European Maritime Safety Agency

Tender Specifications
Attached to the Invitation to tender

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Invitation to tender No. EMSA/OP/21/2023 for Study investigating the safety of hydrogen as fuel on ships

1. Introduction

The European Maritime Safety Agency (EMSA) was established under Regulation (EC) No 1406/2002 of the European Parliament and of the Council[1] for the purpose of ensuring a high, uniform and effective level of maritime safety, as amended. Among its tasks, the Agency provides technical and scientific assistance to the European Commission and European Union Member States on matters relating to the proper implementation of European Union legislation on maritime safety and pollution by ships, including technical assistance in the preparation of submissions to the International Maritime Organization (IMO) as appropriate.

EMSA is applying the environmental management systems ISO 14001:2015 and EMAS (Environmental Management and Audit Scheme of the EU), aiming to continuously improve its environmental performance. EMSA complies with all applicable legal requirements relating to the environment and endeavours to ensure that suppliers comply with its environmental policy[2] within the remit of the activities carried out for the contract. EMSA invites tenderers to consult the document and consider it when preparing tenders.

2. Objective, scope and description of the contract

Study investigating the safety of hydrogen as fuel on ships

EMSA intends to conclude a contract for the provision of a study. The study shall:

- Address the characterization of hydrogen as fuel (see Task 1);
- Develop a functional risk assessment for equipment and systems (Task 2) and a risk assessment for selected ships' designs (see Task 3 and Task 4);
- Develop, on the basis of the findings of Task 1 to Task 4 a goal-based guidance for hydrogen as fuel (Task 5) and the final report (see Task 6).

[1] Regulation (EC) No 1406/2002 of the European Parliament and of the Council of 27 June 2002 establishing a European Maritime Safety Agency (OJ L 208, 5.8.2002, p.1.).
[2] Which can be found at http://emsa.europa.eu/about/environmental.html

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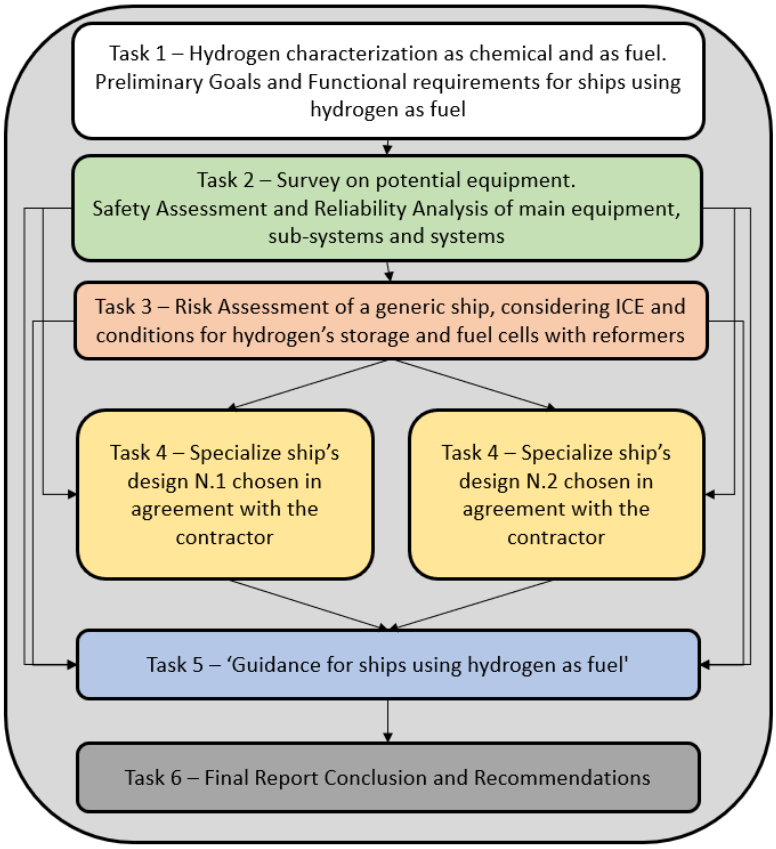
Study logic



The European Green deal[3], Fit for 55[4], and the IMO Strategy[5] put alternative sources of power at the epicentre of the international efforts towards the "greening" of the maritime sector, with the relevance of alternative fuels and power systems for ships constantly increasing. The progressive replacement of the traditional fuels, e.g., heavy fuel oil and marine diesel oil, will have a substantial impact on the way ships are designed and operated and will generate new safety concerns that should be tackled in a consistent and harmonized way across the industry.

The notion that environmental progresses shall not occur at the expenses of safety, is well understood and accepted. However, as matter of fact, some of the greener options that industry is exploring to reduce the green-house gases (GHG) includes the use of energy carriers that pose serious risk for their use on board of ships such as hydrogen.

In this context the role of maritime stakeholders as a whole and of the regulators, is to proof that the technologies are fit for purpose and do not cause threats to the human life, health, and environment, nor to

[3] COM/2019/640 final communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - The European Green Deal.
[4] COM/2021/550 final communication from the Commission to the European Parliament, the European Council, the Council, the European Economic and Social Committee and the Committee of the Regions - 'Fit for 55': delivering the EU's 2030 Climate Target on the way to climate neutrality.
[5] Resolution MEPC.377(80)-2023, IMO strategy for reduction of GHG emissions from ships

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the safety of assets (ships) and to establish clear rules for the safe implementation and deployment of such technologies.

In that respect safety assessment methodologies and reliability analysis[6] will need to be applied at the early stage in the design stage to ensure that the design intent and operational parameters are met as expected. Such safety and reliability assessment methodologies consistently applied to new designs and technical solutions should constitute the basis for drawing up a preliminary set of harmonized rules and progressively reduce the use of dedicated safety assessment across the industry to rely on such harmonised and tested rules.

