MEDITERRANEAN ACTION PLAN (MAP)
REGIONAL MARINE POLLUTION EMERGENCY RESPONSE CENTRE FOR THE MEDITERRANEAN SEA (REMPEC)

Sixteenth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea (REMPEC)

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Agenda Item 6: Illegal and accidental oil and HNS pollution from ships

Readiness of the Mediterranean Region to respond to Marine Pollution Incidents involving Low-Sulphur Fuels and Alternative Fuels

REMPEC
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Note by the Secretariat

The present document presents the Study on Readiness of the Mediterranean Region to respond to Marine Pollution Incidents involving Low-Sulphur Fuels and Alternative Fuels.

Background

1 The 22nd Meeting of the Contracting Parties to the Barcelona Convention and its Protocols Ordinary Meeting (COP 22, Antalya, Türkiye, 7-10 December 2021) adopted Decision IG.25/14 on the Designation of the Mediterranean Sea, as a whole, as an Emission Control Area for Sulphur Oxides (Med SO_X ECA) pursuant to Annex VI to the International Convention for the Prevention of Pollution from Ships (MARPOL).

2 The 79th Session of the IMO's Marine Environment Protection Committee (MEPC 79) (London, UK, 12-16 December 2022) adopted the amendments to MARPOL Annex VI concerning the Med SO_X ECA, **with an expected date of entry into effective application on 1 May 2025.**

3 COP 22 also requested the Secretariat (REMPEC) to provide technical support for the implementation of this Decision, in synergy with IMO, and other relevant stakeholders, through technical cooperation and capacity-building activities, including financial support and resource mobilisation activities.

4 The Fifteenth Meeting of the Focal Points of REMPEC (Malta, 13-15 June 2023) called upon the Secretariat (REMPEC) to provide support for the consistent implementation of the 0.10% sulphur limit under MARPOL Annex VI in the Med SO_X ECA during the biennium 2024-2025.

5 In this context, COP 23[2] agreed to include the following activity in the UNEP/MAP Programme of Work and Budget for 2024-2025[3]: support provided for the consistent implementation of the 0.10% sulphur limit under MARPOL Annex VI in the Mediterranean Sea Emission Control Area for Sulphur Oxides and Particulate Matter (Med SO_X ECA).

6 It is noted that the entry into effective implementation of the Med SO_x ECA, will bring along new challenges to Mediterranean coastal States not only in relation to preventive measures but also to emergency response. To ensure the consistent implementation of the 0.10% Sulphur limit under MARPOL Annex VI in the Med SOX ECA, it is essential to also address emergency response and enhance related capacities. To this effect, the Secretariat commissioned a Study on the Mediterranean Region readiness to Respond to Marine Pollution Incidents Involving Low Sulphur Fuels or Alternative Fuels, herein after referred to as the Study. Funding was secured from the voluntary contribution from the Italian Ministry of Environment and Energy Security (MASE) and the International Maritime Organisation (IMO) Integrated Technical Cooperation Programme (ITCP). A consortium composed of the World Martine University and Cedre was engaged in October 2024, to undertake the Study.

7 The Study was based on the review of the assessments of the level of preparedness to Oil Spill Response in 18 Contracting Parties to the Barcelona Convention (CPs) (2019–2023) and insights gathered through a survey questionnaire administrated to relevant stakeholders in the CPs through REMPEC. The Study highlights several gaps in the preparedness of CPs to respond to oil spill incidents. Outdated or incomplete contingency plans, with limited provisions for addressing risks posed by low Sulphur and alternative fuels, remain a critical concern. Low Sulphur fuels, while compliant with emissions regulations, pose challenges due to their persistence and high viscosity, complicating recovery and cleanup efforts. Alternative fuels each present distinct risks that demand specialized responses.

8 The Study aims to provide a strategic and evidence-based approach to enhancing the Mediterranean region's preparedness and response capabilities for potential marine pollution incidents involving low-Sulphur and alternative fuels. The phases of drafting the Study, from October to December 2024, involving the CPs, the Mediterranean Technical Working Group (MTWG), and Partners included:

- a Questionnaire (15 October), aimed to collect data on national policies, emergency

response mechanisms, and resources available for marine pollution incidents involving low -Sulphur and alternative fuels, and

- an Online validation webinar on policy recommendations and strategic roadmap (18 November), on key insights from the comprehensive assessment of the region's capacity and preparedness to respond to marine pollution incidents, the strategic roadmap and policy recommendations to enhance response mechanisms and regional frameworks for managing low-Sulphur and alternative fuel spills; and on validate, refine, and ensure that the recommendations align with the region's operational needs and strategic objectives.

