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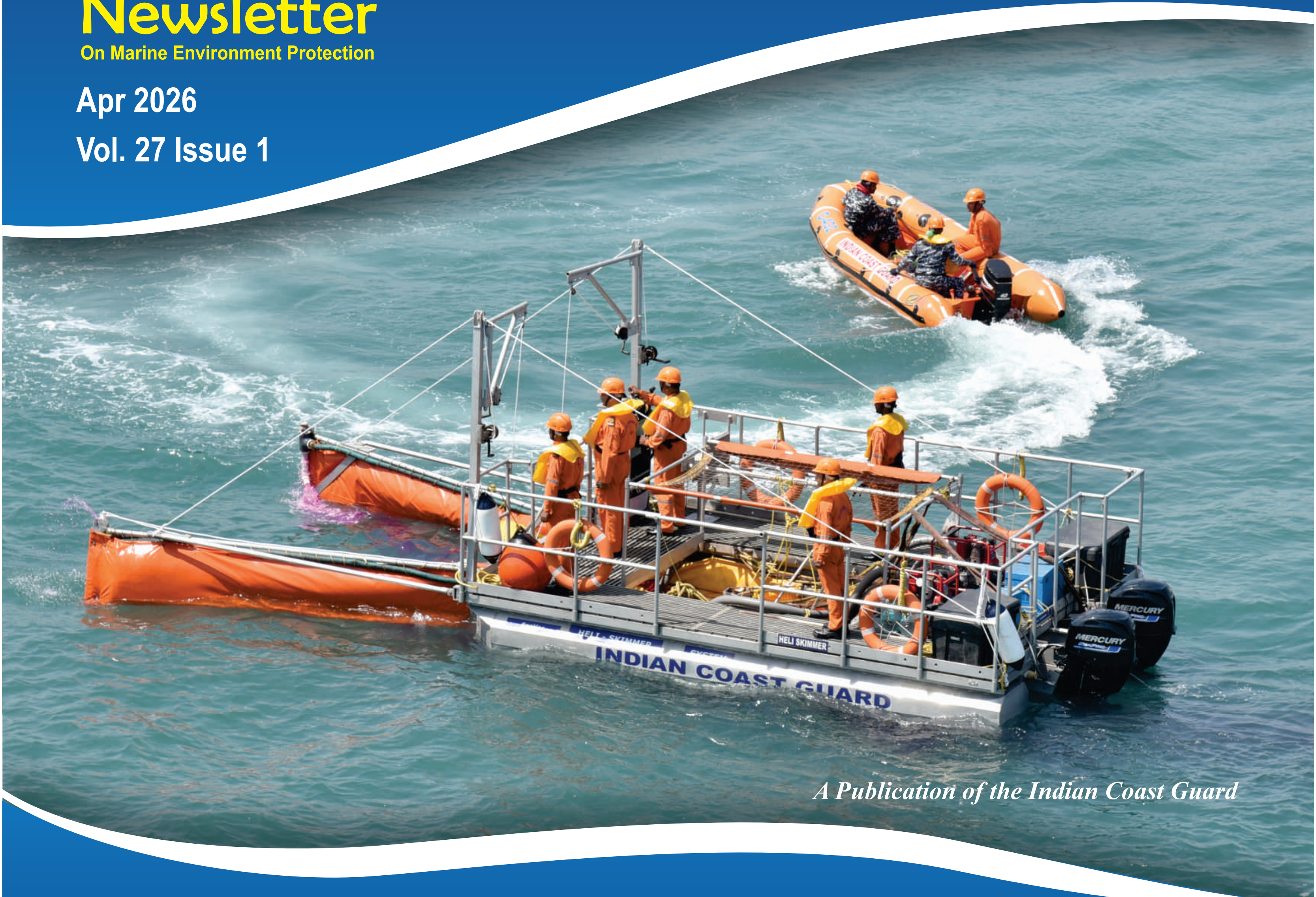

A Publication of the Indian Coast Guard

From the Director General's Desk

Dear Reader,

The maritime transport of Oil and hazardous and noxious substances is an inevitable consequence of economic growth and expanding maritime trade. For India, preparedness for Oil & HNS incidents is therefore a strategic necessity rather than a discretionary option.

India's maritime environment is an engine of national prosperity and a domain of acute vulnerability. Our expanding ports, growing coastal industry clusters, intensifying tanker traffic and the strategic importance of sea lanes together increase both opportunity and risk. Recent years have demonstrated that incidents at sea, whether oil or HNS, can produce consequences that are ecological, economic and social in equal measure. Preparedness, therefore, must remain the organising principle of our maritime stewardship.

The Indian Coast Guard has augmented pollution response assets, refined contingency planning under the NOSDCP framework and promulgated the Crisis Management Plan for HNS spills to clarify roles, responsibilities and response thresholds. These measures allow calibrated actions when time and clarity matter most.

Technology integration such as Satellite surveillance, enhanced SAR analytics and integrated modelling provides early awareness. Yet technology alone cannot substitute for institutional clarity. To this end, the Coast Guard is pursuing collaboration with ISRO, INCOIS, Ports, OHAs and state authorities to ensure near-real-time situational awareness.

Capacity building remains a priority and provisioning of pollution response equipment by all the stakeholders is an important aspect of our preparedness. The recent NOSDCP meeting in Chennai reaffirmed these imperatives and recognised exemplary stewardship by industry partners towards national resilience.

Finally, the Coast Guard's mission is inherently collective. Success depends on the professionalism of our personnel, the cooperation of industry, the vigilance of coastal communities and the support of partner agencies. I urge all stakeholders to treat preparedness as a continuous programme.

I wish all the readers and stakeholders 'Happy Reading'.

Vayam Rakshamah. Jai Hind.

(S Paramesh)
Director General
Indian Coast Guard

10 April 2026
New Delhi

EDITORIAL

The ocean is more than a vast expanse of water. It is the lifeblood of our planet. It sustains economies, regulates climate and nurtures biodiversity. Yet, it remains vulnerable to pollution, over exploitation and human interference in many ways. As guardians of the maritime domain, the Coast Guard bears a solemn responsibility to protect the marine environment while ensuring safe and secure seas.

Environmental protection is not achieved through enforcement alone. It requires fostering a culture of compliance among all stakeholders who are in some way using sea and their activities are impacting the health of oceans. Through regular exercises and training, we encourage establishment of a robust response system to mitigate the effects of any oil or HNS spill.