For the case of the use of hydrogen as fuel, the process briefly described above is developing and the available knowledge for application in the maritime sector is limited, or available from other engineering sectors, and safety and reliability beliefs are mostly built on conjectures on how designs should perform. Given the threat that hydrogen poses to safety, the efforts towards a safe implementation of these new technical solutions shall be ever reinforced. Traditional safety assessment techniques may need to be adapted to cater for the lack of statistical data; this issue poses additional challenges in the overall safety assessment of the technologies.

For these reasons, the contract resulting from this procurement procedure shall assist in these efforts with a view to carry out a structured set of safety assessment and reliability analysis, delivering a guidance addressing ships using hydrogen as fuel to assist the industry and the regulators towards a safe and harmonized deployment of this relevant technology that could demonstrate an important step towards decarbonization of the sector.

2.1 Background

The policy framework for the reduction of GHG is setting ambitious and clear goals to be implemented in a timeline that should bring the European Union to become net-zero emissions by 2050. To achieve such target and early put the emissions on a clear reduction path, new energy carriers (fuels) and new energy converters (engines/fuel cells/batteries) shall be devised, designed, tested and safely implemented in commercial shipping to give the maritime sector the instruments fit to match the targets.

In this context, the present contract shall serve as ground-breaking work to lay down the basis for a safe design and use of hydrogen as fuel, providing for methodologies, safety assessment, reliability analysis and a technical guidance document, so that a certain degree of harmonisation across the industry can take place.

Aerospace industry and process engineering have already considerable experience, knowledge and safety track records on the production, storage, and use of pure hydrogen; in these industries technologies and safety related methodologies are mature, daily implemented based on an existing regulatory and normative work.

In the maritime sector, experience in managing hydrogen as cargo has also been developed (ref. to various IMO codes, resolutions, circulars such as Res.MSC.420(97), and industry standards), while research, technical implementation, pre-normative and regulatory has started to make possible the safe deployment of hydrogen. To this end, several industrial initiatives are being developed from the research stage at low Technology Readiness Level (TRL), up to the deployment phase for the introduction of Internal Combustion Engines (ICEs) and fuel cells able to safely consume hydrogen fuel. Next to these key technical

[6] In this tender the term safety assessment and reliability analysis are mainly referred to equipment and systems, while risk assessment (which includes hazard identification and risk analysis) is mainly referred to risk analysis principles as provided in the IMO guidelines for Formal Safety Assessment.

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developments, the normative and regulatory efforts are also taking place at international (IMO), national and industry levels with a series of initiatives putting forward preliminary classification rules, guidelines, and methodologies for the implementation.

The Tenderer shall take into consideration the following information/documents/initiatives while formulating the technical proposal:

The European Commission, in Horizon 2020 and Horizon Europe, funded several research projects (such as eSHyIPS, H2ENGINE, HERCULES-1-2, HYMETHSHIP, HYSEAS III, HYSHIP, MARANDA, and others), exploring the use of hydrogen as fuel addressing the development of a full-scale demonstrators based for use in commercial vessels.

The IMO Sub-Committee on Carriage of Cargoes and Containers (CCC) is developing, as part of the IGF Code, amendments and guidelines for low-flashpoint fuels and guidance for the safe use of hydrogen as fuel. The most recent results achieved on the development of Interim Guidelines for Ships Using Hydrogen as fuel at CCC 9 and the consequent work of the IMO (MSC and CCC) shall be taken into consideration, in its up-to-date version at the moment of the submission of the Tender.

For the purpose of this call for tenders, it is also relevant the EMSA study 'Use of fuel cells in shipping'[7] as well as the 'Interim Guidelines for Ships Using Fuel Cells Power Installations' (MSC.1/Circ.1647) that should be considered in the development of the proposal.

EMSA Study 'Potential of Hydrogen as a Fuel for Shipping' as it becomes available during the Tendering process.

Furthermore, the following technical documents and standards should also be considered as appropriate:

- NASA-STD-6001B: "Hydrogen Piping and Pipelines
- NASA-STD-8719.24: "Hydrogen Systems"
- NASA-STD-6016: "Materials Selection for Space Systems"
- NASA-STD-5009: "Safety Standard for Explosive Devices"
- ISO 14687, ISO 19880, CGA G-5, IEC 62282, NFPA 2
- ISO/TR 15916:2015 Basic considerations for the safety of hydrogen systems

Major classification societies have already issued guidance, tentative rules, rules, for the verification and certification of ships using hydrogen as fuel, largely based on safety assessment techniques, and drawn up in the form of goal-based standards that shall also be taken into consideration.

2.2 Study Logic

The study logic is the following:

- Characterization of chemical-physical properties of hydrogen and its storage, with explanations why and how each of the chemical-physical properties may impact on the safety of technical arrangements (such as embrittlement, para-to-ortho conversion, flammability, etc…).
- Review of available rules/regulations and best practices, preliminary considerations on a Guidance for the safety of ships using hydrogen as fuel.

[7] Latest News - EMSA Study on the use of Fuel Cells in Shipping - EMSA - European Maritime Safety Agency (europa.eu)

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- Safety assessment and reliability analysis of some specific equipment, systems and system of systems.
- Safety assessment of a generic ship design to assess the basic systems and components.
- Safety assessment of two specific designs/ship types to account for specialized technical solutions.
- Building on the results of the previous steps, draw-up a goal-based Guidance for ships using hydrogen as fuel.

More specifically:

1. The scope of the contract is to draw-up goals, functional requirements, detailed requirements and verification of compliance for ships using hydrogen as fuel (GBS TIER IV[8]), also taking into consideration the on-going work at the IMO CCC sub-committee[9].