9 The Study consists of nine (9) chapters, and five (5) annexes and is provided in document REMPEC/WG.61/INF 9.

Findings of the Study and way forward

10 The Mediterranean region, a vital global maritime corridor, is approaching a significant regulatory milestone with the implementation of the Mediterranean SO_x Emission Control Area (Med SO_x ECA) in May 2025. This regulation limits Sulphur content in marine fuels to 0.10%, aligning with international efforts to reduce air pollution and promote cleaner shipping. The transition is expected to yield substantial environmental benefits, improving air quality, public health, and ecosystem resilience.

11 However, the transition to low Sulphur and alternative fuels such as LNG, ammonia, hydrogen, and methanol presents unique environmental and safety risks. Current response frameworks, primarily designed for conventional oil spills, lack full provisions to address the distinct challenges posed by these fuels.

12 The Study identified key challenges and provided recommendations across four strategic objectives: policy and regulatory improvements, capacity building, enhanced response mechanisms, and stakeholder collaboration. Together, these efforts aim to bolster the CPs and the entire region’s readiness to manage emerging pollution risks effectively, safeguarding its marine environment and socio-economic interests.

Key challenges in the transition to low Sulphur and alternative fuels

13 The shift to low-sulphur and alternative fuels in the Mediterranean presents significant challenges spanning regulatory, operational, and environmental domains. These challenges must be addressed to ensure a resilient and effective regional framework for pollution prevention and response.

.1 Regulatory gaps

- *Incomplete adoption and transposition of international standards:* Several CPs have not fully ratified critical IMO instruments like MARPOL Annex VI, HNS Convention, OPRC-HNS Protocol, and liability frameworks such as 1992 CLC, 1992 Fund Convention and Protocol and HNS Convention. Even ratified instruments often remain untransposed into national legislation, which is crucial for enforcement and compliance. This gap leaves CPs underprepared to manage the unique risks associated with alternative fuels.

- *Outdated or inadequate national frameworks:* The majority of CPs continue to rely on contingency plans that require updating and are primarily focused on addressing conventional marine pollutants, often overlooking the complexities associated with Hazardous and Noxious Substances (HNS). This oversight extends to alternative fuels like ammonia, LNG, hydrogen, and methanol, which introduce unique risks, including flammability, toxicity, and corrosiveness. Without tailored strategies and provisions for these substances, such as specific containment, mitigation, and recovery protocols, existing frameworks fail to

enable effective spill responses. The absence of integrated approaches for both HNS and alternative fuels leaves CPs unprepared to address the evolving risks associated with alternative fuels.

- *Inconsistent enforcement:* Disparities in enforcing Sulphur emission standards and pollution prevention regulations across CPs weakens regional preparedness. The lack of ratification and transposition of key frameworks like MARPOL Annex VI directly impacts enforcement, allowing non-compliant vessels to exploit regulatory gaps. Limited resources, including untrained inspectors and inadequate monitoring technologies, further exacerbate enforcement deficiencies, particularly in high-traffic areas.

.2 Preparedness deficits

- *Insufficient specialized equipment:* Several CPs lack critical tools, including cryogenic containment gear for LNG, ammonia-neutralizing agents, and hydrogen detection systems. These gaps severely limit the ability to respond effectively to alternative fuel spills, especially in high-traffic and ecologically sensitive areas.

- *Limited training and expertise:* Only a small number of CPs participating in the survey reported conducting drills involving alternative fuels, revealing critical training gaps. Responders' lack of familiarity with the unique hazards of ammonia, LNG, hydrogen, and methanol fuels, severely limits their ability to manage incidents effectively and safely.

- *Fragmented cross-border coordination:* The absence of robust frameworks for sharing resources, expertise, and equipment during large-scale incidents hinders regional collaboration. Most CPs lack clear protocols for cross-border assistance, delaying responses and increasing reliance on external support.