Marine environmental protection is a shared responsibility. The Coast Guard remains committed to strengthening international cooperation, investing in advanced response technologies, equipment and training. The real solution depends on collective action from governments, industries and citizens alike.

This magazine is an effort to generate awareness and interest of all the stakeholders by bringing out the latest happenings in our domain. It is heartening to note that there are articles from various stakeholders for the current publication. Further, articles to explore options for enhancing capabilities of ICG for protection of marine environment through satellite monitoring and roadmap for augmenting HNS response capabilities have been included. The endeavour is to reiterate ICG's commitment to preserve and protect our oceans.

Wish all the readers a happy reading. Suggestions are welcome and may be sent on dte-fe@indiancoastguard.nic.in.

(SK Karwasara)
Commandant
Joint Director (FE)

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Website : www.indiancoastguard.nic.in

EVENTS

INTERNATIONAL COASTAL CLEANUP (ICC) DAY – 2025

Introduction

As part of the Government of India's ongoing efforts under the *Swachh Bharat Abhiyan*, in line with the Hon'ble Prime Minister's appeal for a mass cleanliness and sanitation campaign through "*Swachhata Hi Seva*", the Indian Coast Guard conducted International Coastal Cleanup (ICC)–2025 across all coastal States and Union Territories on 20 September 2025. International Coastal Cleanup Day is observed worldwide on the third Saturday of September every year under the aegis of the United Nations Environment Programme (UNEP) and the South Asia Co operative Environment Programme (SACEP) in the South Asian Seas Region. The Indian Coast Guard has been coordinating this activity in India since 2006.

Figure 1. Juhu Beach, Mumbai

Participation

The Indian Coast Guard, as part of International Coastal Cleanup Day, conducted focused activities contributing towards the Swachh Bharat Abhiyan. The event aimed to educate and motivate the local populace to maintain clean seashores and prevent further pollution of the marine environment. This year, Coast Guard Regional Headquarters (West) witnessed the highest participation with 12,537 volunteers, followed by Coast Guard Regional Headquarters (East) with 5,995 volunteers. Nationwide, a total of 26,092 volunteers participated in the ICC–2025 campaign.

Figure 2. Mayabundar Beach, A&N Region

Figure 3. Luni Beach, Mundra

Civil Support

Apart from various Ministries and other Armed Forces, ICC–2025 received overwhelming support from civil authorities, Municipal Corporations, NGOs, Fisheries associations, school and college students, NCC/ NSS cadets, Marine Police, and volunteers from Oil Handling Agencies (OHA).

27TH NATIONAL OIL SPILL DISASTER CONTINGENCY PLAN (NOSDCP) AND PREPAREDNESS MEETING

The 27th National Oil Spill Disaster Contingency Plan (NOSDCP) and Preparedness Meeting was held at Chennai on 05 October 2025. The meeting was chaired by Director General S Paramesh, AVSM, PTM, TM, Director General, Indian Coast Guard. Active participation was witnessed from various Government departments, ports and oil handling agencies. A total of 116 representatives attended the meeting.

Figure 4. 27th NOSDCP & Preparedness Meeting

In his inaugural address, the Chairperson welcomed delegates from various Ministries and Departments of the Central and State Governments,

Figure 5. Inaugural address by DGICG

Regional Commanders of the Indian Coast Guard, representatives from major and non major ports, oil handling agencies and onshore oil installations.

Comdt Kundan, Joint Director (Environment), delivered a presentation providing an overview of the NOSDCP and highlighting key activities undertaken since the previous meeting held in November 2024.The presentation underscored initiatives by the Indian Coast Guard, along with efforts by other resource agencies, to strengthen pollution response preparedness. It also emphasized the urgent need for timely provisioning of pollution response equipment at respective facilities to meet NOSDCP obligations.

During the meeting, Director General S Paramesh, AVSM, PTM, TM, Chairperson, NOSDCP, awarded the “Samudri Paryaavaran Sanrakshan Trophy–2025” to New Mangalore Port Authority and the “Tel Udhyog Paryaavaran Sanrakshan Trophy–2025” to ONGC Western Offshore, Mumbai, in recognition of their environmental protection measures within their respective areas of responsibility.

Figure 6. Samudri Paryaavaran Sanrakshan Trophy

Key issues discussed and deliberated during the NOSDCP meeting included vetting of OSCPs of major and non major ports and OHAs; formulation of CMGs of coastal States and UTs; conduct of training and mock drill for shoreline cleanup, pre contractual OSRO agreements for tankers entering Indian ports; and revision of the PR inventory in respect of ports (Appendix F2.1 of NOSDCP–2015) by the committee constituted by the Ministry of Ports, Shipping and Waterways.

Figure 7. Tel Udhyog Paryavaran Sanrakshan Trophy

Figure 8. 27th NOSDCP Meeting Participants

CRISIS MANAGEMENT PLAN FOR HAZARDOUS AND NOXIOUS SUBSTANCES (HNS) SPILLS AT SEA

The Crisis Management Plan for Hazardous and Noxious Substances (HNS), approved by the Ministry of Defence, was released during the meeting. The plan focuses on critical elements such as inter agency coordination, assessment of risks and vulnerabilities in maritime zones, and involvement of all relevant stakeholders in both planning and response.

Figure 9. Release of Crisis Management Plan for HNS Spill at Sea

Together, these initiatives aim to build capacity, strengthen preparedness and create a resilient and responsive framework to manage chemical emergencies at sea-ensuring that growth and safety progress hand in hand as India advances towards its long term maritime and industrial goals.

ARTICLES

EFFECTIVE EFFLUENT TREATMENT STRATEGIES FOR SUSTAINABLE WATER MANAGEMENT IN REFINERIES

(Nishant Kumar Singh, Noopur Kaushik Bhalla
Process Engineering, Technical Services, ONGC-MRPL,
Mangalore, Karnataka)

Introduction: The Need for Sustainable Water Management in Refineries

Water is a critical utility in refinery operations, supporting crude processing, cooling systems, steam generation, desalting and numerous auxiliary functions. The extensive use of water across these processes generates wastewater containing oil, suspended solids, hydrocarbons, phenols, sulfides, ammonia, dissolved salts and other process-related contaminants.

