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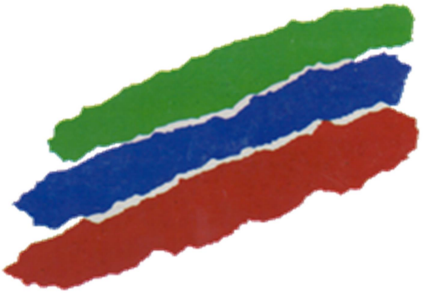
Project Report Handbook

Guidelines for Petroleum Exploration & Developmental Projects in Offshore Areas beyond 12 Nautical miles (incl. Monitoring & Mitigation Measures).

Submitted to:

Directorate General of Hydrocarbons
Ministry of Petroleum & Natural Gas
Government of India



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Report submitted by:

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ABBREVIATIONS

AERB	**Atomic Energy Regulatory Board**
BAT	**Best Available Techniques**
BOD	**Biochemical Oxygen Demand**
CMFRI	**Central Marine Fisheries Research Institute**
COD	**Chemical Oxygen Demand**
COP	**Conference of Parties**
CPCB	**Central Pollution Control Board**
CRZ	**Coastal Regulation Zone**
CTD	**Conductivity Temperature Depth**
DGH	**Directorate General of Hydrocarbons**
DGMS	**Directorate General of Mines Safety**
DO	**Dissolved Oxygen**
EEZ	**Exclusive Economic Zone**
EIA	**Environmental Impact Assessment**
EMP	**Environmental Management Plan**
ETA	**Event Tree Analysis**
FMEA	**Failure Modes and Effects Analysis**
FTA	**Fault Tree Analysis**
GC	**Geneva Convention**
GCF	**Green Climate Fund**
GIPIP	**Good International Petroleum Industry Practices**
GIS	**Geographic Information Systems**
HAZID	**Hazard Identification technique**
HAZOP	**Hazard and Operability Analysis**
HC	**Hydrocarbon**
HHWL	**Highest High-Water Level**
HSE-MS	**Health, Safety and Environmental Management Systems**
IAEA	**International Atomic Energy**
ICRZ	**Island Coastal Regulation Zone**
IMD	**India Meteorological Department**
IMDG Code	**International Maritime Dangerous Goods Code**
IMO	**International Maritime Organization**

IUCN	**International Union for Conservation of Nature**
LAG	**Local Action Group**
LLWL	**Lowest Low -Water Level**
MARPOL	**International Convention for the Prevention of Pollution from Ships**
MoEFCC	**Ministry of Environment, Forests and Climate Change**
MoPNG	**Ministry of Petroleum and Natural Gas**
MPAs	**Marine Protected Areas**
MSL	**Mean Sea Level**
NDC	**Nationally Determined Contribution**
NGT	**National Green Tribunal**
NOAA	**National Oceanic and Atmospheric Administration**
NORM	**Naturally Occurring Radioactive Materials**
NOSDCP	**National Oil-spill Disaster Contingency Plan**
OISD	**Oil Industry Safety Directorate**
OSCP	**Oil Spill Contingency Plan**
OSPAR	**Convention for the Protection of the Marine Environment of the North-East Atlantic**
PEL	**Petroleum Exploration License**
PML	**Petroleum Mining Lease**
PNG Rules	**Petroleum and Natural Gas Rules 1959**
PNGRB	**Petroleum and Natural Gas Regulatory Board**
PSCs	**Production Sharing Contracts**
RA	**Risk Assessment**
RSCs	**Revenue Sharing Contracts**
SAR	**Synthetic Aperture Radar**
SBM	**Synthetic Based Muds**
SOLAS	**Convention for the Safety of Life at Sea**
SOP	**Standard Operating Procedure**
SS	**Suspended Sediment**
UNCLOS	**United Nations Convention for the Law of the Sea**
UNFCCC	**United Nations Climate Change Framework Convention**
WCCP	**Well Control Contingency Plan**
WOMP	**Well Operations Management Plan**

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MESSAGE FROM DIRECTOR GENERAL, DGH

The Government of India continues to place a high focus on energy, and the country's reliance on hydrocarbons is critical for guaranteeing energy security while keeping up with the growing economy. Oil and gas will continue to anchor India's fundamentals on energy mix as the world shifts toward transformation.

For the foreseeable future, India's energy security is dependent on oil and gas. The upstream sector of India is currently supplying energy and will be funding the country's future energy transition.

The Indian government has set strong targets for oil production of 40 million metric tonnes and gas production of 50 billion cubic meters by 2024, as well as even tougher ambitions for growing exploration acreage to 5,00,000 square kilometers by 2025 and 10,00,000 square kilometers by 2030. The government is collecting geoscientific data in less studied sedimentary basins to meet exploration aims in a mission mode.

It is vital for India to explore both onshore and offshore areas in search of hydrocarbons to make the country self-sufficient by increasing domestic oil and gas output. In this backdrop, office of DGH, MoPNG hired the services of CSIR-NIO to conduct a research on the environmental impacts of petroleum exploration and development projects in offshore areas beyond 12 nautical miles. DGH under the aegis of MoPNG, GoI aims to formulate a proposal for international bidding rounds of oil/gas fields for appraising a significant volume of offshore sedimentary basin areas within the Exclusive Economic Zone (EEZ).

The environmental clearance for projects within the territorial water is examined by the Ministry of Environment, Forests and Climate Change (MoEFCC); however, the approval beyond territorial water is not within the jurisdiction of MoEFCC. International standards and benchmarks define the rights and responsibilities of nations w.r.t. their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. With the standard conventions and agreements in place, it is imperative to lay down the necessary Environmental standards and safeguards for protecting marine ecology and preventing marine pollution in respect of offshore areas beyond 12 nautical miles from the coastline for adequately addressing the environmental concerns and their incorporation in the Management Plans.

DGH has envisioned the introduction of standardized guidelines/checklists for compliance by the Operator on Self-Regulated/Certification basis for the hydrocarbon exploration in the areas beyond 12 NM. Accordingly, the study report and handbook on environmental impacts in offshore areas beyond 12 NM have been prepared in collaboration with CSIR-NIO (National Institute of Oceanography) in conjunction with major offshore players of our country.

The Report/Handbook/Guideline titled "*Guidelines for Environmental Impact Assessment Studies on Petroleum Exploration and Developmental Projects in Offshore Areas beyond 12 Nautical miles*" provides a succinct/comprehensive review of E&P activities as well as the guidelines needed to assess, mitigate, and monitor potential environmental impacts from upstream oil and gas exploration and development projects.

DGH congratulates the entire team of CSIR-NIO, experts from upstream E&P sector who were involved in the preparation of the handbook in the form of ready-referral and the detailed report.

DGH is confident that the above endeavors will benefit the new incumbents as well as seasoned professionals involved in offshore exploration and drilling in the areas beyond 12 nautical miles.

Shri S C L Das, IAS
DG, DGH

Acknowledgements

The Report/Handbook/Guideline titled "*Guidelines for Environmental Impact Assessment Studies on Petroleum Exploration and Developmental Projects in Offshore Areas beyond 12 Nautical miles*" is prepared from a series of meetings/discussions of an interdisciplinary team of indigenous professionals in the Oil and Gas sector and scientific experts in the Oceanographic background between June 2021 and March 2022. The Directorate General of Hydrocarbons facilitated the project under the Ministry of Petroleum and Natural Gas.

We sincerely acknowledge Shri. Praveen Kumar Raghav, IFS, ADG (E&C), and DGH, thank you for your wholehearted support in materialising the project.

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To bring this report in drafts and to the final one, the untired efforts, support and contributions made by Shri. G L Das, GM (E&C), is highly appreciable.

We would like to thank Ms Poonam Chugh, Manager (Environment) and Ms Pooja Verma (Consultant, Environment) for helping me to edit, draft, redrafting, collating, and proofread the report at every stage.

We would also like to record our appreciation for the people who worked together towards the materialisation of the Report/Handbook/Guideline to the situation of contemporary vision and expect that this guide will prove to be a real and effective contribution to the healthy and sustainable oceanic environment. My hearty appreciation to the professionals from the Oil and Gas sector is as follows.

Oil Industry Safety Directorate (OISD)
Reliance Industries Limited (RIL)
Oil and Natural Gas Corporation (ONGC)
Oil India Limited (OIL)
Vedanta Limited

Last but not least, we are incredibly grateful to the Directorate General of Hydrocarbons (DGH), Ministry of Petroleum and Natural Gas, for financing this project and their continuous support in finalising this report.

Sd-
Project leader-NIO

Executive Summary

- Office of the Directorate General of Hydrocarbon, Ministry of Petroleum & Natural Gas, Government of India, requested CSIR-NIO to carry out the Study of Environmental Impact of Petroleum Exploration and Developmental projects in offshore areas beyond 12 nautical miles and suggest means for protecting marine ecology and prevention of marine pollution through a proper monitoring and mitigation plan.
- To enhance the hydrocarbon (HC) exploration activities towards the country's growing energy requirements, the Ministry of Petroleum and Natural Gas is formulating a proposal for international bidding rounds of oil/gas fields for appraising a significant volume of offshore sedimentary basin areas within the Exclusive Economic Zone (EEZ).
- The environmental clearance for projects within the territorial water is considered by the Ministry of Environment, Forests and Climate Change (MoEFCC); however, the approval beyond territorial water is not within the jurisdiction of MoEFCC. The unexplored area has come down significantly due to the surveys carried out by DGH in unexplored/poorly explored areas of the country, including deep waters.
- Baseline data of the major sedimentary basin (Gulf of Kutch, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery Basin, Krishna Godavari, Mahanadi Basin, and Andaman Basin) has been prepared by comprehensive analysis of Marine EIA/ monitoring work carried out in the oil fields within the EEZ of India in shallow and deep offshore blocks. We have compiled most of the available reports on the oil field in the western & eastern offshore blocks, books, journal papers, thesis and other documents. For each basin, Meteorological parameters (wind speed, relative humidity barometric pressure, air temperature, solar radiation), physical parameters (currents, wave, temperature, salinity, density, turbidity/TSM), chemical parameters (Dissolved

oxygen (DO), BOD, COD, Nutrients (nitrate- NO_3^-, silicate - SiO_4^- and phosphate – PO_4^{3-}), Dissolved petroleum hydrocarbon, Dissolved heavy metals), sediment parameters, heavy metals, phytoplankton, zooplankton, benthos, the abundance of fish etc., were tabulated through the compilation of the documents. Ultimately, for each basin, the minimum, maximum, and average values of all parameters were calculated, which can be further used to study the impact of the oil and gas project on the marine environment.

- Permissible Limit of effluent discharge and the oil content related to the Petroleum Exploration and Developmental projects in offshore areas beyond 12 nautical miles in the Indian EEZ has been prepared and listed in the Annexure-1 (Table 5.2a of the report)
- Permissible Limit/baseline values of the water column and sediment parameters related to the Petroleum Exploration and Developmental projects in offshore areas beyond 12 nautical miles in the Indian EEZ have been prepared and listed in Annexure-2 (Table 5.2b of the report)
- The chemicals used for hydro testing must be easily biodegradable. Toxicity (96 hr LC50 > 30,000 mg/l for most abundant biota and IUCN red list organism as in Annexure-4, if any) should be minimum as per the criteria; effluent can be discharged off-shore intermittently, at an average rate of 50 bbl/hr/well from a platform to have proper dilution & dispersion without any adverse impact on the marine environment.
- The Marine Protected Areas are natural marine resources for biodiversity conservation and the well-being of the people dependent on them. India has designated four legal categories of protected areas: National Parks, Wildlife Sanctuary, Conservation Reserve and Community Reserve. Suppose Oil and Gas project activity extend to the limit of any of these Marine Protected Areas (MPAs). In that case, a detailed biodiversity action plan is suggested to be prepared to protect and sustain a healthy ecosystem of concern.
- Environmental impacts of oil and gas operations could impact water quality and affect species, populations, assemblages, or ecosystems by modifying

various ecological parameters (e.g., biodiversity, biomass, productivity, etc.). Potential impacts are generally assessed at the project level through some formal process termed an environmental impact assessment (EIA). Various project activities such as Seismic survey, vessel operations, Exploratory & appraisal drilling, Development and Production to the Decommissioning stages were assessed, and the impact on the marine environment has been anticipated. Together with baseline information and anticipated impact, mitigation measures have been suggested to negate the adverse effect on the environment.

- The offshore environmental monitoring provides an overview of the environmental status and baseline data that trends over time due to offshore oil and gas activities. Sampling location, parameters, frequency and strategies were discussed to monitor the environment during the various stages of the project activity, intending whether the environmental status of the offshore oceanic environment is stable, deteriorating or improving due to operators' activities. It is important that results from environmental monitoring can be used to verify predictions and conclusions of the environmental impact assessment study for the respective field or the region.
- Risk Assessment by identifying, analysing, assessing, and communicating risk and accepting, avoiding, transferring or controlling it to an acceptable level by considering the associated costs and benefits of any actions taken.
- A disaster management plan related to offshore Oil and Gas projects has been outlined to set out the appropriate course of action to mitigate the impact of an emergency event. This is to respond immediately to an emergency event to prevent its escalation to a disaster and to provide an early response in such an escalation.
- Natural hazards like cyclones, tsunamis, earthquakes, and oil spills have been discussed, and an action plan has been formulated to respond to such events early.