2. The goals, functional, detailed and verification for compliance requirements shall be drawn-up on the basis of the safety assessment methodologies as carried out in this study and taking into account the results achieved at the IMO sub-committee CCC at the time of the call for tenders' publication and to the extent possible the updates that may become available during the execution of the contract.

3. The safety assessment and reliability analysis shall be executed on components, equipment, generic systems, system of systems, generic ship and specific ships' configurations as specified further in the tender specifications (as specified in the relevant Tasks).

4. Reliability analysis is a relevant step for systems using hydrogen as fuel, since a machinery, equipment or system failure will pose a serious threat to the safety of life, to the ship and to the environment. Various methodologies can be used for this analysis upon the choice of the Tenderer, as further specified in the Tasks description.

5. The safety assessment methodologies concerning equipment, systems and system of systems will be proposed and motivated by the Tenderer (based on the most common relevant standards, also as specified in the Tasks), while for the generic ship and specific ship designs the safety assessment will be based on one of the methodologies contained in MSC-MEPC.2/Circ.12/Rev.2, upon choice of the Tenderer (as further specified in the Task).

6. Upon the results of the safety assessments and the reliability analysis, the Contractor, shall draw-up a guidance document for ships using hydrogen as fuel containing the goals, functional, detailed requirements, and verification for compliance requirements. The Contractor shall also provide for a clear concise analysis of the regulatory gaps in terms of rules and standards, eventually identified.

For reliability analysis of equipment and simple systems or sub-systems, Fault Tree Analysis (FTA), Failure Modes and Effects Analysis (FMEA), Failure Modes, Effects, and Criticality Analysis (FMECA), fuzzy-based FMECA, Probabilistic Machinery Reliability Assessment (PMRA), or combination thereof may be considered. Relevant standards that can be considered are specified in the Tasks.

[8] Ref. to IMO MSC.1/Circ.1394/Rev.2
[9] Ref. to IMO CCC 8/WP.3 Annex 3

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For the risk assessment, appropriate methods, such as Hazard Identification (HazID), Hazard and Operability Study (HAZOP), FMEA, Structured What-If Technique (SWIFT) etc., should be carried out taking into account IEC/ISO 31010:2019 "Risk management -– Risk assessment techniques", EN ISO 17776:2002 'Petroleum and natural gas industries - Offshore production installations - Guidelines on tools and techniques for hazard identification and risk assessment, as further specified in the Tasks' and IMO MSC-MEPC.2/Circ.12/Rev.2.

The following shall be considered:

1. Hydrogen storage in compressed, cryogenic or stored in both forms.
2. Hydrogen molecules from reforming of hydrogen carriers chemicals, such as ammonia, methanol, LNG and others.
3. Use of hydrogen molecules in internal combustion engine, dual-fuel engine, reformers, fuel cells, engine room and machinery spaces;
4. Onboard fuel bunkering of hydrogen (shore-to-ship, ship-to-ship interfaces), fuel containment and fuel supply systems (includes vapour/pressure system);
5. Dispersion analysis;
6. Venting and ventilation systems;
7. Generic hydrogen fuelled vessel with cryogenic hydrogen storage, fuel containment system on deck and in enclosed spaces for new built and retrofitted ship;
8. Generic hydrogen fuelled vessel with hydrogen in pressure vessels with fuel containment system on deck and in and in enclosed spaces;
9. Generic hydrogen fuelled vessel in alternative of point 7 or point 8 with hydrogen storage as combination of below zero temperature and in pressure vessels;
10. For the generic vessel in each of the configurations specified in 7, 8, and 9, consider as prime mover an ICE.
11. Generic hydrogen fuel cells ship (of the most common type installed on board of ships to date) with hydrogen from reformers carried by an energy carrier.
12. Specialize two of the combinations above for a specific ship's design to be chosen in agreement with the contracting authority.

However, upon choice of the Tenderer, additional equipment, systems, system of systems, general ship's arrangements can be proposed for the purpose of the specific Task. The proposals concerning the methodology on how to address the abovementioned listed systems, will be evaluated under the evaluation criteria (Quality Criteria Q1, Q2 and Q3).

Main systems, systems of system and the combination thereof where relevant, to be considered in the safety assessments, should be at least:

- Power generation, internal combustion engines and exhaust after treatment systems, fuel cells,
- Materials for fuel tanks, piping and secondary enclosures,
- Ship arrangements for machinery spaces, fuel systems, fuel preparation room, tank and connection spaces, storage spaces, on-board bunkering stations, valve spaces, air locks,
- Fuel containment system, design, tank's arrangements including secondary barriers, liquid gas tanks, structure, equipment, insulation, support, materials and integrity, location of the fuel tanks,
- Venting and ventilation system,
- Piping and valves,
- Purging,

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- Dewar ullage if applicable,
- Boil-off,
- Pressure relief systems, pressure valves,
- Fuel bunkering system (with regard to bunkering, ISO/TC 18683 may be taken into consideration for the purpose of the risk assessment foreseen in the Tasks),
- Nitrogen system,
- Exhaust system,
- Electrical systems,
- Control and monitoring systems,
- Hydrogen detection,
- Fire detection, and
- Fail safe design features.

Themes / Hazards (these hazards shall be considered in particular for the risk-analysis in Task 2 and Task 3):

- Embrittlement,
- Ortho-to-para conversion,
- Temperature compatibility,
- Adiabatic compression,
- Diffusion and permeation,
- Condensation,
- Flammability,
- Explosion,
- Deflagration,
- Detonation,
- Dispersion of the hydrogen in the ship's spaces for explosion analysis,
- Reactivity, and
- Fire safety.

Horizontal issues to be considered in the safety assessments across all Tasks but in particular in Task 2 and Task 3:

- Materials:
    - Elastomers for cryogenic or high-pressure applications
    - Metals for cryogenic or high-pressure applications
    - Other sealants for cryogenic or high-pressure applications

The International System of Units (SI) shall be used to provide for the units of the physical quantities.
Same physical quantities shall be presented always in the same units.