Refinery wastewater differs significantly from municipal sewage due to its complex composition and variability. Changes in crude slate, operational upsets, turnaround activities and seasonal variations such as monsoon inflow can substantially influence hydraulic and pollutant loads. Historically, Effluent Treatment Plants (ETP) were designed primarily to comply with environmental discharge norms. However, increasing freshwater scarcity, stricter regulations and global sustainability commitments have shifted the focus from simple compliance to resource conservation and water reuse.

Modern refinery wastewater management directly supports global sustainability objectives. By ensuring efficient treatment, reuse and reduced discharge, refinery ETP contribute to achieve various Sustainable Development Goals (SDG).

Today, wastewater treatment is no longer a peripheral utility operation - it is a strategic function central to sustainable refinery growth and environmental stewardship. MRPL Refinery ETP operate through a structured multi-stage treatment philosophy where each unit process enhances the effectiveness of the next.

Effective and responsibly managed ETP operations support key United Nations Sustainable Development Goals such as SDG 6 – Clean Water and Sanitation, SDG 12 – Responsible Consumption and Production and SDG 14 – Life Below Water.

Primary Treatment. The primary treatment stage typically consists of API separator, Tilted Plate Interceptor (TPI) and Dissolved Air Flotation (DAF) systems. These units remove free oil, emulsified oil and suspended solids through gravity separation and flotation mechanisms. Effective oil removal is essential to protect downstream biological systems from shock loads and performance deterioration.

Secondary Treatment. Biological systems, Sequential Batch Reactors (SBR) & Membrane Bio-Reactors (MBR) form the core of organic and nitrogen removal. SBR operate in controlled fill–aerate–settle –decant cycles, enabling efficient reduction of BOD, COD and Ammoniacal nitrogen. MBR further enhance treatment by integrating biological degradation with membrane filtration, producing effluent with very low suspended solids and high clarity.

Tertiary and Advanced Treatment. To meet water recycling objectives, advanced polishing units such as Ultrafiltration (UF) and Reverse Osmosis (RO) are integrated into ETP. UF removes fine particulates and colloids, protecting RO membranes from fouling. RO removes dissolved salts, residual organics and trace contaminants, producing low-TDS water suitable for reuse in cooling towers, utilities and other process applications. This integrated configuration transforms treated effluent into a valuable reusable resource, significantly reducing freshwater intake.

Operational Challenges. Refinery ETPs face several operational challenges such as Variability in hydraulic and organic loading, High phenolic or Ammoniacal nitrogen streams, Chloride impacts on biological activity, Sludge accumulation and MLSS control issues, Membrane fouling in UF and RO systems and Pressure and recovery imbalances in RO skids.

Optimization Measures. Few recommended optimization measures include Proper equalization of high-strength streams, Controlled sludge wasting to prevent dead biomass buildup, Maintaining adequate aeration for nitrification, Timely membrane cleaning, Monitoring cartridge filter fouling trends, Hydraulic balancing across treatment units, Data-driven monitoring and preventive maintenance are essential to sustain long-term reliability and design efficiency.

Suggestive Measures. Suggestive measures for effective water management include Stripped sour water usage in other processing units, Reprocessing of ETP Oily sludge in Delayed Coker Unit (DCU), Utilization of treated sewage water from city to reduce the fresh water consumption, Tilted Plate Interceptor (TPI) automation for effective oil removal, Dissolved Air Floatation (DAF) section effective chemical dosing and scrapping mechanism and Sequential Batch Reactor (SBR) effectiveness F/M ratio, DO levels, Return Activated Sludge (RAS) & Surplus Activated Sludge (SAS) wasting as required.

ETP oily sludge if routed to DCU eliminates the need for downstream centrifuge. Adequate chemical dosing in DAF section enhances demulsification along with effective SBR & MBR system can lead a refinery to meet its water goals.

Conclusion

Effective effluent treatment in oil refineries has transformed from a regulatory requirement into a cornerstone of sustainable operations. Through integrated treatment technologies, disciplined process control and a strong focus on water reuse, modern refineries are converting wastewater into a strategic resource.

SATELLITE SURVEILLANCE OF EEZ AGAINST OIL SPILLS : CAPABILITIES AND GAPS

(Dy Commandant Rahul Chaudhary, NO, ICGS Vijit)

India's Exclusive Economic Zone. India's Exclusive Economic Zone spans approximately 2.3 million sq km, making it the 18th largest EEZ globally. The zone faces persistent challenges from illegal fishing and environmental hazards, particularly oil pollution from shipping accidents, operational discharges and offshore platform incidents.

The Oil Spill Threat. The combination of intensive shipping traffic along major international sea lanes, expanding offshore oil and gas operations and vulnerable coastal ecosystems creates significant oil spill risk. Historical incidents demonstrate the devastating impacts. The 2010 MSC Chitra collision near Mumbai spilled approximately 800 MT fuel oil, contaminating extensive mangrove and mudflat areas. The 2017 Chennai collision released 75 MT HFO, affecting over 35 kilometers of shoreline with toxic compounds persisting in sediments for years.

Detection of oil spills through SAR. Synthetic Aperture Radar (SAR) has been considered an effective technology for mapping and monitoring oil spills in the marine environment, primarily thanks to its weather, illumination and time-independent capabilities. Unlike optical sensors that require daylight and cloud-free conditions, SAR operates in the microwave spectrum, transmitting radio pulses and measuring reflected backscatter to create high-resolution imagery regardless of weather or darkness. Average ocean cloud cover exceeds 60% and darkness prevails 50% of the time, making SAR's all-weather capability essential for persistent ocean monitoring. The physical principle underlying SAR oil detection involves the dampening effect of oil films on ocean surface waves. Oil reduces surface tension, suppressing short capillary and gravity waves generated by wind. This wave dampening creates smoother surfaces that reflect radar signals away from the satellite sensor, producing characteristic dark patches in SAR imagery. The contrast between oil-covered and oil-free water depends on wind speed, sea state, oil type and thickness, radar frequency and viewing geometry. However, SAR-based detection faces significant challenges. The radar cross section of oil-covered water is often indistinguishable from other dark ocean features such as low wind areas, which leads to errors and uncertainties in oil spill detection. Natural biogenic slicks from phytoplankton, algal blooms, rain cells, internal waves, ship wakes and current shear zones all create similar dark features in SAR imagery. The often-claimed high success rate of oil spill detection algorithms using single-polarisation SARs is questionable because SAR images used to train these algorithms are based usually on subjective interpretation and are not validated by on-site inspections.