- Various stages in decommissioning offshore oil and Gas projects and related environmental impacts have been identified. The best minimum footage for the environment has been suggested.
- The possibility of naturally occurring radioactive materials (NORM) during the project activity has been identified, and mitigation measures have been suggested.
- IUCN Red List Marine species in the Indian Ocean Waters have been listed; if any of these organisms were identified in the project domain during the survey, a detailed biodiversity action should be prepared to conserve the organism and its habitat.
- Environmental Management Plan (EMP) discussed HSE-MS, standards, procedures, programmes, practices, guidelines, goals, and targets that must be established and, where necessary, agreed upon with regulators and other stakeholders. Monitoring and auditing will show how well an operation performs and provide a measure of effectiveness. Checklist/SOP and Guidelines for the operators engaging in E&P activities beyond 12 nm have been prepared to adopt better environmental management to negate adverse impacts due to project activity.
  - Guidelines for Oil and Gas fields beyond 12 nautical miles
  - Guidelines for Seismic operations
  - Guidelines for Exploration and appraisal drilling
  - Guidelines for Development and Production
  - Guidelines for the Decommissioning of offshore oil and gas structures
  - Guidelines for Environmental Monitoring program
  - Guidelines for discharge of gaseous emissions
  - Guidelines to the Management Techniques for Drilling Wastes and Production Effluents
  - Guidelines for Oil Spill Response Plan
- Considering the paucity of data pertaining to the region of Kerala-Konkan, Mahanadi and Andaman sedimentary basins around India, NIO recommends

that more studies should be undertaken to generate adequate baseline environmental data to facilitate the preparation of the EIA report.

- The study also recommends some actionable items for all the blocks beyond 12 nm for E&P activities, such as Exploratory surveys, Exploratory/appraisal Drilling, Development/Production phase, Operation Phase and Decommissioning Phase.

1.0 Introduction

To enhance the hydrocarbon (HC) exploration activities towards the country's growing energy requirements, the Ministry of Petroleum and Natural Gas is formulating a proposal for international bidding rounds of oil/gas fields for appraising a significant volume of offshore sedimentary basin areas within the Exclusive Economic Zone (EEZ). While there is a need to enhance oil and gas production, including EEZ areas, environmental safeguards for protecting marine ecology and preventing marine pollution are essential. The environmental clearance for projects within the territorial water is considered by the Ministry of Environment, Forest and Climate Change (MoEFCC); however, the approval beyond territorial water is not within the jurisdiction of MoEFCC. International standards and benchmarks define the rights and responsibilities of nations, w.r.t. their use of the world's oceans, establishing guidelines for businesses, the environment, and the management of marine natural resources. Although environmental standards and safeguards are in place within the territorial waters, it is imperative to lay down the policy for protecting marine ecology and preventing marine pollution in offshore areas beyond 12 nautical miles (NM) to address environmental concerns and adequately incorporate them into the Management Plans. DGH envisions introducing some efficient, standardized checklist/SOPs for compliance by the Operator on a Self-Regulated/Certification basis for the HC exploration in the areas beyond 12 NM.

India has an estimated sedimentary area of 3.36 million sq. km, comprising of 26 sedimentary basins, out of which 1.63 million sq km area is in the land, shallow offshore up to 400 m isobaths with an aerial extent of 0.41 million sq. km and deep water beyond 400 m isobaths with the sedimentary area of 1.32 million sq. km as per renewed categorization of sedimentary basins. Over the last few years, there has been a significant forward leap in exploring the hydrocarbon potential of the sedimentary basins of India. The unexplored area has come down significantly due to the surveys carried out by DGH in unexplored/poorly explored areas of the country, including deep waters and acreages awarded for exploration under NELP/OALP rounds. Concerned efforts are continuously being made to reduce the unexplored area further.

Office of the Directorate General of Hydrocarbons, Ministry of Petroleum & Natural Gas, Government of India, requested CSIR- NIO to carry out the Study of Environmental Impact of Petroleum Exploration and Developmental projects in offshore areas beyond 12 Nautical miles and suggest means for protecting marine ecology and prevention of marine pollution through a proper monitoring and mitigation plan.

1.1 Scope of work

Baseline information on the marine environment for the proposed work has been prepared by CSIR-NIO by exploring various marine EIA reports, published articles, and other available data sources, which will portray the present environmental condition that prevails over the Indian EEZ.

Environmental Impact Assessment assesses the possible positive or negative impact of a proposed project on the environment and the natural, social and economic aspects, i.e., aiming at "Sustainable Development" due to the project activities. The possibilities of modifying these statutory requirements, which are applicable beyond 12 Nautical miles, will be explored by considering offshore environmental conditions and practical options for ensuring Marine Environment protection. Further, the applicability of international regulations, such as 1. The UN Convention on the Law of the Sea 1982, 2. The Barcelona Convention, 1976, 3. OPRC Convention, 1990, 4. OSPAR Convention, 1992, 5. The Espoo Convention 2001 and the Kiev Protocol 2003, 6. Kyoto Protocol (1997/2005), 7. Paris Agreement 2016 to prepare a comprehensive report that protects the marine environment beyond 12 Nautical miles during oil exploration similar to GIPIP (Good International Petroleum Industry Practices) will also be explored.

Due to the oil exploration activities, the project's likely impact on the environment will be assessed based on the baseline data collection and the oil/gas exploration methods. Mitigation methods to minimise the impact of the project on the marine environment will be prepared. All mitigation and avoidance measures will be

designed or formulated to negate the predicted possible and probable impacts described for all relevant environmental parameters, including ecological and physical, biological, geological, and chemical components. The nature and type of the expected potential impacts on the physical, biological, and chemical components will be assessed to the extent possible during the process. Further, international regulations on mitigation measures will address all possible environmental enhancement measures in the report, which generally could improve the project's adverse impact.

The environmental monitoring program aims to formulate a systematic, site-specific plan to monitor the environmental parameters within the impact area during and after the project commission. This would aid in assessing the effectiveness of Mitigation and environmental protection measures implemented for the proposed project based on the existing ecological scenario and the probable environmental impacts appraisal. The assessment of impacts (primary surveys, secondary surveys, field visits, and stakeholder consultations) relating to various environmental components will be utilized. For each environmental attribute, the monitoring plan will specify the monitoring parameters, the location of monitoring sites, the frequency and duration of monitoring, and the applicable standards, implementation, and supervising responsibilities. The efficacy of the mitigation measures is followed during the preparatory and operational phases of the oil/gas exploratory works, which can be assessed and revised based on the monitored results. The environmental attributes to be monitored during the preparatory and operational phases of the project, specific description, and technical details of environmental monitoring, including the monitoring parameters, methodology, sampling locations, and frequency of monitoring, will be prepared in detail in the report.

Risk Analysis (RA) is an extensive hazard analysis that involves identifying and quantifying hazards related to the oil field. RA assesses the damage, injuries, and financial costs likely to be sustained in a geographic area over a given period. The guidelines related to the Oil Spill Contingency Plan will be delineated and reviewed by the Indian Coastal Guard. According to the National Oil Spill Disaster

Contingency Plan (NOS-DCP), this Oil Spill Contingency Plan will be prepared.

The preparation of the impact assessment report will be based on all the above considerations and all possible impact assessment stages with a broad vision of sustainable development.

1.2 Objectives

The proposed study of Environmental Impacts of Petroleum Exploration and Developmental projects in offshore areas beyond 12 Nautical miles, including monitoring & Mitigation Measures, in general, will have the following broad objectives:

(I) Baseline data of the marine environment by comprehensive analysis of Marine EIA/ monitoring work carried out in the oil fields within the EEZ of India in deep and shallow offshore blocks.

(II) To document present legal/statutory requirements related to environmental impact within & beyond 12 NM for ensuring the protection of the Marine Environment

(III) Anticipated Impact of the project on the marine environment and its mitigation methods

(IV) Environmental monitoring, risk assessment, and contingency plan

(V) To suggest SOP for adoption by operators to address environmental concerns.

2.0 Proposed Standard Terms of Reference (ToR) related to Oil and Gas Projects beyond 12 Nautical miles

2.1 Proposed Standard Terms of Reference (ToR) for EMP studies related to exploratory projects beyond 12 Nautical miles

ToR for EMP studies in respect of offshore oil and gas exploration may include, but are not limited to, the following:

1. **Executive summary of the project**
2. **The project description should include**
   - List of the proposed activity.
   - Geographic information of the site.
   - Maps showing the drilling area.
   - Duration of project activities.
   - Information of the proposed drilling rig.
   - Details on support infrastructure, vessel etc.
   - Details on bathymetry data, including sea depth, seawater quality, seafloor relief, navigational information, *etc*.
3. **Environmental Management Plan:**
   - Details on solid waste management for drill cuttings, drilling mud and oil sludge, produced sand, radioactive materials, other hazardous materials, etc., including disposal options during the drilling phases.
   - Details on wastewater generation, treatment and utilisation/discharge for produced water, cooling waters, other wastewaters, etc.
   - Details on oil spill contingency plan.
4. **Environmental Monitoring Program**
   - Details on environmental monitoring programs during drilling activities.

2.2 *Proposed Standard Terms of Reference (ToR) for EIA studies related to Development projects beyond 12 Nautical miles*

The proposed development envisages that the produced hydrocarbons will be handled through producing assets. If the project envisaged that the produced hydrocarbons need to be brought to the onshore terminal for further processing and discharge. In that case, the project proponent needs to abide by the EIA notification and its amendment as applicable.

ToR for EIA studies in respect of the offshore oil and gas, development and production projects may include, but are not limited to the following:

1. **Executive summary of the project**
2. **Project description**
   - A complete description of the project includes proposed onshore and offshore facilities.
   - Geographic information of the site
   - Details on support infrastructure the vessel used for the construction and operation phase of the project.
   - Complete process flow diagram describing each unit, its processes and operations, along with material and energy inputs and outputs (material, water and energy balance).
   - Details on storage of chemicals at the site and measures to prevent hazards.
3. **Description of the environment**
   - Baseline data includes different components of the environment, viz. noise, water and flora & fauna from the study area as mentioned in this manual.
   - The study report details climate and meteorology, including wind patterns, temperature, rainfall, waves, tides, currents, cyclones, earthquakes, etc.
   - Details on establishing a baseline on the area's water resources affected or potentially impacted by the activities in the various phases of the project. This baseline should include a water quality assessment of the project site's

available water sources and zone of influence. The baseline should potentially include parameters such as Total Nitrate, Salinity, DO, pH, Sulphates, Hardness, Phosphates, Conductivity, Heavy metals (Total metals, mercury, lead, copper *etc.*), TDS, Hydrocarbons and Arsenic.

- Details of the basic physical environment, such as tides, currents, and waves, are provided in the study area.
- Studies on flora and fauna, including the main habitat types with a list of species of flora and fauna and their conservation value, give particular attention to any species protected under the law.
- Fisheries study w.r.t. benthos and marine organic material.

4 Anticipated Environmental Impacts & Mitigation Measures

- Details on potential impacts on the sea water quality, sediments, aquatic fauna and flora due to the activities in the various phases of the project.

5 Environmental Management Plan

- Describe mitigation measures, including an EMP, to be implemented to reduce or offset the adverse impacts of proposed activities.
- Identify the preferred option(s) for waste management/disposal method based on environmental grounds, including necessary infrastructure. Specify any residual impacts of waste management, their significance, and any mitigation measures to be undertaken.
- Details on wastewater generation, treatment and utilisation/discharge for produced water, cooling waters, other wastewater, etc.
- Details on oil spill contingency plan.
- Details on occupational health and safety of employees and workers.

6 Analysis of Alternative technologies

- Evaluate alternative options for collecting, treatment, recycling (if appropriate), and disposal of these wastes. Identify any chemicals planned for use in treating or managing these wastes.

7 Environmental Monitoring Program

- Details on environmental monitoring programs during the construction and operational phase.

8 Risk Assessment

- Details on risk assessment include identification of hazards, proposed measures, disaster management plan, contingency plan, emergency response plan, etc.
- Outline of the overall management structure anticipated for the proposed activities.
- Identify emergency preparation and applicable management measures for the proposed activities dealing with the following eventualities as a minimum:
  - Oil spills
  - Cyclones
  - Fires
  - Blow out
  - H_2S, if any.