Note: With reference to the IMO Guidelines for Formal Safety Assessment, only the Hazard Identification and Risk Assessment - Step 1 and Step 2 - will have to be developed, while Step 3 and 4 will not be carried out. (see figure below).

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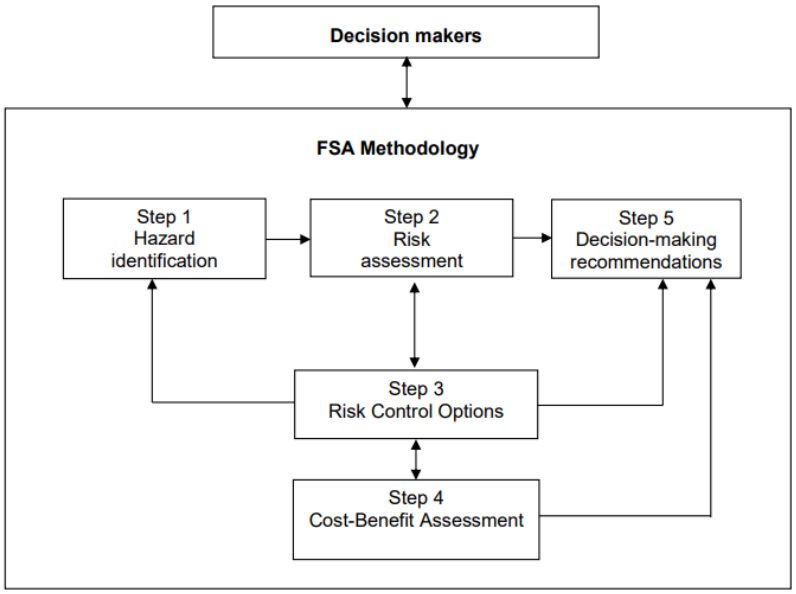

2.3 Generalities

This study is limited to the assessment of the safety for passengers, personnel onboard, third parties and of the ship. The environmental effect from normal operation of hydrogen fuelled vessels as well as environmental damage related to bunkering spills or risks arising from the carriage of chemicals used as hydrogen carriers such as methanol, ammonia, LNG and others are not part of the scope of work. The analysis of the risks concerning chemical hydrogen carriers shall be limited to the risks arising from the reforming process.

2.4 Task 1 – Hydrogen, equipment and their functions

2.4.1 Objective and scope

Task 1.1 *Hydrogen characteristics, safety and protection of life*

In this sub-Task the Contractor shall frame the main characteristics of hydrogen as chemical substance and as marine fuel, analysing the main safety issues:

1. Hazards: chemical-physical and thermal behaviour including flammability and explosions (deflagration and detonation) risks.
2. Risks: to human life (such as asphyxiation, burns, frostbite, hypothermia), equipment, facilities and processes, including medical emergencies.
3. Threats: fire, pressure, release, reactivity, flammability, and explosions.
4. Conditions and methods for safe bunkering and on-board use.

A brief hydrogen accident review (on-land plants, aerospace applications, process engineering, etc.) and status of the regulatory international framework shall be included in this Task.

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Furthermore, considerations on working conditions, effects on human health, safety to life, effect of accidental release event shall be characterized by using and comparing national, regional and global requirements and indications, as well as considering best industries practices.

Data shall be presented in a harmonized way (i.e. same SI units).

Review and assessment of the Personal Protective Equipment (PPE) for ordinary and emergency working conditions shall be carried out. Relevant medical emergencies shall be considered and assessed against the use of PPE.

- NASA-STD-6001B: "Hydrogen Piping and Pipelines
- NASA-STD-8719.24: "Hydrogen Systems"
- NASA-STD-6016: "Materials Selection for Space Systems"
- NASA-STD-5009: "Safety Standard for Explosive Devices"
- ISO 14687, ISO 19880, CGA G-5, IEC 62282, NFPA 2.

Task 1.2 *Preliminary Goals and Functional Requirements*

a. In this sub-Task review and comparisons of existing industry practices, verification and certification rules, national and international rules (with particular regard to the IMO work on hydrogen and fuel cells Guidelines), shall be presented and compared. Review of the applicable relevant standards shall also be provided.

b. Drawing on this information the contractor, by using the IMO Hydrogen Guidelines, shall draw-up preliminary reviewed Table of Contents, Goals and Functional Requirements.

2.4.2 Description

for Task 1.1

In this sub-task the hazards of hydrogen substance and when used as a fuel shall be analysed. Because of limited experience of the use of hydrogen as fuel on-board of ships, thorough consideration should be given to best practices, standards, rules and regulations applicable on land-based and aerospace applications.

Hydrogen as chemical substance related hazards shall be identified and analysed based on existing applicable regulations and laws implemented at national, regional and global level, with particular regard to hazards to human life and to the ship (as specified in 2.2 and 2.4).

Physical, thermodynamic and combustion properties related hazards shall be analysed and put in relation with the expected use of hydrogen as fuel. Chemical-physical hydrogen properties shall be compared with other fuels such as LNG for reference.

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Specific critical chemical-physical conditions (in terms of concentration, temperature, pressure, contaminants) shall be devised and analysed in relation to the foreseen use in specific ship's spaces (such as fuel preparation room, engine room, fuel cells space etc.).

for Task 1.2

A review of industrial best practices, certification/classification rules, national and international rules and regulation shall be carried out, with a view to identifying common provisions, differences and eventual gaps for application in the maritime sector.

A preliminary review of available applicable standards shall also be provided. The standards shall be analysed in respect to their foreseeable application on-board of hydrogen fuelled ships, identifying relevant parts of the standards in relation to the specific application on board.

