Chapter 5

ENVIRONMENTAL MANAGEMENT PLAN

5.1 Introduction

A primary goal of Environmental Impact Assessment (EIA) is to develop procedures to ensure that all mitigation measures and monitoring requirements specified in the approved EIA will actually be carried out in subsequent stages of project development. These mitigation measures and monitoring requirements are set out in this Environmental Management Plan (EMP). A well structured EMP usually covers all phases of the project, from preconstruction right through to decommissioning. The Plan outlines mitigation and other measures that will be undertaken to ensure compliance with environmental laws and regulations and to reduce or eliminate adverse impacts.

Specifically, the EMP outlines:

(i) the technical work program to carry out the EMP, including details of the required tasks and reports, and the necessary staff skills, supplies, and equipment; and

(ii) the planned operation or implementation of the EMP, including a staffing chart and proposed schedules of participation by the various members of the project team, and activities and inputs from various governmental agencies.

The main mechanism for implementation of the EMP is the establishment of an Environmental Management Office (EMO). OIL has a well established Safety & Environment department which in consultation and co-ordination with the Project office will ensure that adequate measures as outlined in the EMP are actually followed and executed during the course of seismic operation. OIL has also a strong Public Relation department to address all public concerns and to make the public aware of the environmental issues, if any, arising during the seismic operations.

Implementation of the EMP requires that:

(i) The detailed final design (plans and specifications) for the project incorporates all mitigation measures specified in the approved EIA.

(ii) The contract for the project includes all mitigation measures to be implemented. The contractor will be made fully aware of the need for complete compliance with the safety and mitigation measures.

(iii) The contractors' performance is duly monitored for compliance with the EMP by competent environmental inspectors. This requires implementation of the Environmental Monitoring Program specified in the EMP.

(iv) On completion of the work, inspection takes place to check that the works, as completed, meet all significant environmental requirements.

(v) The operations stage monitoring program is implemented as specified in the EMP.

(vi) There is effective reporting by the EMO, through the Project Management Office, to show that the EMP is being properly managed.

The detailed EMP along with mitigation measures is given in Table 5.1 (prior to drilling), Table 5.2 (during drilling) and Table 5.3 (non-routine events).

5.2 Leadership and Management Commitment

OIL has demonstrated its leadership and commitment in the management of Health, Safety and environment (HSE) issues in a top-down approach during the long history of its operations. The three key elements to demonstrate this commitment of the company are:

- Ø visible leadership,
- Ø proactive target setting and
- Ø informed involvement (Fig. 5.1).

OIL has ensured its commitment to:

- Ø pursue the goal of no harm to people;
- Ø protect the environment;
- Ø use material and energy efficiently to provide for products and services;
- Ø develop energy resources, products and services consistent with these aims;
- Ø publicly report on its performance;
- Ø play a leading role in promoting best practice in industry;
- Ø manage Health, Safety and Environment (HSE) matters as any other critical business activity;
- Ø promote a culture in which all employees share this commitment.

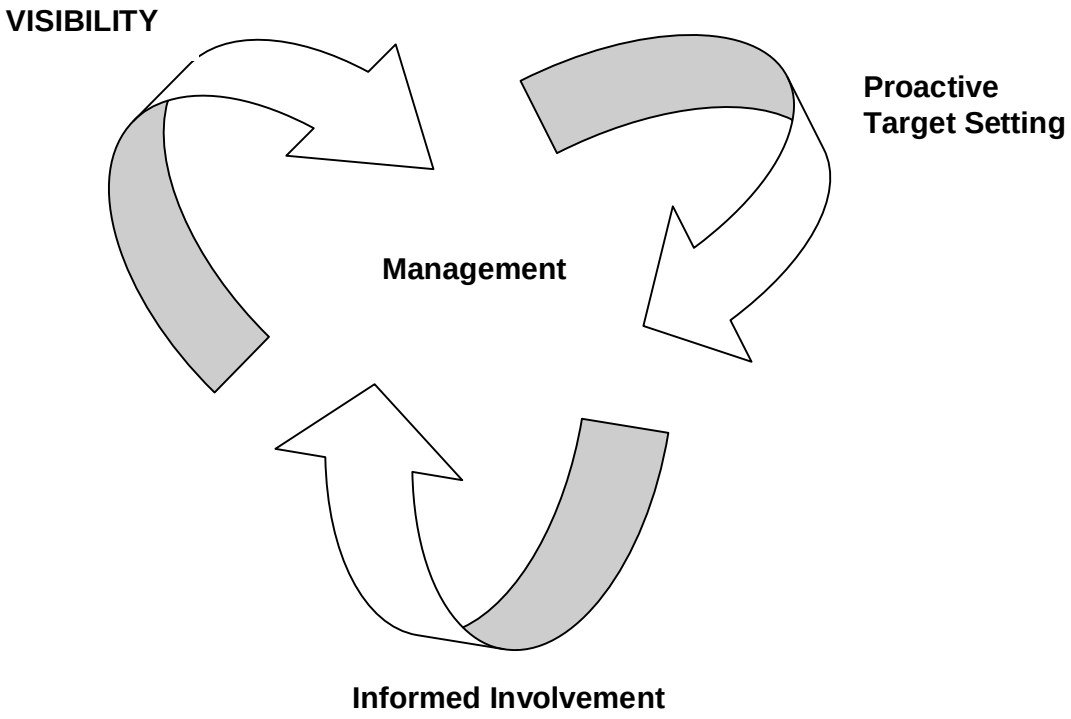

Fig. 5.1 Three key-issues of OIL's HSE Policy

Further, OIL aims to:

- Ø have an HSE performance to be proud of;
- Ø earn the confidence of customers, shareholders and society at large; and
- Ø contribute to sustainable development through protection of the environment.