3.0 Check List/SOPs for E&P operators engaging E&P activities beyond 12 NM

3.1 Seismic Operations:

S No	Activities	Prerequisites	Checks/Permissible Limits
1	Identification of sites	Sites may avoid protected areas and local sensitivities, if feasible	Readings to be captured through an environmental assessment study
2	Scheduling of upstream E&P activities	Least sensitive period of the year (As per the order: Ministry of Fisheries, Animal Husbandry and Dairying; Department of Fisheries)	Operators may avoid the most sensitive periods in the respective areas: The Bay of Bengal from 15th April to 14th June The Arabian Sea from 1st June to 31st July
3	Imaging of the target structures	Lowest possible source levels	From ambient sea noise, 80 dB
4	Acoustic activity	To be started at the lowest practicable level	Measurement & Self Certification
5	30/60-minute Pre-shooting Search	60-min shooting search for deeper waters than 200 m	Measurement & Self Certification

3.2 Exploration and Appraisal Drilling:

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Site selection and design stage	Least sensitive marine habitats and consideration of lifecycle periods for relevant species	• Benthic habitat surveys • A detailed Biodiversity plan has to be prepared if any red-listed IUCN organism is identified as listed in Annexure-4 (Table 6.12 of the report). • Directional drilling to access beneath sensitive areas • Cluster well drilling to be encouraged • Assessment and monitoring of local conditions • Exclusion zones to be developed for key stakeholders like fisheries • Adequate lighting infrastructure	• Operator to comply • Self-Certification
2	Information to the mariners	Notice to Mariners detailing the area of operations	• DG of Shipping • Concerned Port authorities • Concerned State authorities	• Operator to comply • Self-Certification
3	Protection of project vessels	Implement Collision Risk Management Plans	• Adherence to COLREGS • Dynamic placement of drill rigs to reduce the requirement of anchors to reduce the impact on benthic flora and	• Operator to comply • Self-Certification

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
			fauna, operators may avoid anchoring of drill ships.	
4	Dredging/Trenching & Rock Dumping	Delineation of dredging zones to be made considering the sensitive marine habitats and lifecycle times of relevant species	• Benthic habitat surveys • The utilisation of state-of-the-art technologies • Formulation and Implementation of a Dredge Management Plan	• Operator to comply • Self-Certification
5	Vessel Operations	• Optimizing the ship's position • Planned survey track to be followed • Proper handling & maintenance of cabling equipment • Optimized handling of explosives according to procedures and locations • Clear labelling of towed equipment	• Ensuring a gradual start-up of engines, allowing the species to take evasive actions. • Disposal of wastes and oily water in accordance with international regulations (as per MARPOL) • Contingency plans for lost equipment & oil spillage • Timely reporting of all unplanned interactions	• Operator to comply • Self-Certification
6	Site Operations	• Engineering measures to minimise operational noise emissions • Minimise external lighting	• Requirements in the planning process to be met	• Operator to comply • Self-Certification
7	Aqueous Discharges	• Treatment of oily water prior to discharge • Treatment of sewage in accordance with international standards • Proper storage of oils and chemicals • Oil for well test operations to be stored separately	• Contingency plans for oil spillage • Control documentation for storage and disposal • Treatment & discharge of effluents as per MARPOL and GSR 546(E) in accordance with CPCB guidelines • Produced water discharge as per GSR 546(E) in accordance with CPCB guidelines	• Operator to comply • Self-Certification
8	Solid Wastes Disposal	Proper management of solid waste onboard	• Onshore disposal of non-biodegradable domestic waste • Ensuring waste segregation at source for different waste types • No overboard debris/waste discard by closing all containers • Materials to be supplied in bulk to reduce the generation of packaging wastes	• Operator to comply • Self-Certification on non-hazardous waste • Proof of Submission of compliance to Hazardous Rules (Manifest copies) to State/Central Government.

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
9	Muds & Cuttings	Proper management of Muds & Cuttings during drilling	• Non-disposal of OBM in sea • Downhole disposal of OBM wastes • Usage of low-toxicity water-based drilling muds • Adherence to the plan initially outlined	• Operator to comply • Self-Certification • Segregation of Hazardous OBM/SBM and Non-Hazardous wastes like WBM may be done
10	Atmospheric emission/ noise/light	To reduce Atmospheric emission/ noise/light	• Efficient well-test burners • Effective control of H_2S emissions with safety measures	• Operator to comply • Self-Certification

3.3 Development and Production

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	General	• Long-term occupation of sites • All aspects identified for exploration drilling should be applied to permanent sites	• Detailed assessment of environmental implications • Site & Route selection plan for flowlines and pipelines • All checklists mentioned in Exploration & Appraisal drilling (Check list-3.2) are to be followed	• Operator to comply • Self-Certification
2	Site Operations	• Evaluation of constriction & drilling activities • Use of central processing facility, satellite & cluster wells to be minimized • Avoiding gas venting by adopting best engineering practices; This is applicable for new platforms • Waste stream monitoring	• Impact assessment of operational activities, including EMP • Assessment of full implications of well treatment and workover, process, storage, power generation & other support facilities • Incorporation of an oily treatment system for both produced & contaminated water treatment • An onboard sewage treatment system • Assessment of waste gases emissions and effluent limit • A proper plan for treatment and disposal of solid, toxic & hazardous wastes onshore • A detailed waste management plan • Detailed contingency plans	• Operator to comply • Self-Certification

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
3	Environment Monitoring plan	A proper monitoring plan needs to be established for assessing the status of the marine environment, particularly for a long duration of E&P activities	• To adopt a proper monitoring strategy • Frequency of Monitoring • Environment parameters to be studied • Evaluation of environment parameters	• AS per OSPAR guidelines • Once in a year • As per mentioned in the Annexure-3 (Table 5.3 of the report - Guidance for the assessment of baseline components and attributes) • AS per the permissible limit mentioned in the Annexure-2 (Table 5.2b of the report) • Operators to comply as above

3.4 Decommissioning of Offshore Oil and Gas Structures

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Decommissioning & abandonment of offshore installations/pipelines	Site restoration guidelines (SRG) 2018 and its amendments need to be followed by the operators		• Operator to comply with OISD approval

3.5 Post Decommissioning:

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Assessment of decommissioning phases and status of the site environment	• Decommissioning & abandonment of offshore installations/pipelines as per guidelines	•Submission of the written report to OISD comprising: •Summary of decommissioning operation •Description of mitigation measures •Signed statement by authorised representatives in accordance with the Abandonment Plan •Environmental Survey Report with video graphics evidence	• Operator to comply • Self-Certification

3.6 Discharge of Gaseous Emissions:

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Gaseous Emissions	As per MARPOL/CPCB guidelines		• Operator to comply • Self-Certification

3.7 Naturally Occurring Radioactive Materials in Oil & Gas (NORM):

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Wells in production	If any radioactivity is found, follow AERB guidelines		• Operator to comply • Self-Certification

3.8 Oil Spill Response Plan:

S No	Activities	Prerequisites	Checks	Permissible Limits/Compliance (if any)
1	Spilling of oil has occurred	As per NOS-DCP 2015 and amendments		• Operator to comply • Self-Certification

4.0 Guidelines for Oil and Gas fields beyond 12 Nautical miles

Drilling and processing of oil can be considered the most harmful stage of oil E&P because it is a permanent phase, unlike other possible accidents that could occasionally happen, such as oil spills. During the E&P phase, oil rigs release oil waste and produce water that forms 98% of the total waste. It consists of hydrocarbons that cause water toxicity and, eventually, aquatic toxicity. Drilling fluids (drilling muds) are discharged during the drilling process. They may contain toxic substances like benzene, zinc, arsenic, chromium, iron, mercury, barium, and other contaminants used to lubricate drill bits and maintain pressure, e.g., barium acts as a lubricant. Other main polluter factors are greenhouse gases such as carbon dioxide, carbon monoxide, methane, volatile organic carbons, and nitrogen oxides generated directly by offshore rigs and DG sets. These gases are the major climate change concern due to global warming, melting ice at the poles, and ocean acidification. Thus, guidelines have been prepared to minimise the impact of oil and gas exploration activities beyond 12 NM on the marine environment, thereby ensuring a healthy ecosystem.

4.1 Guidelines for Seismic operations

- Use environmental assessment to identify protected areas and local sensitivities.
- For a seismic survey, avoid sensitive locations and times of year for critical activities such as migration, breeding, calving and pupping, as well as fishing areas (Operation avoidance periods: Bay of Bengal 15th April to 14th June; The Arabian Sea from 1st June to 31st July).
- Schedule operations during the least sensitive period.
- Use the lowest possible source levels to image the target structures.
- Start acoustic activity at the lowest practicable level (80 dB) and gradually increase it to the required level to allow marine life to move away from the source.
- Undertake a 30-minute pre-shooting search (60 minutes in waters deeper than 200 m due to deeper diving mammals).

4.2 Guidelines for Exploration and appraisal drilling

- Consider sensitive marine habitats and lifecycle periods for relevant species and communities during the site selection and design stage (Operation avoidance periods: Bay of Bengal 15th April to 14th June; The Arabian Sea from 1st June to 31st July)
- Undertake benthic habitat surveys to identify sensitive habitats and biota and, where feasible, avoid these areas.
- Preparing a biodiversity action plan for the concerned is mandatory if any red-listed organism is found during the baseline survey, as listed in Annexure 4 (Table 6.12 of the report).
- Minimise physical footprint, where feasible.
- Consider directional drilling to access targets beneath sensitive areas.
- Consider cluster well drilling.
- Local conditions, such as waves, wind, and currents, must be fully assessed, as well as the history of cyclones and earthquakes at the site.
- Develop exclusion zones for various key stakeholders, including local fishing communities, and promote awareness of exclusion zones with all stakeholders.
- Ensure all facilities/infrastructure have the appropriate navigation lighting, and all facilities/infrastructure and subsea infrastructure are gazetted and included on nautical charts.
- Issue a 'Notice to Mariners' through the relevant government agencies detailing the area of operations.
- Develop and implement Collison Risk Management Plans for project vessels
- Ensure all vessels adhere to Class certification of the vessel as per Indian Regulation or International Regulations for Preventing Collisions at Sea (COLREGS), which set out the navigation rules to be followed to prevent collisions between two or more vessels
- Consider potential impacts from offshore structures, both positive and negative. In some cases, restoration may be needed to assist in the recovery of damaged or

destroyed habitats or offsets. Consider dynamic positioning on drill rigs to avoid or minimise the need for anchors

Dredging/Trenching and Rock Dumping

- The site selection, design & demarcation, placement and timing of dredging zones should be selected by considering sensitive marine habitats and lifecycle periods for relevant species identified during the detailed baseline environmental monitoring.
- Use state-of-the-art dredging technology that minimises the disturbance and reduces the footprint, duration and volume of dredging, rock dumping and dredge disposal to the minimum required.
- Formulate and implement a dredge management plan describing measures to minimise impacts and deploy suitable management techniques when critical values for marine water quality are exceeded.

Vessel operations

- For ships, ensure gradual start-up of engines and thrusters where possible to allow species to take evasive action.
- Assess whether anchoring or the use of DP would be more appropriate for maintaining a ship's position. Anchoring will lead to seabed disturbance, while DP will result in noise disturbance.
- Remain on the planned survey track to avoid unwanted interaction.
- Dispose of all waste materials and oily water properly to meet national and international regulations. i.e., the oil content of the discharged effluent cannot exceed that specified under CPCB/MARPOL guidelines.
- Apply proper procedures for handling and maintaining cable equipment, particularly cable oil.
- Label all towed equipment.
- All towed equipment must be highly visible.
- Make adequate allowance for deviation of towed equipment when turning.
- Prepare contingency plans for lost equipment and oil spillage.

- Attach active acoustic location devices to auxiliary equipment to aid location and recovery.
- Store and handle explosives according to operators' procedures and regulations.
- Consider using a guard boat in busy areas.
- Report all unplanned interactions with other resource users or marine life to the authorities.

Site Operations

- Offshore facilities/infrastructure should consider engineering measures to minimise operational noise emissions.
- Minimise external lighting as much as possible to that required for navigation and for the safety of deck operations, except in the case of an emergency, and limit the occurrence and duration of flaring, where possible.
- Requirements specified in the planning process must be met, including supply vessel operations.

Aqueous discharges.

- Oily water from deck washing, drainage systems, bilges, etc., should be treated prior to discharge to meet national and international consents.
- Sewage must be adequately treated prior to discharge to meet international standards. Treatment must be adequate to prevent discolouration and visible floating matter.
- Most spills and leakages occur during transfer operations, ensuring adequate preventative measures and spill contingency plan requirements are in place.
- Store oils and chemicals properly in contained areas.
- Limited quantities are to be stored to a minimum level required for operational purposes. Ensure proper control documentation, manifesting, and disposal. Do not dispose of waste chemicals overboard.
- Preferentially, separate and store oil from well-test operations.

Solid wastes

- Collect all non-biodegradable domestic waste and compact it for onshore disposal.
- Ensure requirements specified in the planning process are met with regard to waste treatment and disposal.
- Ensure proper documentation and manifesting.
- Consider waste segregation at the source for different waste types such as biodegradable, non-biodegradable, plastic, etc.
- No debris or waste to be discarded overboard from rigs or supply vessels.
- Waste containers must be closed to prevent loss overboard.
- Spent oils and lubes should be containerised and returned to shore.
- Consider the bulk supply of materials to minimise packaging waste.

Muds and cuttings.

- Mud make-up and mud cuttings disposal requirements must be addressed in the planning process.
- Preferentially, use low-toxicity water-based drilling muds.
- Do not dispose OBM to sea.
- Consider downhole disposal of OBM wastes.

Atmospheric emission/noise/light

- Well-test burners must be efficient, maintained, and burn gas and oil effectively.
- Ensure that requirements addressed in the planning phase are met with regard to emissions, noise, and light.
- H_2S emissions must be effectively controlled. Appropriate safety measures have to be taken if any such emissions are noticed.

4.3 Guidelines Development and Production

- Long-term occupation of sites, including supply and support, will require a detailed assessment of environmental implications, particularly where resource use conflicts arise, and commercially important fish species may be affected.
- All aspects identified for exploration drilling should be applied to permanent sites.
- Consider site and route selection for flowlines and pipelines.