.3 Fuel-specific hazards

While low-Sulphur fuels largely resemble conventional fuels in behavior and risks, alternative fuels such as LNG**,** ammonia**,** hydrogen**,** and methanol introduce distinct hazards. These fuels exhibit unique physical and chemical properties, including flammability, cryogenic risks, toxicity, and corrosiveness, complicating spill management and necessitating advanced containment and response measures. LNG, for instance, poses risks due to rapid evaporation, cryogenic burns, and high flammability, with minimal marine toxicity but significant explosion potential under specific conditions. Ammonia, being highly toxic and corrosive, forms ammonium hydroxide in water, disrupting ecosystems, altering alkalinity, and endangering responders. Hydrogen, with its wide flammability range and extremely low ignition energy, presents severe explosion risks, requiring advanced detection systems despite minimal marine pollution impact. Methanol, while biodegradable, has a low flash point and invisible flames, complicating fire management and demanding specialized training. Understanding hazards associated with each alternative fuel is essential for ensuring its safe adoption and effective spill response.

.4 Knowledge gaps

Limited understanding of the long-term effects of alternative fuel spills—particularly in the Mediterranean's unique conditions, such as high salinity and warmer temperatures—hampers the development of tailored mitigation strategies. The absence of accurate predictive models further complicates response planning, as few tools exist to forecast the behavior of alternative fuels during spills, making preemptive resource allocation and containment efforts challenging. Additionally, public awareness remains

insufficient, with local communities and stakeholders often uninformed about the specific risks of alternative fuels due to a lack of targeted campaigns. This gap in awareness reduces community preparedness and heightens vulnerability during incidents, emphasizing the need for education and outreach initiatives.

.5 Regional and operational constraints

The Mediterranean's critical ecosystems, including seagrass meadows, coral reefs, and wetlands, are exceptionally vulnerable to pollution incidents, with spills posing significant threats to biodiversity, fisheries, tourism, and public health—further compounding the region's socio-economic challenges. High maritime traffic amplifies spill risks, yet many CPs lack the necessary infrastructure, equipment, and trained personnel to address complex scenarios involving alternative fuels. These resource deficiencies can result in delayed responses and exacerbated environmental damage. Moreover, fragmented governance and limited regional agreements could hinder collaborative response, as the absence of harmonized protocols and resource-sharing frameworks impedes timely and effective action during cross-border incidents. Together, these constraints leave the region underprepared for large-scale pollution incidents of low-Sulphur and alternative fuels.

Strategic objectives and recommendations

14 Actionable recommendations structured under four Strategic Objectives (SOs) are offered to enhance the Mediterranean region's preparedness and response capabilities to spill incidents involving low-Sulphur and alternative fuels.

.1 Strategic Objective 1 (SO1) - Policy and regulatory improvements: To strengthen the regulatory framework and ensure alignment with international and regional standards, targeted policy actions are essential. This area of recommendations is intended to enhance national and regional frameworks, strengthen and harmonise enforcement, and develop regional guidelines to manage the specific risks associated with low Sulphur and alternative fuels.

Key recommendations include:

Recommendation	Description	Responsible Parties	Priority
Update national frameworks	Update national legislation to address the risks of low-Sulphur and alternative fuels; Align with international standards such as MARPOL Annex VI, IGF Code, HNS, etc.	CPs, REMPEC	High
Develop regional guidelines	Collaborate on regional guidelines tailored to low-Sulphur and alternative fuels, including LNG, hydrogen, and ammonia.	REMPEC, CPs	High
Strengthen enforcement	Implement advanced monitoring technologies (e.g., EMSA CleanSeaNet) Introduce tiered penalties for violations.	CPs	Medium
Establish liability frameworks	Update compensation mechanisms to address alternative fuel-specific risks; Advocate for international Conventions' amendments.	CPs, REMPEC	Medium

.2 Strategic Objective 2 (SO2) - Capacity building and training: To address the complexities of responding to marine pollution incidents involving low-Sulphur and alternative fuels, REMPEC and the CPs must prioritize targeted capacity-building efforts and specialized training programs. These measures are essential to equip responders with the skills and resources needed for rapid, effective, and coordinated responses to incidents.

Key recommendations include:

Recommendation	Description	Responsible Parties	Priority
Specialized training	Develop tailored training programs on alternative fuels for policymakers, responders, and port authorities.	CPs, REMPEC, Maritime Academies	High
Simulation-based training	Use VR and simulation technologies to train responders on real-life spill scenarios involving alternative fuels.	REMPEC, CPs	Medium
Certification standards	Establish certification programs for responders handling alternative fuel spills.	REMPEC, CPs	Medium
Regional workshops	Conduct regular regional exercises and workshops to test cross-border collaboration and share lessons learned.	REMPEC, CPs	High
Build expert networks	Develop a regional roster of experts to provide technical support during incidents.	REMPEC, CPs	Medium
Knowledge-sharing platforms	Create e-learning platforms and repositories for training materials, case studies, and response protocols.	REMPEC, CPs	Medium

.3 Strategic Objective 3 (SO3) - Enhancing response mechanisms**:** Traditional response mechanisms for marine pollution incidents must be modernized to meet the unique challenges posed by, particularly, alternative fuels. This area of recommendations intends to enhance response mechanisms to ensure swift, effective, and environmentally sensitive management of pollution incidents involving low-Sulphur and alternative fuels.