Of relevance, would be to frame the use, methodologies, reliability of the results of the explosion (fire – detonation – deflagration) analysis, also by doing an analysis of scope and limitations of the most common modelling techniques and tools in use in industrial sectors dealing already with hydrogen as chemical.

Building on these abovementioned reviews, a preliminary table of contents of the Guidance addressing ships using hydrogen as fuel shall be provided and built on the on-going work at the IMO CCC sub-committee. For each chapter and intended regulations, hazards, goals, and functional requirements shall be provided. This preliminary skeleton of the guidance (built on the IMO-CCC results) with the goals and functional requirements shall be used as basis for the safety and reliability assessment and at the same time tested and validated against the work that will be carried out in the next Tasks.

The preliminary skeleton of the guidance shall also contain elements addressing bunkering.

2.4.3 Deliverables

D.1 Deliverable 1 shall contain:

- the analysis findings, regulatory gaps and recommendations in relation to hydrogen as fuel and physical-chemical properties related hazards when used as fuel on board of ships, including the review of the suitable PPEs and relevant existing bunkering guidance

- the comparative analysis of the existing best practices, standards, rules and regulations and the reviewed Table of Contents of the draft IMO Guidance on hydrogen used as fuel on board of ships. including hazards, goals and functional requirements for each intended chapter and relevant provisions.

Evaluation Elements (see also Section 16 Awards Criteria)

The overall description of how the tenderer proposes to execute the Task 1, in respect of the matter at stake, intended sources that will be used, hazards considered and how such hazards are mitigated in the existing rules and regulations, will be evaluated under Quality Criterion Q1.

The preliminary structure/table of contents of the Deliverable shall be submitted by the Tenderer and shall be included in the Technical Offer and subject to evaluation as part of the technical proposal (Quality Criterion 1).

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2.5 Task 2 – Safety assessment and reliability analysis of main components, equipment, sub-systems and systems

2.5.1 Objective and scope

Task 2.1 Review and assessment of the potential and candidate equipment to be used in the systems of a hydrogen fuelled ship and presenting equipment taxonomy, data, attributes, failure data and maintenance data.

Task 2.2 Carry on a safety-assessment and reliability analysis of the main equipment main systems and sub-systems that will be in use on a hydrogen fuelled ship.
The safety assessment and the quantitative reliability analysis shall include main equipment/system/sub-system of a ship using hydrogen a marine fuel such as:

(1) Hydrogen storage system including boil-off management,
(2) Internal combustion engine,
(3) Fuel cells and reformers
(4) Space where the consumers are installed,
(5) Fuel supply and return system,
(6) Ventilation,
(7) Exhaust Gas systems, and
(8) Bunkering system.

2.5.2 Description

for Task 2.1

A preliminarily review of candidate components/equipment/systems to be used in the design of the systems for a hydrogen fuelled ship shall be conducted.

Equipment specifically designed for use on board of hydrogen fuelled ships, equipment repurposed from process, land-based and aerospace applications, or generic suitable relevant equipment should be identified and their main characteristic in terms of functions, materials, reliability data and classification shall be presented.

The most relevant and safety critical equipment/systems shall be selected for the analysis among those which failure may cause serious threat to human life, health and to the safety of the ship.

Elements/equipment/sub-systems such as, but not limited to, materials, sealants, high-pressure pumps, valves, relief valves, piping, et *al*., shall be considered in the analysis that shall include equipment taxonomy, general data, attributes, failure and maintenance data.

The information for the various relevant equipment shall be presented in a harmonised way including details, designs, schemes, data sheets, provided for the analysis of the equipment, systems and systems of systems, proposals, justifications, identification of the critical equipment, systems and systems of systems. The Tenderer shall provide considerations on a preliminary list of relevant equipment and examples the format of the information that will be presented.

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for Task 2.2

Main hazards such as fire, overpressure, release, reactivity, sealants and elastomer behaviour at cryogenic temperatures, explosion, deflagration and detonation, materials resistance, embrittlement, and any other threats shall be considered in the analysis in relation to the intended design and operative conditions of the specific equipment.

The choice of the specific safety assessment and reliability analysis methodologies for this Task at equipment, sub-systems, system level, shall be explained and motivated in the submission by the Tenderer based on the equipment functions and technical characteristics of the equipment and its components.

a. Reliability analysis is a relevant step for systems using hydrogen fuel, as machinery, equipment or components failure will pose a serious threat to the safety of life and human health and to the safety of the ship. Because of the limited experience existing respect to equipment and systems using hydrogen as fuel, the analysis shall be carried out preferably by considering equipment, systems their performances and testing requirements as stemming from other similar applications (land-based process engineering, refrigeration, hydrogen production, etc.). Therefore, both generic reliability (average) data or specific data can be used in the analysis. For the reliability analysis several standards[10] can be used as guidance, upon choice of the Tenderer as appropriate.
For the reliability analysis relevant databases can be used to source the reliability data.

   Relevant performance-based standards such as IEC 61508 'Functional safety of electrical/electronic/programmable electronic safety-related systems', IEC 61511 'Functional safety - Safety instrumented systems for the process industry sector', IEC62061 Safety of machinery - Functional safety of safety-related control systems, can be used as guidance where relevant for the concerned systems. In this frame performance levels and/or safety integrity level may be applicable to hydrogen related technical solutions.

b. The reliability analysis is the basis of the safety assessment carried out at least on the main equipment systems and sub-systems as specified above in this Task.2.