Site Operations

- Evaluate construction and drilling activities and impacts separately from operational activities.
- Maximise use of central processing facility, and use satellite and cluster wells to minimise footprint.
- In terms of long-term disturbance and impact, assess the full implications of well treatment and workover, process, storage, power generation, and other support and accommodation facilities.
- An oily water treatment system for both produced and contaminated water treatment should be incorporated to meet national and international discharge limits.
- Onboard sewerage treatment system.
- Assess the treatment of waste gases and emission limits, particularly where gas is flared.
- Avoid gas venting by adopting best engineering practice
- Onshore treatment and disposal of solid, toxic and hazardous wastes will require proper planning, particularly if local infrastructure is limited in capacity and capability.
- A detailed waste management plan will be required.
- Prepare detailed contingency plans, personnel training, and regular response exercises, considering storage and export systems.
- Monitor waste streams in order to meet compliance requirements.

4.4 Guideline to the Decommissioning of Offshore Oil and Gas Structures

The basic process of decommissioning and abandoning an offshore installation or pipeline is prepared in compliance with MoPNG Notification No. O-32011/75/2013-ONG-I. Dated 2018 and as follows,

- The operator has to shut down oil or gas production, plug the wells deep below the surface, and make them safe.
- Deconstruction, removal and disposal of the topside facilities
- Removal of the substructure.
- Removal of facilities should consider potential impacts on the site, including noise (from explosives), physical disturbance of communities established during the life of the facility and demobilisation routes.
- All debris must be removed from the seabed.
- Identifying, labelling, maintaining, storing, and disposing of equipment contaminated with Naturally Occurring Radioactive Material (NORM) shall follow the Department of Atomic Energy (DAE) guidelines, if any.
- Any facilities and infrastructure handed over to the authorities must include proper instructions for use, maintenance, and proper training procedures.
- Decommissioning offshore structures is subject to international and national laws (MoPNG Notification No. O-32011/75/2013-ONG-I. dated 2018) and should be dealt with on a case-by-case basis.
- Seabed surveys are carried out, and ongoing monitoring is performed to see if any part of the platform/facility remains in place.
- Record and monitor the site as required after appropriate decommissioning activities.
- The development of a trust fund that can be used to decommission the infrastructure when its production life is over should be considered.

Post Decommissioning

Within 90 days after the completion of decommissioning, submit a written report to the OISD that includes the following:

- A summary of the decommissioning operation, including the date it was completed;

- An environmental survey report with a description of any mitigation measures taken, if any.
- A statement signed by an authorised representative certifies that the site was decommissioned according to the Abandonment Plan.
- Environmental Survey Report on the post decommission with video graphic evidence on the status of the site in good condition.

4.5 Guidelines for Environmental Monitoring Programme

Offshore environmental monitoring aims to overview the ecological status and trends over time. Monitoring is intended to indicate whether the environmental quality of the offshore oceanic environment is stable, deteriorating or improving due to operators' activities. Oil & gas projects differ in size, complexity and ecological sensitivity, and factors should be considered when deciding on a monitoring programme. Evaluate the adequacy of mitigation and pollution control measures implemented to reduce the adverse impacts caused during the operation stage; if the environmental quality is not at the anticipated level, further modification is required in the mitigation plans.

Guidelines for Environmental monitoring applied to offshore Oil & Gas platforms are as follows:

- Develop a sampling strategy that includes site selection, the number of locations to be surveyed, samples to be collected, methods, sample storage, preservation, analysis and report writing.
- Site selection for sampling: The plan identifies the location and number of stations, sampling methodologies and analytes to be measured as per OSPAR guidelines. As shown below, the location and number of stations should also be related to the project objective, activity, and development size.

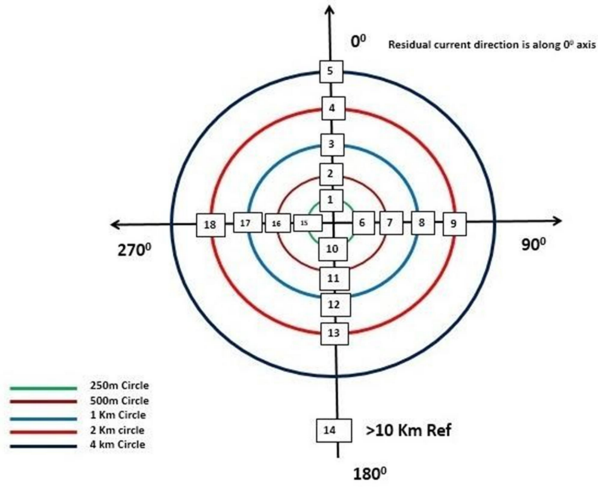


Figure: Sampling Strategy

- Dispersion modelling may also be useful in selecting sampling sites by predicting the deposition of constituents. Attention should be given to understanding previous and current activities in and around the study area and how these activities influence the obtained results.
- Guidance for measuring baseline components and attributes is listed in Annexure-3 (Table 5.3 of the report), which must comply with the limits given in Annexure-2 (Table 5.2 of the report).

Meteorological conditions

One station at the project site

Hourly observations - continuous records during the monitoring period

- Wind speed and direction
- Dry bulb and wet bulb temperature
- Barometric pressure
- Relative humidity
- Solar radiation
- Rainfall

Noise

Noise and vibration measurements should be conducted at least one day continuously on a working and non-working day at one location in the project site during the monitoring period.

Water column sampling

One sample from the surface mid and bottom at each station, process-wise or activity-wise, once in a year (pre or post-monsoon)

- Temperature & Salinity
- Turbidity
- Currents
- Dissolved Oxygen
- pH
- Nutrients (NO3-, NO2-, SiO4- and PO43-) and Ammonia
- Petroleum hydrocarbon
- Heavy Metals

Solid Waste – Sediment Quality

Process-wise or activity-wise, once in a year

- Munsell Soil Colour Chart System and smell
- Particle size distribution
- Organic Carbon
- Heavy metal
- PHC

Biological Parameters

Process-wise or activity-wise, once in a year

- Primary productivity
- Aquatic weeds
- Bacteria, phytoplankton, zooplankton, and benthos (macro and meiofauna)

- Fisheries
- Heavy metals and PHC in mixed plankton and fish
- Diversity indices
- Trophic levels
- Rare and endangered species
- Avifauna

- Sample storage and preservation: Sampling plans should specify the type of container, storage conditions, and maximum holding times for each type of analysis. Sample containers should be clean and properly stored to avoid contamination.
- Quality assurance and quality control (QA/QC): Documentation of the steps taken to ensure that the desired data quality is achieved is necessary to provide initial users with confidence in the reliability of the results.
- Data statistics and analysis: The data analyses to be conducted are dictated by the objectives of the environmental monitoring program. Major statistical data analysis methods are 1) Frequency Distribution Analysis; 2) Analysis of Variance; 3) Analysis of Covariance; 4) Cluster Analysis; 5) Abundance and Biomass Curve; 6) Diversity Index; 7) Multiple Regression Analysis; 8) Time-Series Analysis; 9) Application of Statistical Models.
- Subsea monitoring: An advanced measurement strategy using Landers and ROVs may be used to allow a large number of assessments to be made over a wide temporal and spatial area and track natural seasonal and global changes possibility for real-time measurements.
- Preparation of secondary data: All the relevant secondary data available for different environmental components should be collated and analyzed.
- Reporting: A detailed report should be prepared, including an introduction, methods, results & discussion, overall evaluation and conclusions, recommendations, summary and application of the results. This report should provide guidance to offshore operators on when and how to conduct an environmental monitoring programme.

4.6 Guidelines for Discharge of Gaseous Emissions

General

Air emissions associated with oil and gas exploration and production activities can be generally categorized as arising from three activities: (1) the combustion of fuels for power generation; (2) emissions arising directly from the production, treatment, storage or transportation of produced oil and gas, and (3) flaring of gas.

Best Available Techniques (BAT)

All large combustion plants offshore (both existing and new) may proactively apply integrated prevention and reduction of pollution. This implies the application of Best Available Techniques (BAT). Regulators should refer to BAT when discharge limits are set in the discharge permits and reflect what reduction levels can be achieved without a definite resolution on what technology to use.

When making plans for the development of new fields, it is important to consider the need to reduce emissions to the air. Operators must inform the regulators on BAT considerations at an early stage in the development.

DG sets

DG sets at the production station should conform with the norms notified under the Environment (Protection) Act, 1986.

These trace gas concentrations must be within the ambient quality guidelines and standards as per the national legislated standards

- Use of high-efficiency equipment to minimise power requirement
- Use of low sulphur diesel (15 ppm)
- Power generation plants incorporating low emissions technology
- Renewable energy sources into developments
- Regular plant maintenance
- Regular maintenance and emission control devices on vehicles and machinery

Combustion

- Use of appropriate valves, flanges, fittings, seals, and packings, considering safety and suitability requirements as well as their capacity to reduce gas leaks and fugitive emissions.
- Implementation of effective and regular leak detection and maintenance
- Ensuring new systems/processes do not use ozone-depleting chemicals or chemicals that cause global warming.

Venting

- The adoption of measures consistent with the Global Gas Flaring and Venting Reduction Voluntary Standard (part of the Global Gas Flaring Reduction Public-Private Partnership),
- Tightly controlled and managed flow of gas and a preferential flare rather than vent,
- Vapour recovery units may be installed for hydrocarbon loading and unloading operations.
- Excess gas should not be vented in an emergency or equipment failure but sent to an efficient flare gas system.

Flaring

- Reducing the amount of gas flared from an offshore installation is beneficial both from an environmental point of view and can help avoid the potential waste of resources and reservoir energy.
- Some gas may be utilised for power production at the installation, but if a large amount of gas is produced, possible solutions may be an injection into the reservoir or export through pipelines. Every effort should be made to flare only where necessary for safety purposes.
- The planning and execution of activities regarding flaring reduction are extremely time-consuming and cost-intensive; hence, technologies that could be used to reduce emissions from flaring may be closed flare technology and/or flare gas recovery systems.

- Ensuring a tightly controlled and managed flow of gas.
- Careful flow tip design, implementation of state-of-the-art technology, reduction of levels of nitrogen oxides, particulate matter and carbon dioxide emissions to the atmosphere during flaring.
- Adoption of measures consistent with the Global Gas Flaring and Venting Reduction Voluntary Standard (part of the Global Gas Flaring Reduction Public-Private Partnership) when considering flaring options for offshore activities
- Design of flare gas metering and tip design to minimise the need for flaring through recirculation, off-gas recovery, and/or flare gas recovery process design.
- Maximise flare combustion efficiency by controlling and optimising flare fuel, air, and streamflow rates to ensure the correct ratio of assist stream to flare stream.
- Strictly adhering to safety regulations, minimise flaring from purges and pilots through the adoption of various measures (installation of purge gas reduction devices, vapour recovery units, inert purge gas, soft seat valve technology, and installation of conservation pilots).
- Minimise the risk of pilot blowout by ensuring sufficient exit velocity and providing wind guards.
- In the event of an emergency or equipment breakdown, or during facility upset conditions, excess gas should be flared, not vented if possible.

4.7 Guidelines to the Management Techniques for Drilling Wastes and Production Effluents

Offshore oil and gas activities produce a variety of wastes in the form of aqueous and solid discharges and atmospheric emissions that need to be managed to avoid air and water pollution to the marine environment, especially the smothering of benthic communities and contamination of materials and food sources. Waste management should be included in the planning from the beginning and combined with pollution prevention measures. Prevention and elimination of these discharges and emissions, which pose environmental pollution threats, should be a targeted goal of regulatory activity. New technology makes this goal achievable in some situations.

- The operator should do what is possible to avoid the generation of waste. Any waste generated should be handled in an environmentally and hygienically adequate manner. Solid waste should not be discharged into the sea.
- The operator should prepare a plan connected to waste, including possibilities for waste.
- Reduction, waste segregation, reuse, recycling, energy recovery or treatment.
- Transfer of pollutants from one media to another should be avoided based on risk assessment.

Recommended Preventative Management Techniques:

Considering no discharge of the main waste streams at the planning and construction stage, in particular drilling waste and produced water, the following recommendations may be adopted:

(i) reduce waste at the source by process modification, material elimination, material substitution, inventory control and management, (ii) improved housekeeping, and water recovery; (iii) reuse of materials or products such as chemical containers, and oil-based or synthetic-based drilling fluids; (iv) recycle/recovery by the conversion of wastes into usable materials and/or extraction of energy or materials from wastes such as recycling scrap metal, recovery of hydrocarbons from tank bottoms and other oily sludge, burning waste oil for energy, and the use of produced water for enhanced recovery; (v) reduce the toxicity of effluents through the careful selection of drilling fluids and chemical products used in separation equipment and wastewater treatment systems; (vi) perform radiation surveys of equipment and sites to prevent or minimise the spread of Naturally Occurring Radioactive Materials (NORM), which may be carry out on a central basin in prospecting sedimentary basin; and where NORM-scale formation is anticipated, use scale inhibitors to minimise or prevent the buildup of radioactive scale in tubular.

For offshore discharge of effluents, the oil content of the treated effluent without dilution shall not exceed 40 mg/l for 95% of the observation and shall never exceed 100 mg/l. Three 8-hourly grab samples are required to be collected for a day,

and the average value of soil and grease content of the three samples should comply with these standards.