Satellite Capabilities. India has developed indigenous SAR capabilities through its Radar Imaging Satellite (RISAT) program. The RISAT constellation comprises both X-band and C-band satellites providing all-weather imaging for maritime surveillance, including oil spill detection. RISAT-1, launched in 2012, featured indigenously developed C-band SAR with multiple imaging modes and polarimetric capabilities specifically supporting coastal monitoring and oil spill detection. More recent satellites like RISAT-1A (EOS-04) continue this capability. The European Space Agency's Sentinel-1 constellation provides free C-band SAR imagery with 10-meter resolution and six-day combined revisit capability. ISRO's Bhuvan geoportal integrates remote sensing data with geographic information for oil spill mapping. The Indian National Centre for Ocean Information Services (INCOIS) operates an Online Oil Spill Advisory System providing trajectory modeling and predictions supporting Coast Guard response operations. This system integrates satellite detections with ocean current and wind data to predict oil drift patterns.

Critical Capability Gaps. Despite these capabilities, significant gaps persist in India's satellite-based oil spill surveillance system discussed below: -

- Achieving daily coverage of India's entire 2.3 million square kilometers EEZ remains impossible. Typical revisit times of 3-6 days create substantial surveillance gaps.
- Optimal detection occurs at moderate wind speeds of 10-25 Kn. Below this range, insufficient wave development reduces oil-water contrast and increases false positives. Above this range, strong winds partially overcome oil dampening effects, potentially rendering thin films undetectable. India's monsoon season creates extended periods where wind conditions degrade detection reliability across large ocean areas.
- Other phenomena such as ship tracks, leeward areas, intra-oceanic waves and low wind speed zones can produce similar dark regions,

making it challenging to differentiate actual oil spills from these false positives.

- SAR cannot measure oil thickness or volume that are critical parameters for response planning.

Way Ahead. Expanding satellite constellation capacity could achieve near-daily coverage of high-priority EEZ areas. Emerging commercial satellite constellations demonstrate the potential for persistent monitoring. Also, Implementing advanced machine learning algorithms trained on comprehensive India-specific datasets would enable automated detection with acceptable false positive rates, reducing processing delays from days to hours. We may establish dedicated operational surveillance services modelled on international best practices like Europe's Clean Sea Net. Strengthening institutional coordination through clear legal frameworks, standard operating procedures and integrated information systems would enable efficient response leveraging satellite surveillance capabilities.

Conclusion

India possesses the scientific expertise, technological capability and institutional framework to establish world-class satellite-based oil spill surveillance protecting its maritime environment, economy and coastal communities. The challenge lies in implementation that is making strategic investments, building operational capabilities, establishing coordination mechanisms and sustaining commitment.

OCEAN ACIDIFICATION AND ITS IMPACT ON MARINE LIFE

(Dy Commandant PR Sarvanan, CO, ICGS C-424)

Introduction. The world's oceans constitute the largest active carbon sink on the planet and are central to climate regulation, biodiversity conservation and global food security. However, accelerating anthropogenic carbon emissions are altering the chemistry of seawater at an unprecedented rate. This process termed as ocean acidification, represents one of the most consequential environmental challenges of the 21st century. For a maritime nation such as India with extensive coastlines, island territories and substantial dependence on marine resources, the implications are strategic as well as ecological. Nowhere is this more evident than in the Andaman and Nicobar Islands, a geographically sensitive and ecologically rich archipelago situated in the Bay of Bengal. These islands are home to extensive coral reef systems, seagrass meadows, mangrove forests and highly productive fisheries.

Causes of Ocean Acidification. Ocean acidification occurs when atmospheric carbon dioxide (CO_2) dissolves in seawater, forming carbonic acid. This chemical reaction reduces seawater pH and decreases the availability of carbonate ions essential building blocks for many marine organisms. The principal drivers include Combustion of Fossil Fuels, Industrial and Energy Production Activities and Deforestation and Land-Use Change.

Impacts on Marine Ecosystems. The Andaman and Nicobar supports ecologically significant reef systems. Ocean acidification threatens the ecological equilibrium of this region. Marine organisms such as corals, molluscs, echinoderms and certain plankton species depend on carbonate ions to build shells and skeletons composed of calcium carbonate. As carbonate availability declines, Shell formation becomes energetically costly, Growth rates decline, Structural integrity weakens and Mortality rates increase. In the Andaman Sea, shellfish populations and reef-building corals are particularly vulnerable, potentially affecting artisanal fisheries and aquaculture.

Ocean acidification slows coral calcification making reefs structurally fragile and more susceptible to erosion. When combined with rising sea temperatures, bleaching events intensify, reducing reef resilience. Degraded reefs compromise not only biodiversity but also natural coastal defence systems.

Planktonic organisms form the foundation of marine food chains. Changes in their abundance or physiological functioning cascade through trophic levels. A decline in calcifying plankton could reduce food availability for juvenile fish, Affect migratory species and disrupt breeding cycles.

Emerging research indicates that increased acidity can alter fish metabolism, reproductive capacity and sensory perception. Behavioural impairments such as difficulty in predator detection and navigation have been observed in certain species. For a region where fisheries constitute both a livelihood and a food security pillar, such physiological stressors present long-term sustainability concerns.

Socio-Economic Implications for Island Communities. Coral reef degradation and shellfish decline may result in reduced fish catch, loss of income for coastal communities, Increased vulnerability to food insecurity and Economic instability affecting remote island populations. Environmental degradation can also heighten maritime security challenges including illegal fishing and resource competition areas directly under the operational purview of the Indian Coast Guard.

Strategic Relevance to the Indian Coast Guard. The Indian Coast Guard's charter includes marine environmental protection under the Coast Guard Act. In the Andaman and Nicobar region, its responsibilities intersect directly with emerging climate-induced risks. Key areas of relevance include Environmental Monitoring and Surveillance, Pollution Prevention and Control, Enforcement of Maritime Regulations and Community Outreach and Awareness.

Mitigation and Preventive Measures. Addressing ocean acidification requires coordinated national and global efforts. Key measures include following: -

- Reduction of Greenhouse Gas Emissions.
- Transition to Renewable Energy Sources.
- Sustainable Land-Use Practices.
- Protection and Restoration of Coastal Ecosystems.
- Strengthening International Environmental Cooperation.