   For this Task the safety assessment methodology shall be proposed by Tenderer in the submission phase on the basis of the abovementioned methodologies and taking into account methods foreseen in IEC/ISO 31010:2019 "Risk management -– Risk assessment techniques" and more specifically in ISO 12100:2010 **"**Safety of machinery — General principles for design — Risk assessment and risk

[10] Standards related to reliability analysis that can be considered:

- ISO 13849-1, *Safety of machinery — Safety-related parts of control systems — Part 1: General principles for design*.
- ISO 13849-2, *Safety of machinery – Safety-related parts of control systems — Part 2: Validation*
- ISO 14224:2016 Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment,
- ISO/TR 12489:2013 Petroleum, petrochemical and natural gas industries — Reliability modelling and calculation of safety systems
- ISO 2394:2015 General principles on reliability for structures
- MIL-STD-785B. Military Standard: Reliability program for systems and equipment development and production.

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reduction", EN ISO 17776:2002 Petroleum and natural gas industries - Offshore production installations - Guidelines on tools and techniques for hazard identification and risk assessment, ISO 14224:2016 Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment, or IMO MSC-MEPC.2/Circ.12/Rev.2.

2.5.3 Deliverables

D.2 – Deliverable 2 contains the results of the components/equipment/system review, the safety assessment and reliability analysis for the equipment/systems identified.

Evaluation Elements (see also Section 16 Awards Criteria)

The overall description of how the tenderer proposes to perform the Task 2, in respect to the matter at stake, intended sources that will be used, details, designs, schemes, data sheets, provided for the analysis of the equipment, systems and systems of systems, proposals, justifications, identification of the critical equipment, systems and systems of systems, on which standards the reliability analysis will be carried out, will be evaluated under Quality Criterion Q2.

The preliminary structure/table of contents of the Deliverable shall be included, by the Tenderer, in the Technical Offer and subject to evaluation as part of the technical proposal (Quality Criterion Q2).

2.6 Task 3 – Risk Assessment of a generic ship design

2.6.1 Objective and scope

On the basis of the results of Tasks 1 and 2, carry on a hazard identification and risk analysis for a generic ship in the 3 hydrogen storage type combinations chosen below, by using FSA Guidelines (MSC-MEPC.2/Circ.12/Rev.2) and IEC/ISO 31010:2019 "Risk management – Risk assessment techniques".

The generic ship design shall be discussed and agreed with the Contractor before Task 3 starts to define the ship's concept of operations. The hazard identification shall be performed for the generic ship in the three hydrogen storage type combinations chosen as detailed below.

The analysis may use a generic ship design for which only the spaces relevant to the fuel systems (covering the process of bunkering point to exhaust) and energy converter are considered regardless the mission of the ship. For fuels cells installations, the analysis should consider from the reforming of the hydrogen carrier to the consumption of hydrogen in the fuels cells (of course in this case bunkering and storing is not part of the analysis).

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Two out of the following combinations of hydrogen storage type shall be analysed:

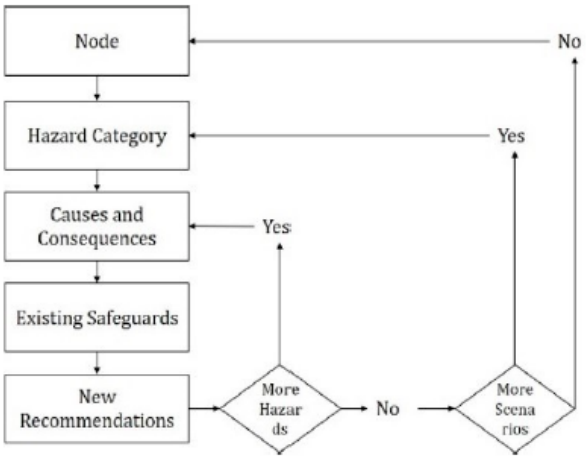
Hydrogen storage type	Storage location onboard	
Cryogenic liquefied hydrogen w/ fuel containment system	On deck	Enclosed spaces
Hydrogen in pressure vessels w/ fuel containment system	On deck	Enclosed spaces
Hydrogen storage below zero temperature and pressure vessels w/ fuel containment system	On deck	Enclosed spaces

In addition, reforming of a hydrogen carrier for use in fuel cells, with reforming system and fuel cells installation shall be analysed.

The reliability analysis and the safety assessment carried out at equipment/sub-system/system level in Task 2 constitutes the basis for the work in this Task 3.

2.6.2 Task 3.1 Hazard Identification

A HazID is a structured approach where documentation/drawings and a set of guidewords form basis for a structured brainstorming for identifying hazards involved with an operation or the use of equipment and/or systems. HazID's are commonly used throughout the industry for all types of safety and risk assessments.



HazID Methodology

The HazID shall be performed by following the key steps:

1. Groundwork to gather all relevant information about the subject of the HazID and conduct a preliminary risk-assessment if necessary
2. Drawing up the Terms of Reference for the HazID which shall contain at least objectives, scope, nodes, methodology and workshops details
3. Executing Workshop sessions,
4. Reporting of the work containing the key recommendations and risk reduction measures.

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The workshop is performed by a group of professionals who are familiar with the design and operation, working under the guidance of a facilitator who is experienced in the use of HazID methodology. To ensure comprehensive identification of hazards, the brainstorming session relies on experienced personnel.

Main goals of the workshop are:

A. Identifying potential hazards that shall be addressed and further analysed in the risk analysis.
B. Provide input to external communication from the project clearly describing how potential risks should be identified and addressed.

At least the following experts shall be participating to the HazID workshop:

C. HazID study Leader and facilitator
D. HazID study Team composed of at least, but not limited to, the following experts:
    - Toxicologist/chemist
    - Internal Combustion Engine designer/expert with specific experience in hydrogen
    - Fuel cells and reforming technologies expert
    - Materials for reactive chemical
    - Ship's designer and integrator
    - Fire safety
    - Hydrogen plant system designer
E. HazID study Scribe

EMSA will be invited as observer (not as part of the HazID team).