Major Discharges

Disposal of drill cuttings & drilling fluids for offshore installations in compliance with The Environment (Protection) Rules, 1986:

- The chemical additives used for DF preparation should have low toxicity, i.e. 96 hr LC50 > 30,000 mg/l as per mysid toxicity test conducted on locally available sensitive sea species.
- The chemicals used (mainly organic constituents) should be biodegradable.
- Barite used in preparation of DF shall not contain Hg> 1 mg/kg & Cd > 3 mg/kg. Total material acquired for the drill site preparation must be restored after the drilling operation, leaving no waste material at the site.

Waste from Drilling Activities

- Drilling wastes in the form of residual drilling fluids and cuttings comprise the principal waste generated during well drilling. Initially, a determination needs to be made on whether or not to prohibit discharge based on its nature/volume and effect on the environment. In certain areas, due to the identification of environmentally sensitive areas, drilling fluids and cuttings may need to be managed to prevent discharge. In areas where discharge is permitted, the disposal method should be based upon careful consideration of drilling fluid formulation and specific environmental conditions at the site.
- Where water-based drilling fluids are employed, additives containing oil, heavy metals, or other substances with negative ecotoxicological properties should be avoided or removed prior to discharge.
- Persistent and toxic substances should be avoided.
- Criteria for the maximum allowable concentration of harmful or hazardous substances should be established.
- If the option of land disposal is used, both the properties of the drilling fluid and the environmental conditions at the proposed disposal site should be carefully

considered to determine the acceptability of the disposal site. This is particularly important in offshore, where the creation of a disposal site on land may lead to environmental damage.

- Environmental considerations favour the use of non-oil-based drilling fluids for drilling.
- In shallow portions of a well, saltwater and saltwater with clay are often used as the primary drilling fluid, and the cuttings and residual fluids can generally be safely discharged into the marine environment.
- Discharge to the marine environment should be considered only where zero discharge technologies or re-injection are not feasible. Based upon site-specific biological, oceanographic and sea conditions, risk assessment methods and dispersal modelling studies should be used to determine whether the discharges should be at or near the seafloor or at a suitable depth in the water columns to keep the impact on marine life as low as possible. These discharges should be considered on a case-by-case basis.
- Where non-aqueous fluids are required, for example, in highly deviated wells or certain geological formations, operators should ensure that harmful or hazardous components are as low as possible and that fluids are recycled as far as practicable. Disposal of cuttings contaminated with such fluids should be assessed on the basis of a comparative assessment of alternatives, including reuse of the material, injection into geological formations and discharge onto the sea bed, taking into account possible impacts on the sea and other environmental compartments.
- Spent oil-based or synthetic-based drilling fluids can often be reconditioned and recycled. Injection into disposal wells or encapsulation of reserve fluid pits containing drilling fluids and cuttings, including those with acceptable levels of NORMs, and other pumpable wastes, are potential disposal techniques. Where geological conditions permit, the re-injection of wastes into the reservoir significantly reduces discharges of cuttings and drilling fluids to the marine environment. Management of down-hole disposal will require diligence to ensure that wastes do not migrate into unsealed or undesirable stratigraphic zones and that

well integrity is maintained. Stabilized burial at approved onshore disposal sites is another alternative.

Production Waste Discharges

- During production, produced water can be properly treated and discharged or may be reinjected.
- Other fluids brought to the surface in connection with completion, workover, well treatment or production may be mixed with wastewater unless those waters are identified as hazardous waste at the time of injection. They can be commingled with produced water for treatment, discharged within acceptable limits, or reinjected in most cases.
- Produced water treatment should be taken into account in the design phase and when significant modifications in operations are carried out.
- As the characteristics of production water differ from one platform to another, no single system can be applied successfully to all offshore platforms. Therefore, a site-specific combination of technologies should be employed based on the characteristics of produced water, such as droplet size, stability of the emulsion, the ratio of droplets/dissolved hydrocarbons, and the presence of other substances such as corrosion inhibitors, solids, and naturally occurring substances.
- Regulators and the industry should consider the options for reducing and eliminating produced water discharged to the sea through the application of BAT, such as injection, downhole separation, or water shut-off. The focus should be on reducing the volume of produced water discharges with the highest loads of oil and other substances.
- Regulators and industry should ensure that BAT and BEP are implemented on each platform and regularly review BAT and BEP. In addition, regulators and the industry should ensure that new offshore platforms or major modifications to existing platforms should consider design changes that minimise discharges.
- Produced sand containing elevated levels of naturally occurring radioactive material should be reinjected, encapsulated, or removed from the site and stored in a safe and environmentally sound manner that is carefully controlled and whose

risks and circumstances have been adequately evaluated. Management of these wastes will require diligence to ensure that radioactive wastes taken to shore are handled and disposed of in accordance with applicable international law and in an appropriate and approved manner. Radioactive materials should be transported in approved containers with proper labelling, which identifies the substance and its special transport and handling requirements. Appropriate record-keeping and proper notification for shippers should be maintained (For details, pl. see NORMS under Additional Studies).

- Deck wash and chemical/fluid releases are another concern to the marine environment, especially where oil-based drilling fluids are in use. A facility plan should be developed to address these potential conditions and methods of spill control, and leak minimisation should be incorporated into facility design and maintenance procedures. These plans, minimisation efforts and controls shall be applied to, but not limited to, material storage areas, loading and unloading operations, oil/water separation equipment, wastewater treatment, waste storage areas, and facility runoff management systems.
- All washdown waters, hydrocarbon-contaminated rainwater and deck wash, and machinery drainage space fluids should be processed through an oil-water separator prior to overboard discharge and should meet Industry-specific standards issued by CPCB under EPA Rules 1986.

Fluid Waste from Well-Testing

- Oil or water containing oil may not be completely incinerated when flaring during well testing. The regulators must determine whether this may be discharged into the sea and, if so, the quality of the fluid which is allowed to be discharged. One possibility is to allow discharge after treatment if the quality of the water is similar to the discharges from produced water or drainage water.

Deck Drainage and Bilge Water

- The use of vessels/ships with a valid International Oil Pollution Prevention Certificate,

- Chemicals storage areas are to be free from residues/spills,
- Vessels to maintain an Oil Record Book, including the discharge of dirty ballast or cleaning water;
- Discharge into the sea of oil or oily mixtures is prohibited except when the oil in water content of the discharge without dilution does not exceed 40 ppm;
- Contaminated deck drainage and bilge water to be contained and treated prior to discharge in accordance with the prevailing norms. Suppose treatment to this standard is not possible. In that case, these waters should be contained and shipped to shore for disposal, and extracted hydrocarbons from oil-in-water separator systems to be stored in suitable containers and transported to shore for treatment and/or disposal by a certified waste oil disposal contractor.

Cooling Water and Brine

- Detailed dispersion and modelling studies are needed to identify appropriate coolant water and brine disposal locations.
- A minimum dosage of biocides and other chemicals and the generation of minimum freshwater for the operational requirement is the major mitigation measures to be adopted in this regard.

Hydrotest Water

The operators shall ensure that the chemicals used for hydro testing should be "environmentally friendly". When concluding a chemical as environmentally friendly, the following criteria (any one) shall be taken into consideration.

- ✓ The chemical cocktail should be easily biodegradable (results in more than 60% biodegradable within 28 days), and Toxicity (96 hr LC50 > 30,000 mg/l for most abundant biota and IUCN red list organism as in the Annexure-4, if any) should be minimum as per the criteria, which can be discharged offshore intermittently with an average rate of 50 bbl/hr/well from a platform so as to have proper dilution & dispersion without any adverse impact on the marine environment. OR
- ✓ Chemical cocktails or individual constituent chemicals should be in Gold or Silver classification as per Chemical Hazard And Risk Management (CHARM)

prepared by the Centre for Environment, Fisheries, and Aquaculture Science (CEFAS). OR

- ✓ Part of OSPAR-PLONOR List (OSPAR List of Substances/Preparations used and discharged offshore which are considered to Pose Little Or No Risk to the Environment -PLONOR)

Produced Water

- ➢ Adopt methods to minimise the quantity of produced water
- ➢ Recycle and reuse produced water
- ➢ Evaluate options for treatment and disposal, including ship to shore, re-injection or discharge offshore.
- ➢ When disposal/re-injection should be done without the leakage of the disposed water
- ➢ Where disposal to the sea is necessary, all means to reduce the volume of produced water should be considered.
- ➢ The produced water discharge outfall should be designed to maximise the dispersion of produced water in the sea to reduce the concentration of constituents that have the potential for environmental impact.
- ➢ Production chemicals should be selected carefully by taking into account their application rate, toxicity, bioavailability, and bioaccumulation potential.
- ➢ A periodic comprehensive assessment of the marine environment should be undertaken, and various management strategies should be employed depending on the levels of pollution due to the project activities.

Ballast Water

- ➢ Strict compliance with local regulatory-authority guidelines should be ensured, and all the ships in international traffic are required to manage their ballast water and sediments in ballast tanks to minimise the risk of invasive marine species.

Produced Sand and Scale

- The management strategies include transporting produced sand, removing from process equipment to shore for treatment and disposal or routing to an offshore injection disposal well, if available.
- If discharge to the sea is the only feasible option, the discharge should meet the guideline stipulated for marine disposal after a sediment dispersion modelling study.
- Any oily water generated from the treatment of produced sand should be recovered and treated to meet the guideline values for produced water.

Drilling Discharges

- Reduce the number of drilling wells and also reduce the generation of drill cuttings and drill fluids.
- Drilling discharges should be as per GSR 546(E)
- Use of appropriate drilling fluid components with biodegradable (mainly organic constituents) and minimum toxicity of 96 hr LC 50 Value > 30,000 mg /l as per toxicity test conducted on locally available sensitive sea species.
- WBM/OBM /SBM should be recycled to the maximum extent possible. The unusable portion of OBM should not be discharged into the sea and shall be brought on-shore for treatment & disposal in an impervious waste disposal pit.
- Thoroughly washed DC, separated from WBM/SBM & an unusable portion of WBM/SBM having toxicity of 96 hr LC50 > 30,000 mg/l, shall be discharged off-shore into sea intermittently, at an average rate of 50 bbl/hr/well from a platform so as to have proper dilution & dispersion without any adverse impact on marine environment.
- Solids control equipment should be available onboard the drill rig to reduce the amount of residual drill fluids on cuttings prior to discharge.
- The following guideline should be adopted if sea disposal is unavoidable: The depth of water below the discharge outlet should be sufficient to allow acceptable

dispersion of the cuttings to occur, bulk cement and additives discharge to be regulated.

Process and Production Chemicals

- Use of low toxicity and water-soluble control fluid, collect the waste fluid in closed systems and send it to the onshore facility for treatment and disposal.
- The equipment designed to reduce the volume of fluid and acids should be neutralised before disposal.
- Use chemical systems in relation to their concentration, toxicity, bioavailability, and bioaccumulation potential.
- The use and discharge of chemicals from the oil and gas industry should be strictly regulated to avoid or reduce possible negative effects on the marine environment.
- The amounts of chemicals used and discharged should be as low as possible.
- All major substances in chemical preparations should meet GSR 546 (E) standard.
- The tests should be performed by laboratories that are approved in accordance with established international standards, such as OECD's Principles for Good Laboratory Practice (GLP) or equivalent.

Biodegradability

- If possible, the substance should be tested in accordance with established standards, such as the seawater test OECD 306 "Biodegradability in Seawater" or equivalent.

Bioaccumulation

- Chemicals that consist of several substances should be tested for the individual organic substance's bioaccumulation potential.
- The substances should be tested according to established standards, such as OECD standards or equivalent.
- For substances where standardised tests are not applicable, as for surfactants, a calculation or a scientific evaluation of the bioaccumulation potential may be performed.

Acute toxicity

- Inorganic and organic chemicals should be tested for acute toxicity.
- Toxicity tests specified in the OSPAR Protocols on methods for testing of chemicals used in the offshore industry should be used.

Assessing chemical risk

- The operators should ensure that risk evaluations are done based on the chemicals' intrinsic properties, time, place, and amounts of discharge, as well as other conditions of significance for the risk. According to environmental risk evaluations, the operator should choose the chemicals that pose the lowest risk of harming the marine environment.
- The operator should have plans to ensure that hazardous chemicals are substituted with substances that pose less risk of environmental harm. The plans shall describe which chemicals are prioritised to be replaced and when this can take place.
- Chemicals should be stored safely and prudently.

Hazardous Waste

- The most effective way of protecting human health and the environment from the dangers posed by hazardous wastes is to ensure the reduction of their generation to a minimum in terms of quantity and/or hazard potential. Minimising the generation of hazardous waste requires the implementation of environmentally sound low-waste technologies, recycling options, good housekeeping and management systems.
- The availability of adequate disposal facilities should be ensured prior to allowing an activity to generate hazardous wastes.
- Hazardous wastes requiring transport to a disposal site should be packaged, labelled, and transported in conformity with generally accepted and recognised international rules and standards in the field of packaging, labelling, and transport.
- Due account should be taken of relevant internationally recognised practices. Transported hazardous wastes should be accompanied by a movement document from the point at which movement commences to the point of disposal.

- Hazardous waste should be segregated in hazardous drums or tanks prior to disposal, and hazardous waste should be managed, handled, and stored according to the Safety Data Sheet.