Conclusion

Ocean acidification is a direct consequence of anthropogenic climate change and represents a significant threat to marine biodiversity, ecosystem resilience and coastal economies. The Indian Coast Guard, operating at the frontline of maritime governance has an evolving role that extends beyond traditional security functions to encompass environmental stewardship. Protecting marine ecosystems from pollution, enforcing sustainable practices and supporting climate resilience initiatives are integral to safeguarding national maritime interests. Preserving the health of the oceans is not solely an environmental imperative, it is a strategic necessity. Ensuring resilient marine ecosystems will contribute to food security, economic stability, disaster resilience and long-term maritime security for India.

ROADMAP FOR AUGMENTING INDIA'S HNS RESPONSE CAPABILITIES

(P/Nvk(RP), Avinash Nayak, CGAS Ratnagiri)

Introduction. India's rapid industrialization, coupled with its strategic location along major maritime trade routes, has significantly increased the movement and handling of Hazardous and Noxious Substances (HNS). These substances pose unique challenges distinct from conventional oil spills or natural disasters. India's expanding chemical trade and strategic maritime position demand robust capabilities to handle HNS spills, where the Indian Coast Guard (ICG) leads as the central coordinating agency. This roadmap outlines strategic enhance-ments to build national resilience against HNS incidents, focusing on tiered response, infrastructure, training and partnerships.

HNS Threats. HNS includes chemicals, gases and liquids beyond oil that harm health, marine life or sea uses when spilled, classified by behaviour like gases, evaporators, dissolvers, floaters or sinkers. India's ports manage high volumes near coastal hubs, with risks from ship collisions, groundings or facility leaks amplified by busy sea lanes.

Roadmap. The foundation of India's HNS response capability lies in building a robust institutional and regulatory framework. Without clear jurisdiction, standardized protocols and internationally aligned liability mechanisms, operational efforts risk fragmentation and inefficiency. The following are recommended: -

- Institutional and Regulatory Measures.
- Technological Upgradation drive.
- Capacity Building and Training.
- Infrastructure and Logistics enhancement.
- Community and Stakeholder Engagement.
- International Cooperation.

Conclusion

The augmentation of India's HNS response capabilities requires a multi-layered and integrated approach. At the same time, the adoption of advanced technologies-including real-time chemical sensors, satellite linked monitoring systems, mobile laboratories and predictive dispersion models-will be essential to enhance detection, containment and mitigation capacities. By investing in preparedness across these dimensions and aligning with global best practices, India can not only safeguard its fragile maritime environment and protect human lives but also strengthen its credibility as a responsible oceanic power, capable of leading regional cooperation and setting benchmarks in HNS management and disaster response.

ENVIRONMENT IMPACT ASSESMENT OF COASTAL MARINE ECOSYSTEM USE OF SPECIFIC TOOLS AND STUDIES

(Assistant Commandant Diganta Sarmah, ICGS Annie Besant)

Introduction. Coastal marine ecosystems represent some of the most dynamic and biologically productive environments on Earth. Yet, they are under severe pressure from human activities including coastal development, industrial expansion, marine transportation, pollution and climate-driven events such as sea-level rise and ocean acidification. The degradation of these environments can significantly alter ecological balance, resulting in losses in ecosystem services such as fisheries productivity, shoreline protection, tourism revenue and carbon sequestration. Environmental impact assessment (EIA) has emerged as a central framework to evaluate and predict how proposed human activities might affect coastal and marine ecosystems. Its aim is to inform decision-making, minimize environmental harm and ensure sustainable use of marine resources. This article explores the principles, tools and case studies associated with the environmental impact assessment of coastal marine ecosystems.

Fundamentals. Environmental Impact Assessment is a systematic process to evaluate likely environmental consequences of proposed projects. In coastal marine environments, the EIA process extends beyond traditional terrestrial concerns to encompass complex physical, chemical and biological interactions across marine, estuarine and near shore zones.

Key Steps in the EIA Process. A coastal EIA generally includes Scoping and Screening for determining the extent of study required, Baseline Data Collection for Comprehensive field surveys to record existing physical, chemical and biological conditions, Impact Prediction and Evaluation to predict how proposed activities will affect the ecosystem.

Geographic Information Systems (GIS) and Spatial Tools. GIS remains one of the most versatile tools in environmental assessment because it integrates spatial data from diverse sources such as satellite imagery, coastal topography and biological surveys into layered maps that communicate patterns and trends effectively. Spatial modeling assists in visualizing overlaps between human activities and ecosystem vulnerabilities.

Biological and Ecological Assessment Tools. Biological indicators are crucial for translating chemical or physical data into ecological significance. Techniques include Sediment Quality Triad (SQT), Ecosystem Modeling Tools and Monitoring Programs.

Remote Sensing and Hyperspectral Imaging. Remote sensing platforms including satellite sensors and airborne imagery are critical for large scale assessments of coastal environments. Hyperspectral imagers capture detailed spectral information across many wavelengths, enabling detection of harmful algal blooms, mapping of water quality variables like chlorophyll and suspended sediments, Classification of bottom types and shallow water habitats.

Case Study - Shipwreck Impact Assessment off the Indian Coast. The Central Marine Fisheries Research Institute (CMFRI) undertook an environmental impact study of the MSC ELSA 3 shipwreck off the Kochi coast, India. Investigators collected water, sediment, and phytoplankton samples across multiple stations to assess water quality changes, potential oil contamination, and benthic community responses. This study illustrates how targeted field data can inform management responses to unplanned marine disturbances.

Conclusion. EIA is a multidisciplinary endeavor that combines fieldwork, modeling, spatial analysis, ecological monitoring and stakeholder engagement. As pressures on coastal systems intensify due to climate change and economic expansion, adopting ecosystem-based and strategic assessment frameworks becomes increasingly vital.

REPORTS

WORLD WATCH

BLACK CARBON EMISSIONS FROM SHIPS MEASURED

Source:https://www.naturalsciences.be/en/science/news/black-carbon-emissions-from-ships-measured

Since 2015, the Belgian Coast Guard aircraft has been equipped with a sniffer sensor that can measure the concentration of pollutants in emissions from ships at sea. Initially, the system was integrated into the aircraft to monitor and analyse sulfur oxide (SOx) emissions, but over the years it has been expanded to include the ability to detect other pollutants. Since 2020, nitrogen oxides (NOx) have also been measured, and in 2021, black carbon also became part of the air monitoring mission.