Hazards scenarios on the generic fuel system and gas engines encompassing the following sequence of operations during the vessel's lifecycle, shall be considered:

- Construction/installation incl. testing and sea trials
- Operations
    - Loading/offloading of passengers and cargo
    - Voyage
    - Bunkering process (ship-to-ship, shore-to-ship, barge-to-ship)
    - Docking
    - Maintenance
    - Lay-up/Idle

The HazID shall take into duly consideration the information of Task 1 and 2 in terms of:

F. Information on hydrogen's chemical-physical and thermal behaviour including deflagration and detonation risks and risks to human life in relation to specific ship's spaces and to the functions of the systems contained.
G. Preliminary hazards, goals and functional requirements.
H. Information in relation to the reliability analysis carried out on the equipment and systems.

The HazID study covers the following areas (as applicable):

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- General arrangement of vessels.
- Hydrogen fuel-storage arrangement and details .
- Hydrogen fuel supply and vapour-handling system, from fuel storage to machinery space.
- Hydrogen fuel arrangement in fuel handling room and engine room.
- General arrangement of the fuel-handling and engine rooms, including their ventilation.
- Main engine safety concepts and vessel integration.
- Reforming and fuels cells arrangements.
- Hazardous area classification plans.
- Ventilation and vents for stored hydrogen fuel, fuel-supply system, machinery space and consumer.
- Hydrogen fuel-bunkering arrangement.
- Safety systems.
- Gas detection and firefighting arrangement .
- Hydrogen purging or inerting arrangements.
- Cargo storage and its impact.
- Bunkering.
- Emergency escape and rescue.

Hazards Guidewords/Check-list that can be considered as preliminary basis for the HazID workshop include the following:

- Fire, explosion, detonation, deflagration hazards
- Fire/explosion – hydrogen initiated
- Fire/explosion – not hydrogen initiated
- Fuel release
- Other hazards generated by materials and substances
- Leakage of liquid hydrogen causing loss of structural integrity
- Mechanical hazards
- Electrical hazards
- Thermal hazards
- Hazards generated by malfunctions
- Collisions
- Dropped objects
- Grounding
- Foundering
- Environmental hazards
- Occupational accidents
- Hazards generated by neglecting ergonomic principles
- Hazards generated by erroneous human intervention
- Hazards specific to bunkering operations

2.6.3 Task 3.2 Risk Analysis

The risk analysis shall be carried out by using FSA Guidelines (IMO MSC-MEPC.2/Circ.12/Rev.2), FSA Step 2. Risks to the (1) human life and to (2) the ship shall be considered (while risks to (3) the environment will not be addressed).

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'*The purpose of the risk analysis in Step 2 (of the IMO MSC-MEPC.2/Circ.12/Rev.1) is a detailed investigation of the causes and initiating events and consequences of the more important accident scenarios identified in step 1. This can be achieved by the use of suitable techniques that model the risk. This allows attention to be focused upon high-risk areas and to identify and evaluate the factors which influence the level of risk*.'

However, because the technology at stake is in its infancy, the level of failure data available is limited and because quantitative risk analysis (e.g. societal risk) notions build on statistics and pre-existing knowledge, different methods/notions could be devised and duly explained in the submission by the Tenderer for evaluation of the quality of the proposal. Risk mitigation, reliability analysis and redundancy of systems shall be embedded in the methodology.

A. Regardless which risk analysis methodology will be proposed by the Tenderer for the generic ship design, the risks emerging from the HazID step shall be analysed, as well as the results of Task 2 shall be taken into consideration when carrying out the risk analysis. Risks such as fire risks in relation to the configuration of the tanks on the ship, explosion, and fire risks in relation to impact or penetration of the tanks either in BLEVE conditions or not, fire and explosion in the fuel preparation room, piping on open decks and inside the ship's structure, explosion in relation to poor ventilation, vapour condensation and unvoluntary releases, shall be considered.

B. Furthermore, the Contractor shall gather statistics of incidents and accidents, release accidents, (including occupational accidents) from land-based chemical and processing industries dealing with hydrogen, on the basis of the results of Task 1 and taking into account the analysis carried out in Task 2 and Task 3.

C. In case a quantitative risk analysis is carried out, frequency assessment, consequences assessment and risk calculation, within a specifically devised risk-model shall be carried out following the intent of the FSA Guidelines Step 2 (MSC-MEPC.2/Circ.12/Rev.2) as specified in Appendix 3 and further in Appendix 5 of the said Guidelines.

    - The frequency assessment shall be based on available incidents and accidents statistics. Databases such as GISIS, EMCIP, IHS Markit and other commercial sources of information shall be used. Specific considerations shall be given to applications for which the use of hydrogen is already implemented on board (such as for fuel cells and refrigeration equipment), hydrogen and fertilizers carriers, by conducting a specific survey to gather additional information (additional respect to the information available in the abovementioned databases) on incidents, accidents, including release accidents and occupational accidents.

    - Risk calculation shall be based on the hazards scenarios previously identified, based on consequences assessment built on statistics, available technical information and relevant experts judgment. Consequences for the safety of human life and health shall be duly considered also by using experts in this domain.

D. Regardless which risk analysis approaches have been followed, the risk analysis shall also include recommendations and mitigation measures (as necessary) for the identified risks. In relation to the toxicity, odour thresholds and cumulated effects on the human health the analysis carried out in Task

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1, shall be taken into account, while formulating the recommendations and mitigation measures. Particular attention should be given to the manning of the equipment and the use of PPE in relation to the identified hazards and risk scenarios.

E. Risk analysis will not include cost-benefit analysis (Step 4 in the FSA Guidelines - (MSC-MEPC.2/Circ.12/Rev.2)).

2.6.4 Deliverables

D.3.1 - Deliverable 3.1 contains the detailed results of HazID and its key findings for the generic ship.