Key recommendations include:

Recommendation	Description	Responsible Parties	Priority
Fuel-specific protocols	Develop tailored response protocols for LNG, ammonia, methanol, and hydrogen.	REMPEC, CPs	High
Invest in equipment	Upgrade stockpiles with specialized gear (e.g., cryogenic booms, ammonia neutralizers, advanced detectors).	CPs, REMPEC	High
Real-time monitoring	Integrate satellite monitoring, drones, and predictive modelling for early detection and response planning.	REMPEC, EMSA, CPs	Medium
Develop dispersion models	Collaborate with research institutions to develop accurate dispersion models for alternative fuels.	REMPEC, Universities	Medium
Rapid response hubs	Establish response hubs in high-risk areas, equipped with alternative fuel-specific kits.	CPs, REMPEC	High
Enhance cross-border coordination	Strengthen regional agreements for mutual aid, resource sharing, and streamlined assistance protocols.	REMPEC, CPs	High

.4 Strategic Objective 4 (SO4) - Stakeholder engagement and collaboration**:** Effective management of marine pollution incidents involving low-Sulphur and alternative fuels demands a multi-stakeholder approach. Active engagement of national authorities, regional organizations, industry players, non-governmental organizations (NGOs), scientific institutions, and local communities is essential to foster trust, build capacity, and align resources for a coordinated response. This area of recommendations intends to enhance stakeholder engagement and collaboration. These efforts will not only strengthen regional preparedness but also ensure the development of a resilient and sustainable framework for managing pollution incidents across the Mediterranean.

Key recommendations include:

Recommendation	Description	Responsible Parties	Priority
Regional stakeholder Forum	Establish a forum for ongoing dialogue between government agencies, private companies, and NGOs.	REMPEC, CPs	Medium
Private sector partnerships	Engage the private sector in funding, resource sharing, and training initiatives.	CPs, REMPEC	Medium
Community awareness	Launch local campaigns to educate communities on alternative fuels and basic response techniques.	CPs	Medium
Research collaboration	Partner with scientific institutions to advance spill response technologies and ecological impact studies.	REMPEC, CPs	Medium
Resource sharing	Develop a centralized database for tracking and deploying regional response resources efficiently.	REMPEC, CPs	Medium
Transparent communication	Establish public communication protocols to provide timely updates on spill incidents and response actions.	CPs, REMPEC	Medium

Strategic Roadmap to implement the recommendations

15 The suggested strategic roadmap employs a phased approach, allowing REMPEC and the CPs to systematically address critical gaps, enhance preparedness, and institutionalize resilience in response to the challenges of low-Sulphur and alternative fuel spills.

.1 In the short-term phase (0–2 years), the focus is on addressing immediate deficiencies by updating regulatory frameworks, launching targeted capacity-building programs, and fostering stakeholder collaboration to lay a strong foundation for response readiness.

.2 The medium-term phase (2–5 years) emphasizes enhancing regional coordination, expanding infrastructure, and integrating advanced technologies for strengthening response mechanisms while scaling up training and certification standards.

.3 Finally, the long-term phase (beyond 5 years) aims at building resilience by achieving and sustaining full operational readiness through harmonized frameworks, deployment of innovative technologies such as AI-powered (predictive) monitoring systems and sustained multi-stakeholder collaboration.

Phases of the strategic roadmap include:

Phase	Focus areas	Outcomes
Short-term (0–2 Years)	• Regulatory alignment and enforcement • Initial capacity building and training • Stakeholder collaboration and knowledge-sharing mechanisms.	• National regulatory frameworks updated. • Foundational response readiness established. • Key partnerships formed. • Awareness campaigns launched.
Medium-term (2–5 Years)	• Scaling up training and certification programs • Developing response hubs and integrating advanced technologies. • Research and innovation adoption.	• Specialized response hubs operational. • Enhanced regional coordination mechanisms. • Standardized protocols adopted. • Real-time monitoring systems in use.
Long-term (+5 Years)	• Harmonization of regional frameworks • Continuous innovation and adaptation.	• AI-powered tools operational. • Continuous training integrated. • Regional resilience fully institutionalized. • Mediterranean-wide resource database implemented.