Non-hazardous Solid Waste

- Proper segregation of wastes (recyclable and non-recyclable) and offshore disposal should be adopted, strictly adhering to the regulatory guidelines.
- Disposal of solid and domestic wastes should conform to international law, such as MARPOL 73/78, and national legislation.
- Sanitary wastes such as sewage and grey water should be processed according to international or local government standards prior to discharge into the marine environment. Processing in an acceptable sanitary waste treatment unit will properly treat waste streams prior to discharge.
- Discharge water from showers, toilets, and the kitchen should be treated on-site in an appropriate effluent treatment plant.

Unplanned Events

Accidental Release of Chemicals

- Chemical spill containment and recovery equipment will be available near chemical inventories,
- Chemical transfers should be undertaken only in suitable weather conditions, and the vessels/drilling units have a valid International Oil Pollution Prevention Certificate.

Spills – Collision/Tank/Pipeline Rupture

- Vessels should maintain suitable lighting, shapes, and navigation at all times to inform other users of the position and intentions of the vessel; hydro testing to ensure leaks are free in pipelines, protection of pipelines by trenching and burial are recommended.

Spills during Refueling and Bunkering

- Refuelling to be conducted in port, where spill risk factors are more easily controlled
- Refuelling at sea to be undertaken by trained personnel using defined procedures during daylight hours except where safety considerations take priority and when sea conditions are sufficiently calm.
- Regular inspection of transfer hose integrity, limiting volumes of fuel held in the transfer hose and the use of fail-safe valves to ensure rapid shutdown of fuel pumps.
- Continuously monitor tank levels to prevent overflow.

Spills from Exploration and Production Facilities

- Oil spill modelling or dispersion modelling should be undertaken to determine the potential impact on the surrounding environment.
- Blowout prevention measures focus on maintaining wellbore hydrostatic pressure by effectively estimating fluid formation pressures and the strength of subsurface formations.
- Well integrity testing should be performed in-par with the Well Operations Management Plan (WOMP), and the Well Control Contingency Plan (WCCP) should be in place.
- If a well workover/intervention is required, well isolation barriers and intervention procedures should be put in place.
- Contingency plans should be prepared for well operations and should include identification of provisions for well capping, relief well drilling and other response measures, including plans for the mobilisation of resources in the event of an uncontrolled blowout; Spill preparedness measures and emergency response procedures in place; Implementation of ongoing maintenance and inspection procedures to maintain facility integrity.

Collision with Marine Fauna and Introduction of Invasive Marine Species

- Monitor for presence and movements of large cetaceans, pinnipeds, and turtles so that avoidance actions can be taken where marine fauna is observed on a collision course with vessels and the application of species-specific management actions to minimise adverse interactions;
- Reduce the potential for entanglement of marine animals in the seismic equipment and rescue and release of entangled animals to the sea.
- Developing an Invasive Marine Species Management Plan and Complying with the International Convention on the Control of Harmful Anti-Fouling Systems on Ships.
- Ensure vessels have a valid Class certification of the vessel as per Indian Regulation/International Anti-Fouling System Certificate, and regular inspections of the hull, including niche areas, cleaning, dry-docking, and regular renewal of anti-fouling coatings, should be adopted in this regard.

4.8 Guideline for Oil Spill Response Plan

An oil spill response plan needs to be prepared at par with the National Oil Spill Disaster Contingency Plan 2015 (NOS-DCP). Operators should be required to have site-specific or operator-specific plans. An oil spill response plan addresses an oil spill volume based on relevant well data, catastrophic loss of a tank ship or barge, or damage to a pipeline. The plan should be supplemented by resource sensitivity maps arranged sequentially by month for those identified by spill trajectories as potentially exposed to oil pollution. The plan should also describe the process for its development, which should include involvement by response entities, both government and private, health officials, scientists, local populations that may be affected, wildlife experts, trustees of resources, and anyone else who may be affected or who may have a role in the response. Operators should allow the opportunity for public review and comment on the plan.

The oil spill response plan should include, in addition to the items described above, the following:

- A brief description of the operation
- Awareness of remote sensing imagery analysis concerning oil spill detection and monitoring on a spatial-temporal scale.
- Description of the site, water depth, seasonal constraints, and logistical support.
- References to all environmental support material that would be relevant to establishing clean-up priorities.
- Details of the operator's capability in using real-time wind and current data to implement an oil spill trajectory model both for the open sea and for ice-infested areas.
- A map depicting sensitive areas to be protected.
- Description of clean-up and containment strategies required for shoreline and ice-covered areas.
- Description of alternative clean-up strategies, such as the use of dispersants and in situ burning, with no response.
- Strategy to respond to small spills from the installation, shore base or loading operations.
- Provisions for transport, storage, and disposal of recovered oil and oil-contaminated materials.
- Spill response crew relief & logistics.
- List or inventory of spill response equipment and their measured efficiency when used as expected in the plan.
- Operators should have access to oil spill countermeasures equipment. The oil spill response plan should itemise equipment on-site for immediate containment purposes.
- The plan should also provide details of oil spill equipment and resources that are not on-site but will be mobilised in the event of a spill; the details should include the type of equipment, required resources, logistics and timing of mobilising the equipment to the site.

- The oil spill response plan should include the qualifications and training of personnel responsible for managing oil spill responses. It should clearly define their authority to take action to respond to such emergencies.
- A national preparedness and response system should be developed to protect the nation's citizens health and safety, the environment, and socio-economic interests.

Exercises and Drills

- To enhance response capabilities, response organisations should conduct regular safety and emergency response drills during which trained workers and emergency responders carry out regular exercises.
- Drills include desk-top exercises and actual equipment and operational deployment exercises.

5.0 Recommendations for Future Course of Action

Limitations to access the region and expensive/unavailability of state-of-the-art equipment and sampling platforms are major reasons for the paucity of environmental data in the Indian EEZ beyond 12 NM. From the compilation of various reports/studies to prepare baseline data for the sedimentary basins in India, the least studied basins are the Kerala-Konkan, Mahanadi and Andaman basins. Hence, it is recommended that studies should be undertaken to generate adequate baseline environmental data for these basins to facilitate the preparation of the EIA report.

NIO recommends following actionable items for all the blocks beyond 12 NM for following E&P activities.

A) ***Exploratory Surveys***: Operators may avoid explorative surveys during breeding periods of fish in the respective areas, such as 15th April to 14th June in the Bay of Bengal and from 1st June to 31st July in the Arabian Sea.

B) ***Exploratory / Appraisal Drilling***: In line with MOEF&CC notifications dt 16th Jan 2020, it is recommended that the operator needs to prepare the Environmental Management Plan as per the best industry practice for blocks beyond 12 NM for the exploratory/appraisal drilling campaign. The report may be prepared by national R&D organisations / MoEF&CC approved/NABET accredited consultants for offshore Oil & Gas operations. The operator must submit the EMP report to DGH before the commencement of drilling activity and also submit the yearly compliance report to DGH until the drilling campaign is completed.

C) ***Development / Production Phase***: For the development facilities beyond 12 NM, the operator would be required to prepare and submit the EIA report to DGH, and DGH may approve the report after due diligence. The operator would be required to submit the yearly compliance reports to DGH for all the recommendations mentioned in the EIA report. The operator would also be required to conduct baseline studies

through MoEFCC-approved / NABET-accredited consultants/ nationally reputed R&D organizations.

For the development facilities beyond 12 NM, the operator would be required to prepare and submit the EIA report to DGH, and DGH may approve the report after due diligence. The operator would also be required to submit the yearly compliance reports to DGH for all the recommendations mentioned in the EIA report, including baseline studies through MoEFCC-approved / NABET-accredited consultants/ nationally reputed R&D organizations.

D) ***Operation Phase***: Prior to the commencement of the operation phase, the operator is required to prepare the Environmental Management Plan and submit it to DGH for consideration. It would be mandatory for the operator to submit a compliance report of the EMP document to the DGH for consideration on a yearly basis.

E) ***Decommissioning Phase***: The EIA report for the selected decommissioning methodology as per the SRG' 2018 guidelines should consider environmental protection methods, and the EIA report for the selected concepts will be submitted by the operator to OISD along with the site restoration plan for approval.

6.0 Disclosure of Consultant

CSIR-National Institute of Oceanography, Government of India, is one of the 37 constituent laboratories of the Council of Scientific & Industrial Research (CSIR), New Delhi.

Our Mission: To continuously improve our understanding of the seas around us and to translate this knowledge to benefit all.

CSIR-NIO was established on 1st January 1966 following the International Indian Ocean Expedition (IIOE) in the 1960s. The institute has since grown into a multi-disciplinary oceanographic research institute of international repute. The principal focus of research has been on observing and understanding the unique oceanographic characteristics of the Indian Ocean. The results have been reported in more than 5,000 research articles so far. The National Institute of Oceanography (NIO) with its headquarters at Dona Paula, Goa, and regional centres at Kochi, Mumbai and Visakhapatnam. The institute has a sanctioned strength of 200 scientists and 100 technical support staff. The primary research areas include the four traditional branches of oceanography - biological, chemical, geological/geophysical, and physical – as well as ocean engineering, marine instrumentation and marine archaeology. With the largest collection of ocean scientists in the country and equipped with suitable ocean research infrastructure, CSIR-NIO serves as an advanced centre of education in ocean sciences.

In addition to basic research, the institute also carries out applied research sponsored by the industry. These studies include oceanographic data collection, environmental impact assessment, and modelling to predict environmental impact. The institute also provides consultancy on a number of issues, including marine environmental protection and coastal zone regulations.

The institute has the necessary expertise supported by equipment and infrastructural facilities to carry out the marine survey and EIA studies. EIA consultants are the regular staff of CSIR-NIO and are listed below.

Department	Name of Consultant	Specialisation
Physical Oceanography	Dr. Muraleedharan K R	Coastal Processes, Hydrography, Large-Scale Ocean Processes, Numerical modelling, Marine EIA/EMP
	Dr. Dinesh Kumar P.K	Coastal Processes, Climate Change, Marine EIA
	Dr. Revichandran C	Coastal Processes, Hydrography, Beach Erosion & Coastal Protection
Chemical Oceanography	Dr. Gireesh Kumar TR	Nutrient Cycling & Biogeochemistry, Chemical processes at the benthic boundary layer, Marine Pollution, Marine EIA
	Dr. Maheswari Nair	Nutrient Cycling & Biogeochemistry, Marine Pollution
Biological Oceanography	Dr. Madhu NV	Primary Productivity & Trophic Dynamics, Ecology & Ecosystem Functioning, Marine Biodiversity
	Dr. Jyothibabu R	Zooplankton Ecology & Ecosystem Functioning, Productivity & Trophic Dynamics, Marine Biodiversity
	Dr. Anas Abdulaziz	Molecular Biology, Biotechnology, Biogeochemistry & climate change, Ecology & Ecosystem Functioning,
	Dr. Abdul Jaleel KU	Benthic Ecology & Ecosystem Functioning, Productivity & Trophic Dynamics, Marine Biodiversity

Mandate

- To disseminate knowledge on the waters around India.
- To develop knowledge on physical, chemical, biological, geological, geophysical, engineering and pollution aspects of the waters around India.
- To provide support to various industries, government and non-government organisations through consultancy and contract research.

Industrial Consultancy

Industrial units dealing Port and Harbour development, Oil and Gas exploration, shipbreaking yards, fertilizers, pharmaceuticals, paper, chemicals, petroleum and cement are being set up along the coast. Most of these industries need guidance and advice to identify suitable areas and modes to discharge their treated effluent into the sea so that the environmental impact is minimal. Power plants look for appropriate sites in their vicinity to draw large quantities of seawater to serve as a coolant. Other developmental activities such as the expansion of ports and harbours, deepening of navigational channels and construction of offshore facilities, require an assessment of their potential environmental impact.

Apart from carrying out the research work, NIO provides services to various organizations in solving ocean-related problems and assists in carrying out work in the marine environment through sponsored or consultancy projects. As per the project requirement, NIO scientists collect physical, chemical, biological, geological and engineering data through field measurements using moored/drifting buoys and research vessels. We also utilize the data transmitted by a number of satellites equipped with oceanographic sensors. These data are analyzed and interpreted along with outputs of numerical models to understand various coastal and oceanic processes and their roles on the marine environment due to industrial activities.

Bathymetry, Seabed Engineering, CRZ Demarcation

NIO conducts bathymetry, seabed engineering, and CRZ demarcation surveys for offshore industry developmental projects that meet international standards. Surveys for CRZ demarcation for coastal stretches of the sea, bays, estuaries, creeks,

rivers and backwaters, which are influenced by tidal action, are carried out as per MoEFCC guidelines.

Environmental Impact Assessment and Environmental Monitoring

NIO carries out Environmental Impact Assessments for developmental projects in the marine area as per MoEFCC notification dated 14th September 2006.

Oil spill risk analysis and preparation of contingency plan

The facilities where crude oil and products are stored and handled have the potential for oil spill.