5.3 Policy and Strategic Objectives

5.3.1 Policy

OIL develops and reviews its HSE Policy and sets its strategic objectives in relation to HSE issues. Based on these guiding principles, OIL has developed an HSE Policy that clearly demonstrates its commitment to managing impacts associated with the project. The success of OIL depends on its ability to continuously improve the operational performance while protecting the natural environment. It is a commitment, which is in the best interests of the customers, the employees, the shareholders and the society at large.

To meet the above commitment, OIL shall:

(i) Seek external certification of the environmental component of the HSE management systems against a recognized, independent system standard.

(ii) Seek to prevent pollution and minimize environmental impact from existing and planned activities. This includes identifying environmental hazards and risks and implementing appropriate controls to ensure that the risks are reduced to a level 'as low as reasonably practicable'.

(iii) Recognize the priority of preventing oil and chemical spills, and maintain contingency arrangements in co-operation with the authorities and emergency services to respond responsibly and appropriately to environmental emergencies.

(iv) Promote a culture of environmental awareness and support environmental training.

(v) Discuss environmental matters with the stakeholders, and report the environmental performance both internally and externally.

(vi) Carry out Environmental Impact Assessments for new projects and significant changes in existing facilities and operations.

(vii) Contribute to sustainable development and support biodiversity.

(viii) Use materials and energy efficiently.

(ix) Report all significant environmental incidents, and take measures to prevent recurrence.

(x) In association with industry forums, work with the government authorities to help develop environmental policy, regulations and standards and promote best environmental practice in the oil and gas industry.

(xi) Ensure compliance with relevant environmental laws and regulations, industry codes of practice, and other standards and policies voluntarily.

(xii) Set minimum environmental expectations and performance improvement objectives and targets, measure performance, and adjust activities accordingly.

(xiii) Conduct internal and external audits and management review to ensure that appropriate resources are in place to carry out this policy, and ensure that policy objectives are being met.

(xiv) Require all the contractors to manage environmental matters in line with this policy.

With a view to strengthen the above commitment, the OIL has tried to formulate and continuously upgrade the following:

- HSE Training Standard;
- HSE Requirements Standard for all its Contractors;
- Use of Energy, Material and Resources Standard;
- Land Management Standard;
- Discharge to Land and Water Standard;
- Environmental Noise and Vibration Standard;
- Waste Management and Minimization Standard; and
- Biodiversity Standard.

In evolving these standards, the OIL is following the relevant standards laid down by the Ministry of Environment and Forests, Government of India, Central Pollution Control Board, State Pollution Control Board and all other agencies, as well as International Rules, regulations and Guidelines.

5.3.2 Organization

The OIL has built up an organizational structure for implementing the above commitment to HSE policy with the following principal features:

- To establish a system for management of HSE risk in the company based on the HSE Policy and all other associated policies for Health, Safety and Environment.
- To establish line of responsibility for operation of the system and detail the roles that all members of the organization are required to play in the day to day operation for developing a fully functioning system with an appropriate Management Structure.
- To address the organization of people and their responsibilities, the allocation of resources, the training and competence of OIL staff and contractors, and the standards and documentation required for sound HSE performance.

All the above are particularly important in the event of any accident, environmental emergency, etc.

5.3.3 Hazards and Effects Management (HEMP)

The proposed activities have the potential to harm people and the environment, to cause damage to or loss of assets, to defer hydrocarbon production, to cause financial loss, and to adversely impact the Company's reputation. To address these risks, the company has adopted a comprehensive Hazard and Effects Management Process (HEMP) as a structured approach to identifying and managing the hazards and potential effects of all the activities associated with the seismic survey.

The HEMP studies shall include:

(i) identification of the major hazards to people and the environment;
(ii) assessment of the related risks;
(iii) developing and implementing measures to control these risks;
(iv) evaluation of the sufficiency of risk reduction;
(v) planning to recover from the effects of the hazard if control measures fail; and
(vi) thorough documentation of the process of the evaluation.

Hazards and effects management is the core of the Health, Safety and Environment Management System (HSEMS). The risk assessment procedure and different risk levels are already discussed in Chapter 4.

The potential consequences of an event considered as a hazard are given in details in Chapter 4. The expected likelihood of occurrence of the hazard is always to be kept under consideration and a procedure is to be laid down for meeting the eventuality.

The above exercise is to be repeated for all possible and envisaged hazards identified in the previous chapter in relation to the activities, and then the risks are to be grouped into three different categories as follows:

(i) High Risk - Intolerable.
(ii) Medium Risk - Tolerable but requires demonstration of the procedure to be followed in case of occurrence.
(iii) Low Risk - Tolerable.

Activities involving High (intolerable) Risk shall not proceed unless all of the following conditions are met:

(i) it is confirmed that the activity is necessary and there is no feasible alternative;
(ii) there has been a detailed assessment to demonstrate that the controls are suitable, and the risks are reduced to the tolerable level; and
(iii) senior management has endorsed the decision to proceed with the activity.