Figure 10. The coastguard aircraft during a sniffer mission over the Belgian part of the North Sea (Image: NL Coast Guard)

"In June 2025, the aerial surveillance team published a scientific article in Atmosphere describing black carbon emissions from maritime traffic in the southern North Sea and the English Channel based on 886 measurements taken between 2021 and 2024. This is the first scientific study of this scale to compile and analyse actual measurements of black carbon from ships. The measurements were taken in the maritime areas of Belgium, the Netherlands, France and the United Kingdom.

What is "Black Carbon"?

Black carbon is a category of carbon-containing fine particles smaller than 2.5 micrometres (1 micrometre or 1 µm is equal to one thousandth of a millimetre). It mainly comes from the incomplete combustion of carbon-containing fuels such as fossil fuels (like diesel and coal) but also biomass (wood) and biofuels.

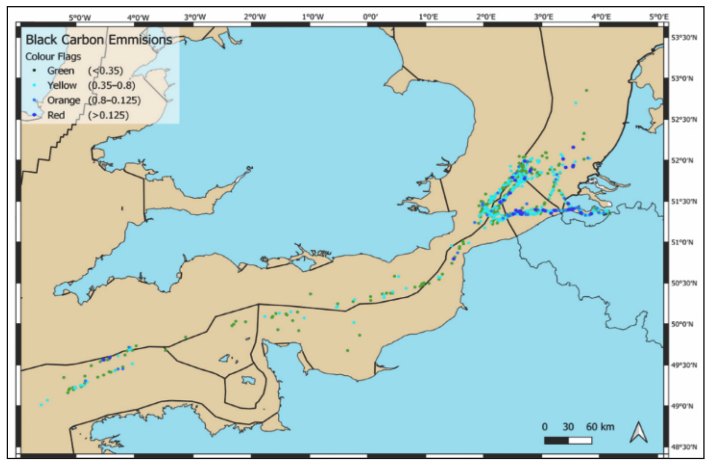

Figure 11. Spatial distribution of black carbon emission measurements, with colours indicating the measured levels (in g black carbon/kWh)

As a fine particle, black carbon has an impact on the health of the population exposed to it. Although the exact climate impact of black carbon remains a subject of debate and it is not classified as a greenhouse gas, it is clear that it contributes significantly to climate change. This is partly due to its ability to absorb solar radiation when it settles on polar ice, making it darker.

Interpretation of the Results

The long-term research led to a number of conclusions that will be refined in the future with additional data. The main conclusion is that air measurements of black carbon emissions from ships at sea are feasible and that the accompanying observation protocol provides valuable information about the actual extent of these emissions. Until now, such information has been derived from measurements taken under controlled and simulated conditions rather than at sea under real conditions.

The data also suggest that black carbon emissions from ships may have been underestimated. It also appears that ECA-compliant fuels (low-sulphur fuels permitted in the “emission control area” to which the North Sea belongs) contribute to a significant reduction in black carbon emissions. In addition, it also appears that engine load is a determining factor for black carbon emissions.

Science in the Service of Enhanced Sustainability

Black carbon emissions from shipping are not yet regulated, although discussions have been ongoing since 2011 to find the best ways to limit these emissions and their impact. These discussions are taking place within the International Maritime Organisation (IMO), a specialised agency of the United Nations responsible for establishing international rules relating to the safety and security of maritime transport, but also in relation to the prevention of marine and atmospheric pollution by ships.

As a basis for such discussions, the IMO naturally needs robust scientific data, and this is where the new Belgian insights can play a valuable role. Belgium, represented in the IMO by the Directorate-General for Shipping (Federal Public Service Mobility and Transport), brought the research conducted by the Institute for Natural sciences to the attention of the international maritime community here on 21 November 2025. In this way, Belgium aims to raise awareness of the issue of black carbon and provide concrete elements to support the development of effective regulations on black carbon emissions from shipping.

On 26 November 2025, Belgium was also elected as a member of the IMO Council in London, thanks to the ongoing efforts of DG Shipping. The election, formalisation and presentation of Belgian scientific insights to the IMO demonstrate the importance our country attaches to international scientific and political cooperation and its strong support for the transition to a sustainable and less polluting shipping sector.

Decouple the global economy from its addiction to fossil-fuel-based synthetics. If they succeed on the current terms, the world may find itself with a "plastic treaty" that does everything except stop the plastic.

THE GHOST SHIP AND THE BILL: TOBAGO’S LONG ROAD TO RECOVERY

Source:https://www.guardian.co.tt/news/international-group-starts-process-for-38m-compensation-for-tobago-oil-spill-6.2.2407118.eff24a7066

It has been over two years since the overturned barge Gulfstream began spewing thousands of barrels of persistent oil into the pristine waters off Cove, Tobago. While the black sludge has largely been cleared from

Figure 12. Workers from T&T Salvage Inc secure the overturned Gulfstream barge to tugs during the refloating exercise at Cove, Tobago in August 2024

the beaches, the financial and legal murky waters surrounding the February 2024 disaster are proving much harder to navigate.

The Cost of the Cleanup

Recent reports from the International Oil Pollution Compensation (IOPC) Fund have finally put a price tag on the initial recovery efforts. The fund currently estimates the payout for the disaster at approximately £4.2 million ($38 million TT). While compensation payments have officially commenced, the IOPC warns that the administrative and financial tail of this spill will likely wag until at least 2027.

The scale of the financial burden is immense. The Tobago House of Assembly (THA) has already reported spending upwards of $72.1 million on cleanup operations significantly exceeding the $50 million initially allocated by the Central Government. By April 2025, the IOPC had received 290 claims totaling over **US$30.3 million**, covering everything from fisheries and beach cleaning to aerial surveillance in nearby Bonaire.

The Vanishing Villain

At the heart of this environmental crisis is a high-seas mystery: the whereabouts of the tug Solo Creed. The vessel, which was towing the Gulfstream when it capsized, has become a maritime phantom.

Despite being detained by Angolan authorities in mid-2024 and formally arrested by a court later that year, the vessel reportedly "escaped arrest" shortly thereafter. Since then, it has vanished from global tracking systems. The Trinidad and Tobago government has even resorted to hiring specialized satellite surveillance firms to scour the oceans, but as of late 2025, the tug remains undetected.

