will not have an important impact on the water resources available. The overall impact may be considered as low. The following measures should be taken to reduce the water consumption:

- Use of high pressure cleaning equipment.
- Repair of all the water leaks.
- Recycling and reusing of the water from the pit by installing "a submersible pump on floats"[3].

2.4.3 Liquid Waste Impact

Drilling slurries, drilling fluid, and rinse water are disposed of in the pit. Domestic wastewaters will be disposed of in the septic pits.

The composition of the pit varies depending on the drilling mud, the various chemicals used (coagulants, corrosion inhibitors, friction reducers,), and the types of formations drilled. Crude oil (occurring in the case of a spill) contains different kinds of hydrocarbon molecules in addition to heavy metals.

The main impacts would be the contamination of the groundwater as a result of either the release from the mud pits, chemical spills, oil spills and from loss circulation during the drilling. Furthermore, the contamination of the underground water will have an impact on the population which use wells to draw water for irrigation and domestic consumption.

Spillage into surrounding areas may destroy vegetation, contaminate the soil and habitat. "The impact on human health depends on whether exposure was from ingestion, inhalation, or skin contact, and whether the exposure was for a short or a long time"[4]. The overall impact of liquid waste is then considered as high. The following actions are taken to reduce the overall impact.

- The wells will be cased and cemented for all the various phases.

- A blowout preventer will be installed in advance on top of the well when reaching potential hydrocarbon formations and the drill crew is well trained in terms of well control.
- Procedures and rules for handling chemical to prevent spills will be handed to all the staff.
- Fluid compositions will be selected on the basis of the best practical environmental option.
- The pit will be sized to contain all the fluids, and its bottom will be lined with an impermeable material to avoid chemicals infiltration into the aquifer.
- "Containment devices should be installed around pumps and power generation equipment to collect spills, leaks and other oily fluids"[3].

2.4.4 Solid Waste Impact

Drilling for oil produces a large variety of solid wastes including:

- Special wastes (all types of metals, electric cables, metallic packing, wastes of electronic equipment, containers under pressure (spray), rags contaminated by the hydrocarbons, used tires, and filters).
- Dangerous special wastes (batteries and accumulators, and compressors of cooling).
- Inert wastes (glass, rubber, ashes, concrete)
- Medical wastes (syringes, bandaging, gloves…).
- Domestic wastes (packing cardboard and paper, residual cooks, wood and plastic bottles).
- Drill cuttings. This waste occupies first place in terms of volume and probably in terms of toxicity. Cuttings are a mixture of mud and various types of waste from different rock layers crossed during the drilling.

Many of the wastes include materials or substance that could contaminate soils and groundwater (like oil based mud cuttings) and constitute a hazard to the environment and people. Therefore, the impact can be considered as high. The implementation of a waste management plan will reduce the significance of the impact of solid waste disposal. The following guidelines can be followed:

- Collection, segregation, storage, and incineration of combustible wastes.
- Recyclable waste sent to recycling facilities.
- Use of water based mud whenever possible.
- Use of less toxic mud additives.
- Burn and flare pits will be lined with compacted tuff.

2.4.5 Air Emission Impact

Drilling operations produce significant air emissions. They consist essentially of the discharges from drilling equipment engines, vehicles, incineration in the burn pit, and from the flaring of crude oil during the well test.

"Pollution is particularly high from diesel engines that power the vast majority of vehicles and machinery operating within the drilling operation, and has been shown to cause severe respiratory ailments in humans and wildlife"[5]. The impact of these emissions may be considered low and highly localised. The guidelines for reducing air emission include the following:

- Switch off vehicle engines when they are stopped.
- Water the soil using water trucks whenever unsealed surfaces have the potential to release dust.
- Ensure good maintenance strategy for machinery and vehicles.

2.4.6 Noise Impact

The drilling operations generate enormous noise impacts in relatively quiet areas. The major sources of noise are the drilling rig engines, compressors and generators. The danger represented by an exposure to the noise depends on two factors namely, "the resonant level and the length of exposure"[6]. In addition, drilling rigs and compressor stations operate around the clock (non-stop), offering no rest for people or wildlife in the area.

Noise exposure from the drilling site will have a slight impact on the Camp due to distance and even for the fauna. Thus, impact may be considered as low and localised.

The guidelines for reducing noise pollution include the following:

- Workers must be protected against noise by wearing suitable equipment especially when noise exceeds 83 dB).
- All areas of work where the level of the noise is over 83 dB will be designated as zones requiring ear protection.
- The exhausts of the various motors and engines are fitted with silencers (use of absorbers).

2.4.7 Impact on Fauna, Flora, and Habitat

The primary source of impact on fauna, flora, and habitats is the site preparation activities (in particular when using bulldozers), road traffic (movement of vehicles), and well sites operation (noise, light, liquid waste generation, dust, visual presence); which result in the loss of habitat and the disturbance or displacement of wildlife.

Dozens of truckloads carrying equipment and/or water are necessary for the drilling of each well site, and "with 24 hours a day drilling operations considerable noise and activity disrupt previously tranquil settings"[5]. Such a situation will lead to a degradation of the overall habitat, especially for some species that rely on the habitat, namely reptile and invertebrate species. Moreover, the interest for spills and pits to wildlife creatures seeking for water may result in mortality. The overall impact will be medium, because once the drilling well finished, the vegetation will naturally take over once again and the habitat will not be affected as to constitute a risk for animal species. Moreover, animals flee the presence of humans.

The following mitigation measures should be taken:

The road traffic within the area should be minimised whenever possible. Drivers should use existing tracks when possible and limit off road driving.

Pits must be protected by a fence.

The use of bulldozers should be minimised.

Use of deflector lights that point downward towards the ground.

2.4.8 Socio-economic Impact

No direct negative impact is expected on the population, but the people of the hamlet situated near drilling site may be temporally disturbed by the noise and the dust generated by the track passing nearby. Furthermore, there might be a risk of road accidents. Moreover, children may venture near drilling sites to play and swim in the mud pit.

The principal impacts on agriculture will lead to the loss of vegetation and soil degradation due to the clearance of new roads which may in turn result in financial losses for the people living on agriculture.

Short-term employment and business opportunities could be made available to the local communities during the drilling operations; these will have some positive impact on the prevailing socio-economic conditions.

2.4.9 Visual Impacts

The building of the access roads, the drilling platform and the mud

pits affect the landscape. The visual impact will be medium. Even at the end of the drilling operations and after the site restoration has taken place, the initial state of the site can never be recovered. Nevertheless, some actions must be taken:

- The sizes of the drilling plat-forms, mud pits, and temporary camps are kept to the minimum necessary.
- Cleaning of the drilling site and waste removal.

3. CONCLUSION & RECOMMANDATION

Environmental Impact Assessment measures the potential environmental impacts resulting from the drilling activities. It is an efficient management tool which incorporated all aspects of the drilling operations.

A number of potential impacts are identified during the detailed assessment process and mitigation measures were addressed to reduce such impacts. However, the assessment impact remains very subjective and should be reviewed and improved continuously.

Recommendations for further minimisation of the adverse impacts to ensure the success of the drilling campaign in an environmentally acceptable manner include:

- Establishment of an effective waste management plan
- Perform specific studies of pollution impact on aquifers (real infiltration rates).
- Consider the feasibility of using water-based mud while drilling for additional phases.
- Monitoring programmes of air emissions.

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