Activities involving Medium (but tolerable) Risk are allowed to proceed only after it can be demonstrated that the risks associated with the activity are managed to the allowable level, with the demonstration being proportional to the risk.

Activities involving Low (tolerable) Risk may proceed in accordance with no additional assessment, but in accordance with normal HSEMS practices.

OIL has to formulate a fundamental response structure to interface with contractors, subcontractors, host government agencies, and non-government organizations that could become involved during emergencies of major magnitude for several reasons:

- it identifies immediate response teams, resources and responsibilities;
- it provides for a cascading of resources appropriate to the situation; and
- it enables allocation of financial and management requirements appropriate to the situation.

OIL should put in place a general Crisis and Emergency Response Procedure (CERP) which encompasses all types of emergencies. The CERP has a comprehensive list and structure of key documents supplying an overview and detailing supporting procedures. Appropriate response teams should be in place at OIL before embarking on the activities proposed.

The Crisis and Emergency Response System should consist of :

(i) A Site Control Team (SCT);
(ii) An Emergency Co-Ordination Team (ECT);

(iii) A Crisis and Emergency Management Team (CEMT);

(iv) A Crisis Manager;

(v) External Contractors who are to be contacted in case of emergency;

(vi) Governmental authorities and organizations who are to be informed and consulted during a crisis,

(vii) Prominent NGOs, Experts and Consultants for help and cooperation during any crisis.

The Crisis Manager is the overall leader of the response on behalf of OIL. The role of the Crisis Manager is to maintain an overview of the incident and to ensure that appropriate communications are maintained to locally based senior personnel and other stakeholders. The Crisis Manager may utilize the Crisis and Emergency Management Team (CEMT) to perform the Crisis Management duties.

The Site Control Team (SCT) is responsible for undertaking source control and response operations during a Tier 1 incident. For larger incidents, there may be several teams in different areas, coordinated by the Emergency Co-Ordination Team (ECT).

The SCT consists of on-site facility personnel under the command of the Site Controller (SC) and is primarily responsible for the initial response to an incident. The SCT is responsible for:

- Ø ensuring the safety of personnel (with support of the site safety officer),
- Ø immediate incident response,
- Ø incident notification to OIL management,
- Ø obtaining support as needed from local contractors, and other agencies including local Government officials and NGOs,
- Ø incident investigation (as directed by more senior management), and
- Ø actions follow-up and close out (as directed by more senior management).

The Emergency Co-ordination Team (ECT) is responsible for supporting the overall response to an incident, and will be activated to the extent necessary depending on the circumstances and the magnitude of the incident.

The Crisis and Emergency Management Team (CEMT) is responsible for providing additional expertise and to facilitate management of the response efforts and acquisition of additional resources. The CEMT expands to include additional advisory and support roles, as needed, and plays an important liaison role with Central and State government officials as also the officials of the Pollution Control and other Environment Regulatory authorities.

5.3.4 HSE Audit and Review

Audit Programme

HSE Audits provide OIL with a systematic and independent means to assess the adequacy of the business controls on HSE risk management. Audits are different from management or supervisor inspections. While both are concerned with the collection of evidence to demonstrate compliance with business controls, audits focus on systems of controls rather than specific controls on tasks or activities.

OIL management carries out both inspections and audits. Senior management inspections are covered by a specific procedure for HSE inspections that provides details on the purpose and focus of inspections.

The objective is to describe how OIL plans, structures, executes and records HSE audits. Each audit will have a specific area of focus, but all will examine a system to gauge whether:

- Ø minimum HSE requirements and expectations are being met and if there are significant gaps between policy and performance;
- Ø HSE risks to the business are sufficiently identified;
- Ø Appropriate HSE controls have been set and are in place; and
- Ø Controls that have been implemented are effective in managing the HSE risks.

A hierarchical system of HSE audits should be organized and kept in operation. The tier category of an audit is to be assigned based on risk. The following three tier audit is envisaged to give the best results:

(i) Tier I Audits are ‘one-off’ audits that are carried out at a specific location or in relation to a specific activity such as:

- Ø at construction mobilization and contractor qualification;
- Ø scheduled periodic audits by the line; and
- Ø prior to start-up of low risk activities;

(ii) Tier II Audits are asset, facility or activity (operational or project) specific audits, including selected pre start-up audits. These audits are programmed in HSE Plans and carried out to assess:

- Ø the alignment of the sub HSE Management System with the OIL HSE Management System; and
- Ø the accuracy and currency of any related HSE Cases.

(iii) Tier III Audits are the highest level audits to be carried out within OIL on the Corporate HSE Management System or selected elements of it in order to assess the appropriateness and effectiveness of the HSE Management System. These audits are incorporated in the Company's Integrated Audit Programme that is controlled by the Internal Audit mechanism.

Review programme

A key component of the HSE Management System is a formal process whereby senior management reviews it to ensure that:

(iii) it continues to satisfy both the current and future business needs; and

(iv) the system is functioning to continually improve HSE performance.

Senior management of OIL should review the HSE Management System annually in the first quarter of the year in a manner that is detailed in the Procedure for HSEMS Reviews. The purpose of the review is to identify the possible need for changes to the Company's policies and strategic objectives in the light of changing circumstances and the commitment to strive for continual improvement. The review process is documented, with the results recorded to assist in implementing any recommended changes that become apparent through the review.