Energy Minister Dr. Roodal Moonilal has reaffirmed the government's commitment to the chase, stating that the state will continue to pursue a $244 million claim once the vessel is located and its elusive owner is identified.

Logistics and Lingering Waste

While the Gulfstream barge itself was finally removed, broken up and sold for scrap in March 2025, the physical remnants of the spill still haunt the island. During a recent visit to the archipelago, IOPC Claims Manager Mark Homan met with local officials to discuss the "final mile" of the cleanup: the disposal of contaminated waste.

Currently, the oil-soaked debris remains stored in three specialized pits at the Studley Park dump. However, a definitive timeline for the final removal or treatment of this hazardous waste has yet to be established, leaving a literal scar on the landscape as a reminder of the incident.

What Lies Ahead

The international community will be watching closely this November when the IOPC governing bodies meet in London. This meeting is expected to provide a comprehensive update on the Gulfstream Major Claims Fund, which has already raised £10 million to address the fallout.

For the people of Tobago, particularly those in the tourism and fishing sectors, the wait for full restitution continues. With additional claims for tourism losses expected to surface and the search for the Solo Creed ongoing, the Gulfstream incident remains a sobering case study in the difficulties of holding "ghost" shipping operations accountable for environmental devastation.

THE OCEAN'S GARBAGE PATCH: DENMARK'S TOXIC DUMPING CRISIS

Source:https://politiken.dk/edition/news/art10645162/Potentially-toxic-harbor-sludge-pressures-marine-environment

The large ship drags a cloud of brown sludge behind it as it rotates in the blue-green seawater. The mass doesn't quickly sink to the bottom but spreads visibly in the water and remains on the surface for a long time.

A massive vessel rotates in the shimmering blue-green seawater, but it leaves more than a wake behind it. A thick, brown cloud of sludge billows from the ship, refusing to sink. Instead, it lingers on the surface, spreading like a stain across the marine environment. This is the reality of "dumping" a large-scale practice in Denmark that experts warn is turning the seabed into a toxic wasteland.

Figure 13. Large Ship Dumping Sludge in the Clean Ocean

A "Desert" in the Making

Dumping involves the disposal of tons of dredged seabed, often moved during harbor maintenance or the deepening of shipping channels. While it might seem like moving dirt from one spot to another, the reality is far more dangerous. Harbors are magnets for industrial pollutants that have settled over decades. When this sludge is dredged up and dumped into the open sea, these "buried" toxins are reintroduced to the water column and spread across the ocean floor.

According to a new, yet-to-be-published analysis from the think tank Ocean Institute, the scale of this practice is staggering. Between 2015 and 2023, roughly 18.4 million cubic meters of dredged material were dumped into Danish waters. To put that in perspective, it is the equivalent of 87,000 truckloads of sludge every single year.

"Nearly all of our marine areas are already in poor chemical condition," says Stiig Markager, a professor and marine biologist at Aarhus University. "It is unacceptable to dump harbor sludge filled with toxins into an environment that is already under such pressure."

The "Forever" Problem

The danger lies in what is hidden within the silt. Harbors contain a cocktail of eleven common, highly persistent "forever chemicals" and heavy metals. These substances, which include mercury, lead, cadmium, and TBT (a once-common ship paint additive now banned for its extreme toxicity), do not break down. Instead, they accumulate in the food chain.

Henriette Selck, a professor at RUC and senior consultant at the Ocean Institute, warns that if this continues, Denmark's marine environments risk becoming "deserts." "We've seen in some of our fjords that life has virtually vanished," she notes. "If we continue to pollute, we risk the fish disappearing completely."

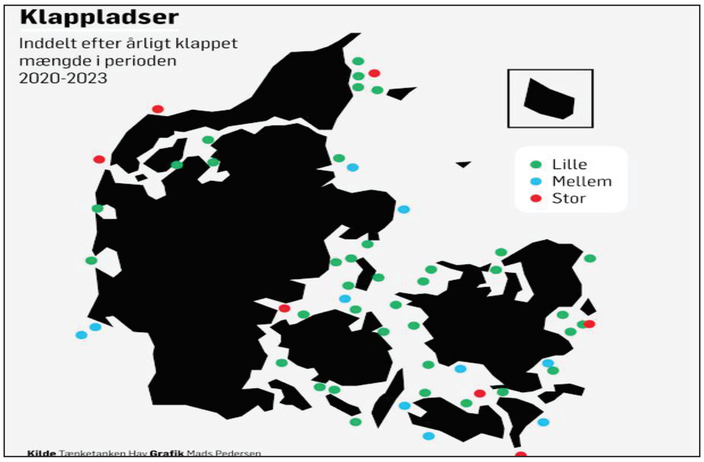

Figure 14. Map of dumping sites. Green is a small amount of dumping, blue is a medium amount of dumping, and red is a large amount of dumping

The Toxic Eleven: What's in the Sludge

Authorities typically measure 11 harmful substances to evaluate harbor pollution. These chemicals are known to reduce reproduction, weaken immune systems, disrupt hormones, and increase mortality in marine life:-

- **Heavy Metals**: Arsenic, Lead, Cadmium, Chromium, Copper, Mercury, Nickel, Zinc.
- **Chemical Compounds**: TBT (Tributyltin), PAH (Polycyclic Aromatic Hydrocarbons), and PCB (Polychlorinated Biphenyls).

Lessons from the Past: Toxic Starfish

While comprehensive modern studies on the chemical impact of dumping are rare, historical data provides a grim forecast. A 2003 study of the Port of Rotterdam revealed that areas used for dumping had concentrations of mercury two to three times higher than untouched areas.

The biological impact was even clearer: starfish at the dumping sites contained twice the amount of mercury, zinc, and PCBs compared to their counterparts in clean waters. Because these toxins stay on the surface of the seabed after dumping, they are immediately available for ingestion by bottom-dwelling organisms, moving steadily up the food chain to the fish on our plates.

A Call for Modern Waste Management

For experts like Markager, the current approach to harbor maintenance is an outdated relic. He compares the practice to throwing household trash into a nearby forest rather than using a bin.

"It's always cheaper just to throw your waste out in the yard," Markager says, "but that doesn't make it acceptable in 2025."