Action plan to operationalize the strategic roadmap

16 The following action plan provides actionable steps aligned with the roadmap's phases and recommendations, ensuring implementation consistency.

Recommendation	Key actions	Strategic objective	Stakeholders
Laying the foundation: Action plan for short-term phase (0–2 Years)			
Update regulatory frameworks	• Establish national implementation committees • Conduct gap analyses and align with IMO instruments	SO1	CPs, REMPEC
Develop regional Guidelines	• Create standardized spill protocols tailored to alternative fuels	SO1	REMPEC, CPs
Initial training workshops	• Conduct workshops focused on alternative fuel spill protocols	SO2	REMPEC, EMSA
Establish Initial Response Hubs	• Allocate basic stockpiles in high-risk areas • Train personnel in foundational spill response	SO3	REMPEC, Local Authorities
Strengthening preparedness: Action plan for medium-term phase (2–5 Years)			
Expand response hubs	• Upgrade hubs with specialized equipment (e.g., cryogenic tools)	SO3	CPs, REMPEC
Enhance cross-border drills	• Conduct biennial cross-border exercises • Test communication and resource-sharing frameworks	SO4	REMPEC, EMSA
Standardize certifications	• Develop responder certification programs aligned with international standards	SO2	Maritime Academies, REMPEC
Integrate real-time monitoring	• Deploy satellite and drone-based monitoring systems	SO3	EMSA, CPs, Private Sector
Achieving and sustaining operational readiness: Action plan for long-term phase (+5 Years)			
Harmonize frameworks	• Align national legislation with international standards and update regularly	SO1	CPs, REMPEC, IMO
Predictive models for monitoring	• Fully operationalize predictive models for spill response	SO3	EMSA, REMPEC
Establish permanent training centres	• Institutionalize continuous professional development programs for responders	SO2	Maritime Academies, REMPEC
Strengthen multi-stakeholder partnerships	• Collaborate on habitat restoration and spill mitigation initiatives	SO4	REMPEC, NGOs, Private Sector

Monitoring and evaluation

17 A robust monitoring and evaluation framework is critical for tracking the implementation of the strategic roadmap and ensuring continuous improvement. Key Performance Indicators (KPIs) shall be developed and utilized to measure progress across focus areas such as regulatory frameworks, capacity building, response mechanisms, and collaboration. Examples include the percentage of CPs updating national legislation, the number of revised contingency plans, the number of responders trained, and the integration of real-time monitoring systems. Collaborative efforts will be tracked by counting the frequency of joint drills, stakeholder meetings, and formalized cross-border agreements.

18 To ensure adaptability, feedback loops shall be established. CPs shall provide annual progress reports to REMPEC, detailing completed activities, challenges faced, and KPI achievements. These reports would be consolidated into regional overviews to provide transparency and identify gaps. Additionally, biennial periodic reviews will incorporate lessons learned from drills and real incidents, assess emerging challenges, and recommend adjustments to the roadmap to optimize resource allocation and response strategies.

Funding and support mechanisms

19 The successful implementation of the roadmap requires diverse and sustainable funding mechanisms. National budgets of CPs will play a pivotal role in covering essential activities, including personnel training, acquiring specialized equipment, and developing infrastructure. At the regional level, pooled funds, such as the MedFund or the proposed Blue Fund, will support collaborative training programs, resource-sharing initiatives, and other capacity-building efforts. International grants from organizations like IMO, UNEP, and the EU will provide critical resources for advancing innovative response technologies and enhancing preparedness. Furthermore, private sector partnerships will enable co-financing of advanced spill response tools and foster collaboration with industry stakeholders to address pollution challenges effectively. By leveraging these funding avenues, the roadmap can ensure sustained progress and resilience-building across the Mediterranean region.

Actions requested by the Meeting

20 **The Meeting is invited to**:

.1 **take note** of the information provided in the present document; and

.2 **comment** as deemed appropriate on
- key recommendations provided in paragraphs: 15.1 to 15.4,
- phases of the strategic roadmap provided in paragraphs: 16.1 to 16.3, and
- action plan provides actionable steps aligned with the roadmap's phases and recommendations, in paragraph 17.

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