The objective is to review components of the HSE Management System including the scope, source of review data, process and records produced. The review process closes the gaps in

the HSE Management System with the results of it feeding directly back into the cycle of strategic objective setting and HSE Plan development. Results of the review process also form the basis of the HSE Annual Assurance process.

5.3.5 Contractor HSE Management

Contractors will perform over a large part of the work managed by OIL. Accordingly, appropriate management of HSE by the contractors is a fundamental part of the HSE Management System.

One major HSE objective is that all contractors and suppliers shall manage HSE in line with OIL's HSE MS. This will be achieved by:

(i) Clear HSE criteria and performance targets that the contractors must meet prior to tendering and during work for OIL.

(ii) A pre-qualification and screening process designed to check the HSE performance and abilities of contractors before they are allowed to work for the OIL.

(iii) Systematic management overview and audit of contractor operations, including site supervision where appropriate, to monitor performance and enforce adherence to agreed standards.

(iv) Assistance where appropriate in training and capacity building in order to generate improvements in HSE performance and abilities, thereby allowing more firms, particularly small and local firms, to participate in OIL projects.

5.4 Environmental Training and Awareness

The minimum HSE training requirements for OIL and its Contractors are to be specified within the Standard for HSE Training in consultation with the Company's environmental consultant.

Of particular importance is the target population for each training course. Each HSE Course Specification defines the categories of personnel who are required to attend HSE training as

the target population. The personnel specified constitute the minimum population required to attend, however, the relevant Department of OIL or Contract Holder may add additional personnel where this is considered necessary to the work.

Contract Holders will use the Standard in conjunction with Contract HSE Management, to develop the specific HSE training requirements of each Contract. This information will be included in the Contract Scope of Work /Terms and Conditions and used to assess the Contractor's HSE Management Plan. When preparing a contract specific HSE training plan, HSE training requirements for both pre-mobilization and pre-execution stages will be specified. This enables the completion of HSE training to be linked to applicable contract mobilization milestones.

5.5 Environmental Monitoring Plan

Environmental monitoring programs should be implemented to address all activities that have been identified to have potentially significant impacts on the environment, during normal operations and upset conditions. Environmental monitoring activities should be based on direct or indirect indicators of emissions, effluents, and resource use applicable to the particular project. Monitoring frequency should be sufficient to provide representative data for the parameter being monitored. Monitoring should be conducted by trained individuals following monitoring and record-keeping procedures and using properly calibrated and maintained equipment. Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken.

A number of environmental performance indicators have to be continuously monitored during the entire duration of the drilling operations and after the operations are over at least for a period of 10 years, preferably in a 10 km area surrounding the drill site. The minimum monitoring requirements for the drilling programme are listed in Table 5.4. These are based around the 35 Global Reporting Initiative (GRI) Indicators. The GRI aims to develop globally applicable Sustainability Reporting Guidelines to be used by organizations for reporting on the economic, environmental and social dimensions of their activities, products and services.

The major environmental concerns associated with onshore oil and gas production are drilling waste fluids or muds, drilling waste solids, produced water, and volatile organics. The drilling waste muds may be fresh-water gel, salt water (potassium chloride or sodium chloride), or oil invert-based systems. The oil invert mud systems may contain up to 50 percent by volume of diesel oil.

The drilling waste may contain drilling muds (bentonite), bore-hole cuttings, additives (polymers, oxygen scavengers, biocides, surfactants, lubricants, diesel oil, emulsifying agents, and various other wastes that are specifically related to the drilling activities.

The drilling waste solids, which are made up of the bottom layer of drilling mud sump materials, may contain drill cuttings, flocculated bentonite, weighting materials and other additives. Additional wastes from the drilling process include used oils, cementing chemicals, and toxic organics.

Field processing of crude oil will generate several waste streams including contaminated wastewater, tank bottoms which may contain lead, emulsions, and heavy hydrocarbon residues which may contain polynuclear aromatic hydrocarbons (PAHs). Cooling tower blowdown, boiler water, scrubber liquids, and steam production wastes are also generated, as well as contaminated soil, used oil, and spent solvents.

Wastewaters that are generated typically contain suspended solids. To control the growth of micro-organisms in sour water, usually a biocide or hydrogen sulfide scavenger (for example, sodium hypochlorite) is used prior to its re-injection or disposal. Crude pipelines are routinely cleaned by pigging operations which can lead to spills and to the generation of sludge containing heavy metals. Solid wastes which do not contain toxics are used as back-fill material.