Our consultancy is in the following areas:

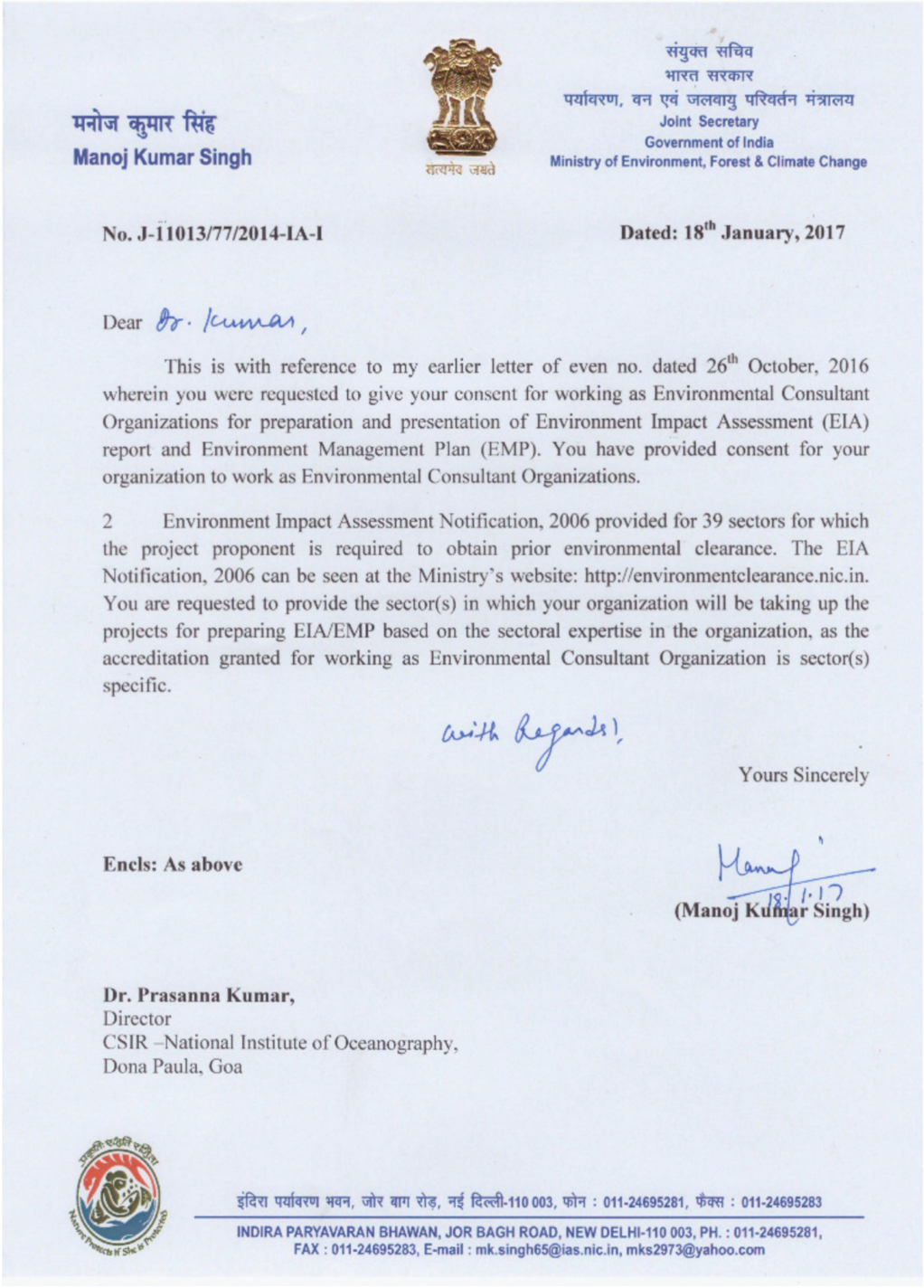
- Environmental Impact Assessment and Environmental Monitoring
- Bathymetry, Seabed Engineering, CRZ demarcation
- Evaluation of design parameters for coastal & offshore facilities
- Site selection for marine outfall, seawater intake, jetty, SPM and submarine pipelines
- Numerical modelling
- Oil spill risk analysis and preparation of contingency plan
- Biofouling and corrosion
- Underwater Surveys

Numerical modelling

- Simulation of tides and tidal currents
- Storm surge estimation
- Coastal circulation
- Thermal plume mapping
- Pollutant transport in creeks, estuaries and coastal ocean
- Prediction of nearshore and deep -water wave statistics and wave spectra
- Sediment transport
- Beach changes
- Water quality
- Offshore and nearshore spectral wave modelling
- Ecological modelling
- Oil spill modelling

MoEFCC Certificate

Ministry of Environment, Forest and Climate Change identified CSIR-National Institute of Oceanography as an expert organization to carry out Marine Environmental Impact Assessment and Environmental Monitoring studies.



मनोज कुमार सिंह
Manoj Kumar Singh

सत्यमेव जयते

संयुक्त सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Joint Secretary
Government of India
Ministry of Environment, Forest & Climate Change

No. J-11013/77/2014-IA-I

Dated: 18th January, 2017

Dear Dr. Kumar,

This is with reference to my earlier letter of even no. dated 26th October, 2016 wherein you were requested to give your consent for working as Environmental Consultant Organizations for preparation and presentation of Environment Impact Assessment (EIA) report and Environment Management Plan (EMP). You have provided consent for your organization to work as Environmental Consultant Organizations.

2 Environment Impact Assessment Notification, 2006 provided for 39 sectors for which the project proponent is required to obtain prior environmental clearance. The EIA Notification, 2006 can be seen at the Ministry's website: http://environmentclearance.nic.in. You are requested to provide the sector(s) in which your organization will be taking up the projects for preparing EIA/EMP based on the sectoral expertise in the organization, as the accreditation granted for working as Environmental Consultant Organization is sector(s) specific.

with Regards!,

Yours Sincerely

Encls: As above

(Manoj Kumar Singh)

Dr. Prasanna Kumar,
Director
CSIR –National Institute of Oceanography,
Dona Paula, Goa

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स्वर्ण जयंती वर्ष

सी एस आई आर - राष्ट्रीय समुद्र विज्ञान संस्थान
(वैज्ञानिक एवं औद्योगिक अनुसंधान परिषद)
दोना पावला, गोवा 403 004 भारत

CSIR - National Institute of Oceanography
(Council of Scientific & Industrial Research)
DONA PAULA, GOA - 403 004, India

75 Years of CSIR Touching Lives

डॉ. एस. प्रसन्न कुमार
कार्यकारी निदेशक
Dr. S. Prasanna Kumar
Acting Director

NIO/BDG/Gen-2017/1
23 January 2017

Ref: No. J-11013/77/2004-IA-I dated 18 January 2017

Dear Shri Manoj Kumar Singh,

CSIR-National Institute of Oceanography has the required expertise for preparing the Environment Impact Assessment (EIA)/Environment Management Plan (EMP) of projects in below mentioned sectors.

i) Offshore oil and gas exploration, development and production
ii) Oil & gas transportation pipeline (crude and refinery/petrochemical products) passing through national parks/sanctuaries/coral reefs/ecologically sensitive areas including LNG Terminal
iii) all ship breaking yards including ship breaking units
iv) Ports, Harbours
v) common effluent treatment plants (CETPs).

We give our consent to work as Environmental Consultant Organisation for above mentioned Sectors listed in EIA notification, 2006.

With best regards,

Yours sincerely,

(Prasanna Kumar)

Shri Manoj Kumar Singh,
Joint Secretary,
Ministry of Environment, Forests and Climate Change,
Indira Paryavaran Bhawan, Jor Bag Road, Aliganj,
New Delhi-110003

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Annexures

Annexure-1

Permissible Limit of Effluent Discharge and the Oil Content related to the Petroleum Exploration and Developmental Projects in Offshore Areas beyond 12 Nautical miles in the Indian EEZ

S. No.	Parameter	Offshore Discharge Standards
1	pH	5.5-9.0
2	Temperature	Ambient ± 3 ^{o}C
3	Suspended Solids	100 mg/l
4	Oil and Grease	10 mg/l – 40mg/l*
5	Cyanides	0.005 mg/l
6	Fluorides	1.5 mg/l
7	Chromium(Cr)	0.1 mg/l
8	Copper	0.05 mg/l
9	Lead	0.05 mg/l
10	Mercury	0.01 mg/l
11	Zinc	0.1 mg/l
12	Nickel	0.1 mg/l

*Discharge of effluents, the oil content of the treated effluent without dilution shall not exceed 40 mg/l for 95% of the observation and shall never exceed 100 mg/l. Three 8–hour grab samples are required to be collected daily, and the average value of oil and grease content of the three samples shall comply with these standards.

Annexure-2

Permissible Limit/Baseline Values of the Water Column and Sediment Parameters related to the Petroleum Exploration and Developmental Projects in Offshore Areas beyond 12 Nautical miles in the Indian EEZ

	Parameters	Sedimentary Basin							
		Gujarat	Saurashtra	Mumbai	Kerala Konkan Lakshadweep	Cauvery	KG	Mahanadi	Andaman Sea
Water	pH	7.5-8.5	7.5-8.5	7.5-8.5	7.5-8.5	7.5-8.5	7.5-8.5	7.5-8.5	7.5-8.5
	BOD (mg/l)*	≤ 3.0	≤ 3.0	≤ 3.0	≤ 3.0	≤ 3.0	≤ 3.0	≤ 3.0	≤ 3.0
	NO_3^- (µM)*	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
	PO_4^{3-} (µM)*	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Cr (µg/l)	ND	ND	0-29.1	ND	ND	1.0-7.0	0-0.1	<0.01
	Cu (µg/l)	ND	ND	0-29.7	0.2-6.2	0-0.5	33.9-65.9	ND	<0.01
	Zn (µg/l)	ND	ND	0-31.4	0.9-17.2	0.3-1.3	0.6-10.5	ND	<0.01
	As (µg/l)	ND	ND	0-31.2	ND	ND	42.0-70.4	0.-0.1	<0.01
	Cd (µg/l)	10.0	10.0	10	10.0	10.0	10.0	10.0	10.0
	Ba (µg/l)	ND	ND	0-27.6	ND	ND	3.9-6.1	ND	ND
	Pb (µg/l)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	Hg (µg/l)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
	PHC (µg/l)	<15.0	<15.0	<15.0	<15.0	<15.0	<15.0	<15.0	<15.0
Sediment✦	Cr (µg/g)	≤ 81.0	≤ 81.0	≤ 81.0	≤ 81.0	≤ 81.0	≤ 81.0	≤ 81.0	≤ 81.0
	Cu (µg/g)	≤ 34.0	≤ 34.0	≤ 34.0	≤ 34.0	≤ 34.0	≤ 34.0	≤ 34.0	≤ 34.0
	Zn (µg/g)	≤ 150.0	≤ 150.0	≤ 150.0	≤ 150.0	≤ 150.0	≤ 150.0	≤ 150.0	≤ 150.0
	As (µg/g)	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2
	Cd (µg/g)	≤ 1.2	≤ 1.2	≤ 1.2	≤ 1.2	≤ 1.2	≤ 1.2	≤ 1.2	≤ 1.2
	Ba (µg/g)	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2	≤ 8.2
	Pb (µg/g)	≤ 46.7	≤ 46.7	≤ 46.7	≤ 46.7	≤ 46.7	≤ 46.7	≤ 46.7	≤ 46.7
	Hg (µg/g)	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15	≤ 0.15
	PHC (µg/g)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0

ND = No Data

*Surface values

✦Permissible limit for heavy metals in the sediments is prepared based on the Sediment Quality Guidelines (SQGs) developed by the National Oceanic and Atmospheric Administration (NOAA). This criterion is recommended due to the paucity of data sets in the Indian EEZ and also considering the large data variability within the basin.

Water quality standards for coastal waters and marine outfalls by CPCB is adopted for BOD, Hg, Pb, and Cd. The above limits are based on the data sets available in the Indian EEZ, and values should be revised incorporating future baseline environmental monitoring. An environmental survey should be carried out prior to the award of blocks to various operators, and the corresponding data sets should be included as the permissible limit of that particular block.