The proposed solution is a total ban on the dumping of harbor sludge. In its place, experts advocate for the construction of a national treatment plant designed to clean and process polluted harbor silt from across Denmark. By concentrating the toxins and treating them on land, the maritime industry could maintain its channels without sacrificing the very life that makes the sea a vital resource.

As the data from the Ocean Institute suggests, the "out of sight, out of mind" philosophy of ocean dumping is no longer sustainable. Without a radical shift in how we handle our underwater waste, Denmark's blue-green waters may soon hold nothing but shadows and silt.

Indian Coast Guard
Annual Calendar of Pollution Response Training and Exercise - 2026

Date	Venue	Coordinator	Participants
OPRC Level – 1			
19-24 Jan	Chennai	CG PRT(E)	ICG & Stakeholders
09-13 Feb	Mumbai	CG PRT (W)	
09-13 Mar	Sri Vijaya Puram	CG PRT (A&N)	ICG, ANC & Stakeholders
06-10 Apr	Vadinar	CG PRT (NW)	ICG & Stakeholders
13-18 Apr	Chennai	CG PRT(E)	
04-12 May	Sri Vijaya Puram	CG PRT (A&N)	ICG, ANC & Stakeholders
18-22 May	Chennai	CG PRT(E)	ICG & Stakeholders
15-19 Jun	Mumbai	CG PRT (W)	
06-10 Jul	Vadinar	CG PRT (NW)	
17-25 Aug	Sri Vijaya Puram	CG PRT (A&N)	ICG, ANC & Stakeholders
07-11 Dec	Mumbai	CG PRT (W)	ICG & Stakeholders
07-11 Dec	Vadinar	CG PRT (NW)	
OPRC Level – 2			
02-06 Feb	Sri Vijaya Puram	CG PRT (A&N)	ICG, ANC & Stakeholders
09-13 Feb	Vadinar	CG PRT (NW)	ICG & Stakeholders
09-13 Mar	Chennai	CG PRT(E)	
06-10 Apr	Mumbai	CG PRT (W)	
06-10 Jul	Chennai	CG PRT(E)	
21-25 Sep	Vadinar	CG PRT (NW)	
05-09 Oct	Sri Vijaya Puram	CG PRT (A&N)	ICG, ANC & Stakeholders
16-20 Nov	Mumbai	CG PRT (W)	ICG & Stakeholders
OPRC Level – 3			
15-19 Jun	Chennai	CG PRT(E)	ICG & Stakeholders
05-09 Oct	Mumbai	CG PRT (W)	
HNS Operational Level Course			
23- 25 Mar	Chennai	RMPRC	ICG Officers
14-16 Dec			

Date	Venue	Coordinator	Participants
OPRC - 1 & 2 Course for FFC & ASEAN			
16-20 Feb	Chennai	RMPRC	OPRC Level-1
23-27 Feb			OPRC Level-2
03-07 Aug			OPRC Level-1
10-14 Aug			OPRC Level-2
07-11 Sep			OPRC Level-1 for ASEAN countries
PART- B (EXERCISES)			
Area Level Exercise			
11-12 Feb	Visakhapatnam	RHQ(E)/ CGDHQ-6	Eastern Region & Stakeholders
24-25 Sep	Kochi	RHQ(W)/ CGDHQ-4	Western Region & Stakeholders
10-11 Nov	Mundra	RHQ(NW)/CGDHQ-15	NW Region & Stakeholders
24-26 Nov	Dhamra/ Paradip	RHQ(NE)/ CGDHQ-7	NE Region & Stakeholders
17-18 Dec	Sri Vijaya Puram	RHQ(A&N)/CGDHQ-14	A&N Region & Stakeholders
Local Level Exercise			
10 Feb	Chennai	CGDHQ-5, Adani Port Limited Kattupali	ICG, Adani Port Limited & Stakeholders
16-17 Mar	Goa	CG DHQ-11, MPA	ICG, MPA & Stakeholders
23 Apr	Gopalpur	CGDHQ-7, Gopalpur Port	ICG, Gopalpur Port & Stakeholders
23-24 Apr	Kochi	CGDHQ-4, CoPA	ICG, CoPA & Stakeholders
28 May	Tuticorin	CGDHQ-16, VOCPA	ICG, VOCPA & Stakeholders
24 Jun	Visakhapatnam	CGDHQ-6, VPA	ICG, VPA & Stakeholders
23 Jul	Karaikal	CGDHQ-13, Adani Port	ICG, Adani Port & stakeholders
12-13 Aug	Sri Vijaya Puram	CGDHQ-14, Sri Vijaya Puram Port	ICG, Sri Vijaya Puram Port Stakeholders
20-21 Aug	Campbell Bay	CGDHQ-10, Campbell Bay Port	ICG, Campbell Bay Port & Stakeholders
08-09 Sep	Haldia	CGDHQ-8, HDC	ICG, HDC & Stakeholders
08-09 Oct	Porbandar	CGDHQ-1, Porbandar Port	ICG, Porbandar Port & Stakeholders
13-14 Oct	New Mangalore	CG DHQ-3, NMPA	ICG, NMPA & Stakeholders
26-27 Oct	Diglipur	CG DHQ-9, Diglipur Port	ICG, Diglipur Port & Stakeholders.

Date	Venue	Coordinator	Participants
17-18 Dec	Mumbai	CG DHQ-2, JNPA	ICG, JNPA & Stakeholders
25-26 Feb	Mumbai	CG DHQ-2	ICG & Stakeholders
10-12 Mar	Jakhau	CG DHQ-15	
22 Apr	Gopalpur	CG DHQ-7	
28 Apr	Kochi	CG DHQ-4	
28-29 Apr	Haldia	CG DHQ-8	
06-07 May	Goa	CG DHQ-11	
29 May	Tuticorin	CG DHQ-16	
25 Jun	Visakhapatnam	CG DHQ-6	
22 Jul	Karaikal	CG DHQ-13	
18 Aug	Chennai	CG DHQ-5	
18-19 Aug	New Mangalore	CG DHQ-3	
08-09 Oct	Porbandar	CG DHQ-1	
21-22 Oct	Kavaratti Island	CG DHQ-12	
PART – D {Oil Spill Shoreline Cleanup (Multi-State ME)}			
06 Jan & 13-15 Jan	DD & NH and adjoining districts of Maharashtra & Gujarat	NDMA	ICG & Stakeholders

"Synergy for Safer and Cleaner Seas"

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