The following is a general characterization of the overall wastewater stream from crude processing:

Parameter	Typical values (average) milligrams per liter (mg/L)
Oil and grease	7-1,300 (200)
Total organic carbon	30-1,600 (400)
Total suspended solids (TSS)	20-400 (70)
Total dissolved solids (TDS)	30,000-200,000 (100,000)
Biochemical oxygen demand (BOD5)	120-340
COD	180-580
Phenols	50
Cadmium	0.7
Chromium	2.3
Copper	0.4
Lead	0.2
Mercury	0.1
Nickel	0.4

Major sources of air emissions include fired equipment, vents, flares (including those from compressor stations), and fugitive emissions. These may contain volatile organic compounds (VOCs), sulfur oxides, hydrogen sulfide, and nitrogen oxides. Air Emissions from Oil and Gas Production have the following general characteristics:

Gas production	
Sulfur Oxides	Less than 0.1 grams per cubic meter (g/m3) of gas produced
Nitrogen Oxides	10-12 g/m3 of gas produced
VOCs	0.1-14 g/m3 of gas produced
Methane	0.2-10 g/m3 of gas produced
Oil Production	
Nitrogen Oxides	3.7 grams per kilogram (g/kg) oil produced
VOCs	3.3-26 g/kg oil produced

Pollution Prevention and Control programs should focus on reducing the impacts of wastewater discharges, oil spills and soil contamination and on minimizing air emissions. Minimizing the quantity of discharge should be stressed. Process changes might include the following:

- Maximize the use of freshwater gel-based mud systems.
- Eliminate the use of invert (diesel based) muds. In case where the use of diesel-based muds is necessary, reuse the muds.
- Recycle drilling mud decant water.
- Prevent degradation of sweet wells by sulfate reducing bacteria by the use of hydrogen sulfide scavengers.
- Select less toxic biocides, corrosion inhibitors, and other chemicals.
- Minimize gas flaring. However, flaring is preferred to venting.
- Store crude oil in tanks with the large ones (greater than 1,590 m3) having secondary (double) seals.
- Minimize and control leakage from tanks and pipelines.
- Practice corrosion prevention and monitor above and below ground tanks, vessels, pipes etc.
- Remove hydrogen sulfide and mercaptans from sour gases (releasing greater than 1.8 kg of reduced sulfur compounds per hour) before flaring.
- Use knock-out drums on flares to prevent condensate emissions.
- Regenerate spent amines and spent solvents or send off-site for recovery.
- Use low nitrogen oxides (NOx) burners in process heaters.
- Provide spill prevention and control measures (bunds and hard surfacing for storage tanks; pressure relief valves; and high-level alarms).
- Recover oil from process wastewaters.
- Segregate storm water from process water.
- Implement leak detection and repair programs.

A reclamation and closure plan for the site is required. This plan should be developed early in the project and should address the removal and disposal of production facilities in an environmentally sensitive manner, the restoration of the site, and provisions for any ongoing maintenance issues. Where possible, progressive restoration should be implemented.

Implementation of cleaner production processes and pollution prevention measures can provide both economic and environmental benefits. In drilling operations, the use of fresh water should be minimized by maximizing the use of drilling mud pond decant water. Eliminate sour gas emissions by sweetening and reuse.

Typically, air emissions of toxic organics are minimized by routing such vapors to recovery systems, flares, or boilers. Tail gases are scrubbed to remove sulfur compounds. The decant from the drilling mud disposal sump is treated by coagulation and settling before discharge. Alternatively, the sump fluids may be injected down hole into an approved disposal formation. The drained and settled drilling mud solids are disposed on land: capping; mixing, burying, and covering; trenching; or encapsulating. Other options include land spreading, land filling, incineration (for destruction of toxic organics), or in-situ solidification/fixation. Effluents from the crude process may be treated using coagulation, de-emulsification, settling, and filtration.

Storm water is settled and if necessary, treated (coagulation, flocculation, and sedimentation) before discharge.

Emission levels for the design and operation of each project are to be established as per the Environmental Impact Assessment (EIA) process, based on existing legislations, CPCB norms, etc., as applied to local conditions and must be acceptable to regulating agencies.

All of the maximum levels should be achieved for at least 95% of the time that the plant or unit is operating, to be calculated as a proportion of annual operating hours. The emissions levels to be achieved during Oil and Gas Production (Onshore) should be as per CPCB norms and the target levels may be as follows:

Parameter	Maximum value milligrams per normal cubic meter (mg/Nm^3)
VOCs (including benzene)	20
Hydrogen sulfide	30
Sulfur oxides (for oil production)	1,000
Nitrogen oxides	
Gas-fired	320 mg/Nm3 (or 86 ng/J)
Oil-fired	460 mg/Nm3 (or 130 ng/J)
Odor	Not offensive at the receptor end*

*H2S at the property boundary should be less than 5 $\mu g/m^3$

The emissions requirements can be consistently achieved by well-designed, well-operated and well-maintained pollution control systems and these should be continuously monitored. The effluent levels should be achieved as per CPCB norms and the following levels may be taken as the targets:

Parameter	Maximum value milligrams per liter (mg/L)
pH	6-9
BOD5	50
Total suspended solids (TSS)	50
Oil and grease*	20
Phenol	1
Sulfide	1
Total toxic metals**	5
Temperature increase	less than 3°C

*Up to 40 mg/L is acceptable for facilities producing less than 10,000 tpd.

** Includes antimony, arsenic, beryllium, cadmium, chromium, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc.

The effluent should result in a temperature increase of no more than 3 degrees Celsius at the edge of the zone where initial mixing and dilution takes place. Where the zone is not defined, use 100 meters from the point of discharge.

Noise abatement measures should achieve either the CPCB norms or a maximum increase in background levels of 3 dB(A). Measurements are to be taken at noise receptors located outside the project property boundary.

In all cases of monitoring, frequent sampling may be required during start-up and upset conditions. Once a record of consistent performance has been established, sampling for the parameters listed above should be as detailed below.

(i) Air emissions of above listed parameters should be assessed on an annual basis.