Annexure-3

Guidance for the Assessment of Baseline Components and Attributes

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
A. Meteorological parameters				
Meteorological ▪ Wind speed and direction ▪ Barometric pressure ▪ Dry bulb temperature ▪ Wet bulb temperature ▪ Relative humidity ▪ Rainfall ▪ Solar radiation	One at the project site	Hourly observations - continuous records during the monitoring period	Mechanical/automatic weather station	IS 5182 Part 1-20 Sit-specific primary data is essential Secondary data from IMD, New Delhi, for the nearest IMD station
Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
B. Noise and vibration				
Hourly equivalent noise levels	One location in the study area	At least one day continuous in a year on a working and non-working day during monitoring period	Instrument: Sensitive Noise level meter (preferably recording type)	Min: IS: 4954- 1968 as adopted by CPCB

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
C. Water Environment				
▪ Temperature & Salinity ▪ Turbidity ▪ Currents ▪ Dissolved Oxygen ▪ pH ▪ Nutrients (NO_3^-, NO_2^-, SiO_4^- and PO_4^{3-}) and Ammonia ▪ Dissolved Petroleum hydrocarbon ▪ Dissolved Heavy Metals	One sample from surface mid and bottom at each station (See the sampling diagram for each well)	Process-wise or activity-wise. Once per year (pre or post-monsoon)	Collected and analyzed as per protocol	The purpose of impact assessment on water (offshore environment) is to assess the significant impacts due to leaching of wastes or accidental releases and to contaminate

species ▪ Sanctuaries / National park / Biosphere reserve				meiobenthos, studies of macrofauna, aquatic vegetation and application of indices, Heavy metals & PHC in mixed plankton and fishes Abundance and Biomass Curve Diversity, Shannon, similarity and dominance indices
Avifauna ▪ Rare and endangered species ▪ Sanctuaries / National park / Biosphere reserve	For the studies, chronic as well as short-term impacts should be analysed, warranting data on microclimate conditions			Secondary data to collect from Government offices, NGOs, published literature

Attributes	Sampling		Measurement Method	Remarks
	Network	Frequency		
D. Solid Waste – Sediment Quality				
▪ Munsell Soil Colour Chart System and smell ▪ Particle size distribution ▪ Organic Carbon ▪ Heavy metal ▪ PHC	Grab and Composite samples. Recyclable components have to be analyzed for the recycling requirements	Process wise or activity-wise. Once in a year	Analysis IS 9334 : 1979 IS 9235 : 1979 IS 10158 : 1982	Impacts of hazardous waste should be performed critically depending on the waste characteristics and place of discharge.
E. Biological Environment				
Aquatic ▪ Primary productivity ▪ Aquatic weeds ▪ Bacteria, Phytoplankton, zooplankton and benthos ▪ Fisheries ▪ Heavy metals and PHC in mixed plankton and fish ▪ Diversity indices ▪ Trophic levels ▪ Rare and endangered	Considering the probable impact, sampling points and number of samples to be decided on established guidelines on ecological studies based on-site eco-environment setting within 10 km radius from the proposed site	Process wise or activity-wise. Once in a year	Standards techniques (APHA et. Al. 1995, Rau and Wooten 1980) to be followed for sampling and measurement	Sampling for aquatic biota Plankton net Sediment dredge Depth sampler Microscope Field binocular Preliminary assessment Microscopic analysis of plankton and

Annexure-4

IUCN Red List Marine species in the Indian Ocean Waters

Major Class	Common English Name (Scientific Name)	Geographical distribution of IUCN Red List Marine Species around Sedimentary basins in India
Fishes	Sea Horse (All Sygnathidians)	Mainly found in Cauvery, Krishna Godavari and Mahanadi basin. Tamil Nadu (including Puducherry) emerged as the state with the highest catch, where a median of 75% of the annual seahorse catches occurred, followed by Odisha (16.8%) and Andhra Pradesh (3.4%).
	Pointed Sawfish (*Anoxypristis Cuspidate*)	Found inshore, often in river deltas and estuaries of Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery Krishna Godavari, Mahanadi basin and Andaman basin. No robust estimates of historic or current population size exist. However, distribution has been greatly reduced and that the population numbers have declined dramatically in the recent past.
	Porcupine ray (*Urogymnus asperrimus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. It favors sand, coral rubble, and seagrass habitats in inshore waters to a depth of 30 m.
	Giant Grouper (*Epinephelus*	Krishna Godavari, Mahanadi basin and Andaman basin. From Indian waters this

	lanceolatus)	species is reported from Andaman and Nicobar Islands and from the coasts of Andhra Pradesh and Odisha, inhabits lagoon and seaward reefs at depth of a few to at least 50 m.
	Largetooth sawfish (*Pristis microdon*)	Kerala Lakshadweep Konkan, Mumbai offshore, Mahanadi basin.
	Giant guitarfish (*Rhynchobatus djiddensis*)	Historically, widely distributed along the entire Indian coastal waters (Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin). Now, it is found in the Western Indian Ocean from the Red Sea to the Eastern Cape in South Africa, which occupies the continental shelf to 70 m (generally shallower than 35 m).
	Longcomb sawfish (*Pristis zijsron)*	Andaman basin. A 5.13 m (16 ft. 10 in.) specimen was caught off Port Blair in the Andaman Islands in 1967.
	Ganges shark (*Glyphis gangeticus*)	Mahanadi basin. Largely restricted to the rivers of Eastern and Northeastern India, particularly the Hooghly River of West Bengal, and the Ganges, Brahmaputra, and Mahanadi in Bihar, Assam, and Odisha, respectively.
	Humphead wrasse (*Cheilinus undulates*)	Kerala Lakshadweep Konkan, Krishna Godavari and Andaman basin. This species' distribution in India includes Lakshadweep,

		Gulf of Mannar, the East Coast and the Andaman and Nicobar Islands.
	Scalloped hammerhead (*Sphyrna lewini*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Black teatfish (*Holothuria nobilis*)	Kerala Lakshadweep Konkan, Mumbai offshore, Gujarat basin, Saurashtra basin. The black teatfish occur only in the Indian Ocean. Specifically, it can be found off the East Coast of Africa, the West Coast of India, and around associated islands.
	Golden sandfish (*Holothuria scabra*)	Andaman basin
	Prickly redfish (*Thelenota ananas*)	Kerala Lakshadweep Konkan
	Longheaded eagle ray (*Aetobatus flagellum*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Reticulate eagle ray (*Aetomylaeus vespertilio*)	Very rare in Kerala Lakshadweep Konkan
	Dwarf sawfish (*Pristis clavata*)	Historically, it is found throughout Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.

	Redmouth Grouper (*Aethaloperca rogaa*)	Kerala Lakshadweep Konkan
	Cloudy Grouper (*Epinephelus erythrurus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Barred-chest Grouper *(Epinephelus faveatus*)	Kerala Lakshadweep Konkan, Cauvery basin and Andaman basin. It is found in the Indian Ocean and has been recorded from Southern India, Sri Lanka, the Andaman and Nicobar Islands
	Giant Grouper (*Epinephelus lanceolatus*)	Krishna Godavari, Mahanadi and Andaman basin. From Indian waters this species is reported from Andaman and Nicobar Islands and from the coasts of Andhra Pradesh and Odisha.
	Humpback Grouper (*Cromileptes aitivelis*)	Kerala Lakshadweep Konkan and Cauvery basin. In India, this species is rare and few specimens have been collected from Kanyakumari, Tamil Nadu and Vizhinjam, Kerala.
	Squaretail Coral Grouper (*Plectropomus areolatus*)	Kerala Lakshadweep Konkan, Cauvery basin and Andaman basin.
	Ocean Sunfish (*Mola mola*)	Several reports showed that this species has found very rare in all sedimentary basins of India. Earlier, landings of oceanic sun fish

		(*Mola mola*) at Visakhapatnam and West Bengal in the East Coast, Bombay, Veraval and Malpe in Karnataka in West Coast have been reported.
	Bigeye Tuna (*Thunnu sobesus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Madagascar Kob, Southern Meagre (*Argyrosomus hololepidotus*)	Mahanadi basin. Very rarely found in the North-West Coast of India.
	Brick Seamoth (*Pegasus laternarius*)	Cauvery basin, Krishna Godavari basin, Andaman basin
	Spotted Seahorse (*Hippocampus kuda*)	Mainly found in Cauvery, Krishna Godavari and Mahanadi basin.
	Three-spot Seahorse (*Hippocampus trimaculatus*)	Mainly found in Cauvery, Krishna Godavari and Mahanadi basin.
	Tawny Nurse Shark (*Nebrius ferrugineus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Common Thresher Shark (*Alopias vulpinus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin.

	Silky Shark (*Carcharhinus falciformis*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Pondicherry Shark (*Carcharhinus hemiodon*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Oceanic Whitetip Shark (*Carcharhinus longimanus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Sharptooth Lemon Shark, Sicklefin Lemon Shark (*Negaprion acutidens*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Whale Shark (*Rhincodon typus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Great Hammerhead (*Sphyrna mokarran*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Winghead Shark (*Eusphyra blochii*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Irrawaddy River	Mahanadi basin

	Shark (*Glyphis siamensis*)	
	Broadfin Shark (*Lamiopsis temminckii*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Mottled Eagle Ray (*Aetomylaeus maculatus*)	Mainly found in Cauvery, Krishna Godavari and Mahanadi basin.
	Banded Eagle Ray (*Aetomylaeus nichofii*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Porcupine Ray (*Urogymnus asperrimus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Blotched Fantail Ray (*Taeniurops meyeni*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi Basin and Andaman basin.
	Zonetail Butterfly Ray (*Gymnura zonura*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
Marine Mammals	Fin Whale (*Balaenoptera physalus*)	Reports showed that it is found in Mumbai offshore basin, Kerala Lakshadweep Konkan, Cauvery basin, Mahanadi basin.
	Blue whale	Mumbai offshore, Kerala Lakshadweep

	(*Balaenoptera musculus*)	Konkan
	Sei whale (*Balaenoptera borealis*)	Mumbai offshore, Kerala Lakshadweep Konkan
	Common Dolphin (*Delphinus delphis*)	Gujarat basin, Saurashtra basin, Kerala Lakshadweep Konkan, Cauvery basin
	Bottlenose Dolphin (*Tursiops truncatus*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Striped Dolphin (*Stenella coeruleoalba*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Irrawaddy Dolphin (*Orcaella brevirostris*)	Mahanadi basin
	Rissos Dolphin (*Grampus griseus*)	Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin
	Finless Porpoise (*Neophocaena phocaenoides*)	Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin
	Cuviers Beaked whale (*Ziphius cavirostis*)	Kerala Lakshadweep Konkan

Coelenterates	Reef Building Coral (All Scleractinians)	Kerala Lakshadweep Konkan, Gujarat basin, Cauvery basin and Andaman basin.
	Black Coral (All Antipatharians)	Andaman basin
	Sea Fan (All Gorgonians)	Andaman basin
Echinodermata	Sea Cucumber (All Holothurians)	Gujrat basin, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari and Andaman basin
Turtles	Loggerhead Turtle (*Caretta caretta*)	Kerala Lakshadweep Konkan, Cauvery basin, Mahanadi basin and Andaman basin
	Green turtle (*Chelonia mydas*)	Gujarat basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. It occurs in the West and East Coasts of India, Lakshadweep and Andaman and Nicobar Islands.
	Leatherback turtle (sub-pop) (*Dermochelys coriacea*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin.
	Hawksbill turtle (*Eretmochelys imbricate*)	Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. In India, hawksbills are mainly found in the Lakshadweep islands, Andaman islands, and few beaches in the Nicobar islands such as Indira Point at the southern tip of Great Nicobar (here turtles often have to crawl over reefs and rocks to

		reach the nesting beach).
	Olive Ridley (*Lepidochelys olivacea*)	Gujarat basin, Saurashtra basin, Mumbai offshore, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Gahirmatha beach of Odisha is largest mass nesting site for the olive ridley turtles in India.
Molluscs	*Cypraea lamacina*	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar, Tamil Nadu
	Cypraea mappa	Gujarat basin, Cauvery basin, Andaman basin. Mainly found in Andaman & Nicobar, Pondicherry, Gujarat, Tamil Nadu, and Lakshadweep.
	Cypraea talpa	Gujarat basin, Cauvery basin, Andaman basin. Mainly found in Andaman & Nicobar, Pondicherry, Gujarat, Tamil Nadu, and Lakshadweep.
	Placenta placenta	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Lakshadweep, East and West coast of India and Andaman and Nicobar islands.
	Lambis truncate	Kerala Lakshadweep Konkan, Cauvery basin and Andaman basin. Mainly found in Lakshadweep, Tamil Nadu and Andaman & Nicobar

	Turbo marmoratus	Andaman basin
	Strombus plicatus sibbaldi	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Lakshadweep, East and West coast of India and Andaman and Nicobar islands.
	Fasciolaria trapezium	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi Basin and Andaman basin. Mainly found in Andaman & Nicobar, Pondicherry, Gujarat, Lakshadweep, East and West coasts of India
	Harpulina arausiaca	Kerala Lakshadweep Konkan, Cauvery basin. Mainly found in Pondicherry, Lakshadweep, South East Coast of India
	Trochus niloticus	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Andaman & Nicobar and East and West coasts of India.
	Lambis scorpius	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Tamil Nadu, Andaman & Nicobar and Lakshadweep
	Lambis crocea	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Tamil Nadu and Andaman &

		Nicobar.
	Lambis chiragra arthritica	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Tamil Nadu, Pondicherry, Andaman & Nicobar and Lakshadweep.
	Lambis millepeda	Andaman basin
	Lambis chiragra	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Tamil Nadu, Pondicherry, Andaman & Nicobar and Lakshadweep
	Cassis cornuta	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi Basin and Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar and East and West coasts of India.
	Cypracasis rufa	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar and Tamil Nadu.
	Hippopus hippopus	Andaman basin
	Tridacna squamosal	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Tamil Nadu and Andaman and Nicobar islands.
	Tudicla spiralis	Kerala Lakshadweep Konkan, Cauvery basin. Mainly found in Lakshadweep and Tamil Nadu.

	Cassis cornuta	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar and East and West Coasts of India.
	Nautilus pompilius	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar and East and West coasts of India.
	Tridacna maxima	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Tamil Nadu and Andaman and Nicobar islands.
	Charonia tritonis	Kerala Lakshadweep Konkan, Cauvery basin, Andaman basin. Mainly found in Lakshadweep, Tamil Nadu and Andaman and Nicobar islands.
	Conus malneedwards	Gujarat basin, Saurashtra basin, Mumbai offshore, Kerala Lakshadweep Konkan, Cauvery basin, Krishna Godavari, Mahanadi basin and Andaman basin. Mainly found in Lakshadweep, Andaman & Nicobar and East and West coasts of India.