(ii) Liquid effluents from production operations should be analyzed for the above listed parameters on a daily basis, except for metals which can be monitored on a monthly basis or when there are significant process changes.

Monitoring data should be analyzed and reviewed at regular intervals and compared with the operating standards so that any necessary corrective actions can be taken. Records of monitoring results should be kept in an acceptable format. These should be reported to the responsible authorities and relevant parties, as required.

The environmental performance indicators may be grouped into seven key parameters:

- Physical presence
- Resource Requirements
- Atmospheric Emissions
- Solid Wastes
- Aqueous Discharge
- Accidental Emissions
- Reputation / Costs

These environmental performance indicators have been referenced in Table 5.4.

Table 5.1. Environmental Management Plan and Mitigation Measures (Prior to Drilling Operations)

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
Land acquisition -Failure to identify and obtain necessary permits for Land acquisition from the Department of Forests and approvals from Assam State Pollution Control Board for construction & operations.	Ensure that all necessary protocols are followed and legal requirements implemented: Ensure that appropriate legal requirements have been met with regard to land occupancy, land ownership or usage rights, notice and compensation, etc. Establish and clearly document all land agreements with owners, users and state authorities.(Forest Department) Mark out site boundaries.	Actions to be initiated by OIL for interaction with the concerned officials in the Forest Dept and Pollution Control Board, prior to release of actual location to identify necessary permits and the approval mechanism. Apply for approval for Land acquisition with proper maps and prescribed fees with due involvement of the Forest dept at ground level.	Drilling team, OIL	Accomplished - Pre-deployment of topographic survey team Accomplished

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	Acquiring necessary approvals from State Pollution control Board in a timely manner	Preliminary site survey was carried out by OIL to mark the road & site requirement on ground and the state Forest dept was approached with exact location maps in hand for Land. Drilling & Permit team met the Pollution Cpontrol authorities to apprise them of the plan and to identify and apply for necessary permissions prior to construction phase and prior to drilling phase.	OIL Drilling team	Accomplished. "Consent to establish" permission Accomplished – Prior to construction. "Consent to Operate "– To be obtained prior to drilling operations.

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
Soil erosion	Minimize the extent of site clearance area, by choosing best layout with respect to existing topography. Minimize removal of trees at site Collect topsoil removed during road development/construction, site preparation, etc. and stockpile the same at edge of site to be used to the extent possible for site restoration later.	Detailed contour maps of the site prepared with big trees marked on it to work out the best layout to minimize cut & fill & avoid cutting of trees. Existing nullah at site to be used as waste pit to avoid removal of trees cutting huge pits. To see that arrangement is in place for collection.	OIL Drilling Team Do	Accomplished - Prior to site preparation and other construction activities. Plan to minimize tree cutting prior to site construction and ensure implementation on ground during site construction phase To be continued till demobilization.
Habitat disturbance	Mark out road & site boundaries.	Clear boundary marks are in place	Drilling team	Prior to any construction activity (road or site)

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	All bulldozer operators and other manual laborers involved in road and site preparation will be trained to strictly confine their works within the defined site boundaries.	Maintenance of integrity of boundary markers by the workforce at all times.	OIL Drilling Team	Throughout the road & site construction operations.
	Effluent pits at site pose a threat for wild animals and more so to the elephants.	A natural nullah at site will be used as Liquid (Major) effluent pit. Other pits (Cutting & sludge) will be cut at site after fencing the location is complete.	Do	Do
	Animal movement corridors, if any, will be identified and all works will be carried out away from the same.	Obtain Animal movement records from Forest department.		Throughout the road & site construction operations.

Table 5.2. Environmental Management Plan and Mitigation Measures (Drilling Operations)

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
Waste and Effluent Management	Identify the procedures for collection, handling and disposal of each waste and prepare a Waste management plan. Implement waste management plan at site	A comprehensive waste management Plan to be prepared for strict implementation Waste management plan to be implemented during drilling and available for inspection at site.	OIL Drilling Team and HSE department	Prior to drilling operations.
Drainage	Detailed drainage design will be a part of the site design to ensure that mud and associated drainage system is isolated from the rig drainage system.	Rig contractor to be selected in accordance with HSE Mgmt System requirements	HSE Department OIL	Throughout the operations
Water from rig wash down may contain trace amounts of drill fluid and residual chemicals. There will be discharge of sewage and grey water	All discharges from the rig will be treated and discharged as per State Pollution Control Board norms. This needs to be more specific, item wise.	Pre-operation inspection The discharge to be inspected daily to ensure that no pollution or non-permitted discharge is occurring.	Rig's maintenance staff	Do

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	Special measures to be taken during high rains for ensuring that wastes of any kind are not washed away by the rainwater. Pools of stagnant water collecting near the drill site to be removed promptly to prevent breeding of mosquitoes.	'On site' monitoring to ensure adherence to good housekeeping measures. Proper drainage will be designed and implemented	OIL Drilling Team and HSE Department	Do
Fuels, Lubricants and Chemicals Management, Major & minor spills	a) Prepare a comprehensive Oil Spill Contingency Plan (OSCP) to handle all major & minor spills b) Keeping all fuels, lubricants and chemicals in well-designed storage facility with regular inventory checking. b) Ensure that OSCP is implemented during operations. c) Removing all used and unused lubricants and chemicals to some secure place. d) Executing delivery of fuel to drilling site under strict supervision and carrying out refueling operations in an area with impervious flooring and surface drainage with oil interceptor.	Checklist of all drums and containers located within footprint of the storage area Awareness generation among all workers with mock exercises. Setting up an arrangement for removing unused lubricants and chemicals. Keeping an inventory of all fueling and refueling operations.	OIL Drilling Team in association with HSE department Do Do Do	Prior to commencement of drilling operations Through out the operations. Do Do Do

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	e) Use of suitable delivery trucks	Check all delivery trucks for suitability & ensure that they meet necessary HSE requirements	OIL drilling team and HSE department	Throughout the operations
Site Contamination	Impervious liners in place for fuel, lubricants and chemical storage area, cuttings containment area.	Keep site clean at all times. Design site to include protective measures and entrapment facilities.	OIL Drilling Team and HSE dep[artment	Prior to drilling operations.
	Effective bunds capable of containing 110% of the volume of the largest container within and enclosing all potentially contaminating materials. To be used for fuel, lubricants and chemicals storage area.	As above .	Do.	Do
	Non-contaminated and potentially contaminated runoff will be kept separate. Non-contaminated runoff will be routed to off-site area. Potentially contaminated surface runoff will be treated.	Ensure separate runoff routes during site design.	Do	Do
	Oil drip pans will be used wherever there is significant potential for leakage but not limited to.	Drip pans in place. Absence of visible signs of soil contamination.	Oil HSE department	Throughout the drilling operations.

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	All spills/leaks contained, reported and cleaned up immediately. Contaminated soil to be dug up, placed in drums and subsequently removed from site.	Oil Spill Contingency Plan to be in place and implemented. Arrangement to be made.	Do Do	Do Do
Noise and Vibration (both construction and operational)	Checklist of all machineries with record of date of procurement, installation and age. Regular maintenance of all equipments. Implement good working practices to minimize noise. Wearing of eye defender when appropriate	Inventory of all machineries to be prepared and submitted to OIL HSE for review. . Maintenance of Log Book to be prepared and submitted for review. No machinery running when not required. Distribute to work force to ensure utilization	Rig Contractor Rig Contractor Do HSE Department	Prior to commencement of drilling operations Prior to and during drilling operations During Drilling operations
Air Emissions	Operate all equipment within specified design parameters.	Equipment maintenance	Rig Mechanic	During Drilling operations

ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	Store all dry, dusty material (chemicals, etc.) in sealed containers.	Absence of stockpiles or open containers of dusty materials.	Rig's maintenance staff	During Drilling operations
	Minimize duration of testing by careful planning.	Options for MDT ,Open Hole DST to be explored for shorter test & included in the plan if found suitable	OIL Drilling Team	Do
	Minimize emissions during well testing (flaring).	Effective separation of oil & gas to be achieved and the separated oil will be trucked to OIL and only dry clean gas will be flared.	Do	Do
	Minimize dust generation from truck movement	Road wetting if required.	Do	Do
Solid Wastes. Wastes will include galley wastes, scrap metal, waste oil & surplus chemicals.	Garbage will be processed in a compactor & stored in a designated area on the rig.	Pre-operation inspection to ensure waste disposal facilities meeting OIL HSE standards.	HSE Department	Throughout the drilling operations
	Material such as scrap metal, waste oil & surplus chemicals will be disposed of in a controlled manner through authorised waste contractors.	Do	Do	Do

Table 5.3. Environmental Management Plan and Mitigation Measures (Non-routine events)

NON-ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
Non-routine events and accidental releases (well kicks, blow out)	Draw up Oil Spill Contingency Plan (OSCP) and Emergency Response Plan (ERP) & keep it updated.	Monitor strict compliance with the provisions of OSCP and ERP.	HSE Department	Throughout drilling operations
	Maintain state of readiness for quick response including plan awareness and training and regular exercises.	Records of interaction between the management and the work force. Records of training and drills.	Do	Do
	Risk of loss of well control minimised through			
	• Proper well design which will ensure that the hydrostatic weight of mud will overcome formation pressure.	• Ensure that all available offset data are examined for proper design parameters.	Drilling Engineer	Prior to Drilling
	• Proper drilling program design to ensure selection of properly rated BOP equipment.	• Same as above	Do	Do
	• Ensure that the OIL's supervision team & Rig contractor's relevant operating personnel are trained to handle well control situations and hold relevant well control training certificates.	• Same as above	Drilling Team	Do

NON-ROUTINE OPERATIONS				
Hazard & Effect(s)	**Proposed Mitigation**	**Required Actions**	**Responsible**	**Completion**
	• Ensure that advanced detection system is in place and BOP equipment is well maintained.	• Well monitoring equipment to detect influx from reservoir. Pressure detection service provided by Mud-logging contractor. Blow-out preventers tested on installation and routinely.	Do	Do
	Spill Response (For all spills). Spill kits will be on the drill site to handle spills comprising adsorbents; approved containers for storage and transport of spill wastes, disposable bags, gloves/goggles, etc.	While at the drilling location, any spill will be reported promptly in accordance with OIL's HSE requirements.	Drilling Contractor	

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Table 5.4. Minimum Monitoring Requirements for the Drilling Programme (Environmental performance indicators shaded in grey will require monitoring during the drilling and afterwards)

Hazard	Environmental Performance Indicator	Requirement	Estimate / Measurement	Estimated Well Inventory	Frequency
Physical Presence	Location & size of land owned, leased or managed in biodiversity rich habitats	Lat/Long & area in lease/licence area (km2) see Environmental Impact Assessment (EIA)			See Env. Mgmt Plan (EMP)
	Description of major impacts on diversity	Short description see EIA			See EMP
	Total land owned, leased or managed for production activities or extraction use	Drilling lease/licence area (km2)			Per well if temporary & full lifecycle if permanent
	Impacts of activities & operations on protected & sensitive areas	Short description of impacts for drilling programme			See EMP
	Amount of impermeable surface as percentage of the land purchased or leased	Drilling lease-licence area/well location area + access road area			Per well Full lifecycle

	Changes to natural habitats resulting from activities & operations & percentage of habitat protected or restored	Short summary of impacts/restoration see EIA			See EMP
	Objectives, programmes & targets for protecting & storing native ecosystems & species in degraded areas	If relevant, short summary see EIA			See EMP
	Number of IUCN Red List species with habitats in areas affected by operations	If relevant short summary see EIA			See EMP
	Impacts of transportation used for logistical purposes	Short summary of impacts see EIA			See EMP
	Business units currently operating or planning operations in or around sensitive areas	Number in-country at designated sites etc			Country/year
Resource Requirements	Total materials use by type (excluding water)	Materials inventory estimate (te):			Per well
		Casing			
		Pipe/tubing			

		Mud components & additives			
		Cement			
		Concrete			
		Gypsum			
		Chemicals			
		Lubes			
		Fuel			
		Other			
		Total (te)			
	Percentage of materials used that have been reused or recycled from wastes	Identify re-use/recycle from inventory in 'Total materials' above (te)			Per well
	Direct energy use segmented by primary source	Fuel use estimate for power (te)			Joules per well
	Indirect energy use	Fuel use by transport to/from rig location & base (te)			Joules per well
	Total water use	Meter Usage (te)			Per day

		Dip tanks (te)			
		Visual (te)			
		Other (te)			
		Total (te)			
	Initiatives to use renewable energy sources & to increase energy efficiency	Short description/% improvement			Per well/ well programme
	Water source & related ecosystems/habitats significantly affected by use of water	Short description			See EMP
	Annual withdrawals of ground & surface water as a percent of annual renewable quantity of water available from source	Short description			Per well/year
	Total recycling & reuse of water	See 'total water use' above – recycle estimate by measurement (% improvement)			Per well

	Other indirect (upstream/downstream) energy use & implications	Energy consumption - production of materials used:			Literature for main materials x inventory per well (Joules/well)
		Steel (casing/well heads) (te)			
		Diesel/Pseudo-oil (te)			
		Cement (te)			
		Total (te)			
	Reclaimable & actual reclaimed product after useful life	Muds (% theoretical/actual reclaimed)			Per well
Atmospheric Emissions	Greenhouse gas emissions	Fuel use (te)			Per well
		Estimate from UKOOA/OGP emission factors:			
		CO_2 (te)			
		CO (te)			
		N_2O (te)			
		CH_4 (te)			
		VOCs (te)			

		Other (specify)			
	Use & emission of ozone depleting substances	Refrigerants - specify type:			Per well
		Halon - specify type:			
	NOx & Sox emissions	NOx (te) - estimate from emission factors			Per well/well programme
		SOx (te) - estimate from emission factors			
	Other relevant indirect greenhouse gas emissions	Test flaring (te)			Per well
		CO2 (te)			
		CO (te)			
		N_2O (te)			
		CH_4 (te)			
		VOCs (te)			
Solid Wastes	Total amount of wastes by type & destination	Waste/recycle inventory estimates (te):			Per Well
		Plastic (te)			
		Paper/cardboard (te)			

		Wood (te)			
		Scrap metal (ferrous/non-ferrous) (te)			
		Drums (te)			
		Waste oil (te)			
		Medical (te)			
		Chemicals (te)			
		Other (specify) (te)			
		Total (te)			
	All production, transport, import, or export of any 'hazardous' waste (under Basel convention)	Chemicals – estimate (te)			Per well
Aqueous Discharge	Significant discharges to water	Cuttings/mud – estimate from hole vol / mud loss (te)			Per well
		Sewage/grey & wash water - estimate (te)			Per well

		Run-off – hardstanding area/mm rain (te)			Per well
	Water sources & related ecosystems/habitats affected by discharge of water & run-off	Short description see EIA			See EMP
Accidental Emissions	Significant spills	Number of oil spills			Per well
		Amount spilt (te)			
Reputation/ Costs	Significant environmental impacts of products or services	Short description see EIA			See EMP
	Performance of main suppliers relative to environmental programmes & procedures (performance against established targets: waste reduction, increased recycling, no of spills, fuel efficiency, discharge reduction	Rig contractor			Per well
		Mud contractor			
		Cement contractor			
	Total environmental expenditures by type	Accounting protocol: EIA cost (Rs.)			Per well

		Permitting (Rs.)			
		Direct mitigation costs (Rs.) - Equipment - Disposal costs - Restoration			
		Advisor time writing costs (Rs.)			
		Management time writing costs (Rs.)			
		Savings on materials/efficiencies (Rs.)			
		Licence costs/fines (Rs.)			
		Other (specify Rs.)			
		Total (Rs.**)**			