D.3.2 - Deliverable 3.2 contains the results of the risk analysis and its key findings.

Evaluation Elements (see also Section 16 Awards Criteria)

The overall description of how the tenderer proposes to perform the Task 3, in respect of the matter at stake, intended sources that will be used, details on how the risk analysis will be performed and which sources of information will be used, will be evaluated under Quality Criterion Q3.

The preliminary structure/table of contents of the Deliverables shall be included in the Technical Offer and subject to evaluation as part of the technical proposal (Quality Criterion Q3).

2.7 Task 4 – Risk Assessment of two specific ship's configurations

2.7.1 Objective and scope

In this Task, hazard identification and risk analysis for two specific ship types by using FSA Guidelines (MSC-MEPC.2/Circ.12/Rev.2) shall be carried out on the basis of the same methodology applied in Task 3 for the generic ship using the same hydrogen storage type and considering the results of Task 1 and 2.

Each ship type will have to be analysed in only one of the hydrogen storage type combinations analysed in Task 3. The combination of ship type and hydrogen storage type will have to be agreed with the Contractor on the basis of the results of Task 1 to Task 3. Preliminary proposals on which ship types should be considered in the analysis, shall be made by the Tenderer for the purpose of evaluation of the Tender.

On the basis of the above, the Contractor shall draw-up a safety assessment for the specific ship types specifying the differences with the generic ship type on design, equipment, systems and general arrangement, also by identifying the systems' boundaries and interfaces with those analysed for the generic ship.

The hazard analysis of this task builds on the results of the HazID conducted in Task 3 by using a simplified set-up sufficient to address the differential hazards and risk in relation to the specific ship types. The Tenderer shall explain how this hazard analysis will be carried out.

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2.7.2 Description

For the purpose of this task, the risk analysis shall be adjusted to address hazards and risks related to the specific ship's configuration chosen. For this ship type/configuration, occupational incidents and accidents shall be introduced in the scenarios. Information, data, safety practices also not related to the shipping sector shall be considered (especially in the risk mitigation).

The general arrangements of the ship design shall be presented by the Contractor.

Hazards such as cargo handling with respect to dropping of objects for on-deck tanks, piping purging for certain type of arrangements such as on-deck tanks, ventilation, dispersion, and discharge in general and close to accommodation spaces and manned spaces, dispersion, and fire analysis in relation to exposure of life-saving appliances, shall be considered in the risk assessment as appropriate.

In the hazard and risk analysis specific considerations shall be given to the mitigation measures (risk control measures) of the of the identified hazards and consequential risks.

2.7.3 Deliverables

D.4 - Deliverable 4 contains the hazards analysis and risk assessment on two chosen ship's configurations

Evaluation Elements (see also Section 16 Awards Criteria)

The overall description of how the tenderer proposes to perform the Task 4, in respect of the matter at stake, intended sources that will be used, details on how the risk analysis will be performed and which sources of information will be used, will be evaluated under Quality Criterion Q3.

The preliminary structure/ table of contents of the Deliverable shall be included, by the Tenderer, in the Technical Offer and subject to evaluation as part of the technical proposal (Quality Criterion Q3).

2.8 Task 5 – Guidance for ships using hydrogen as marine fuel

2.8.1 Objective and scope

On the basis of the analysis performed in Task 1 (rules and regulation comparisons, preliminary table of contents, goals and functional requirements), the results of Tasks 2, 3 and 4, and the available IMO Guidelines for ships using hydrogen as fuel in their up-to-date version, and fuels cells (MSC.1/Circ.1647), the Contractor shall draw-up a goal-based Guidance addressing ships using hydrogen as fuel and reformed hydrogen.

The goal-based Guidance shall cover Tier IV as defined in MSC.1/Circ.1394/Rev.2. and shall identify the provisions for which a specific risk-assessment is required as well as regulatory and standardization gaps.

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2.8.2 Description

The structure

The structure of the Guidance shall follow MSC.1/Circ.1394/Rev.2 up to Tier IV as far as 'IMO requirements' are concerned.

Each Chapter shall be structured in (1) Hazards (2) Tier I - Goals, (3) Tier II - Functional Requirements, (4) Tier III – Verification of conformity, (5) Tier IV - Technical Requirements.

The verification of conformity should clarify how the functional requirements are addressed by detailed requirements.

Furthermore, each Technical Requirement shall be accompanied by a brief justification explaining the reasons why such a technical requirement is needed (e.g. based on the actual status of the technology, experience with other similar equipment or systems, best engineering practices, etc).

For the applicable technical provisions, it shall be specified if a specific risk assessment of the final design is required.

The stakeholder's consultation

The Contractor shall consult the maritime stakeholders on the draft of the Guidance for ships using hydrogen as fuel, with a view to cater for comments and suggestions.

The Contractor shall consult the widest possible groups of relevant stakeholders, including European National administrations, designers, process engineers, chemical and health experts, engine manufacturers, shipyards, operators and classification societies.

After the stakeholder's consultation on the draft of the Guidance, the Contractor shall hold a Workshop (virtually, in presence or hybrid, addressed to maritime stakeholders'), to discuss the draft Guidance and the comments received, with a view to issue a revised version of the Guidance.

2.8.3 Deliverables

Deliverable D.5.1 containing the Goal Based Standard *'Guidance for ships using hydrogen as fuel'*, structured as specified in the previous paragraphs.

Deliverable D.5.2 containing information on regulatory gaps and a proposal for a goal-based structure of a guidance addressing the bunkering process.

Evaluation Elements (see also Section 16 Awards Criteria)

The methodology (timing, groups to be consulted and how) of the stakeholders' consultation and the preliminary structure/table of contents of the Deliverables shall be included, by the Tenderer, in the Technical Offer and subject to evaluation as part of the technical proposal (Quality Criterion Q4).

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2.9 Task 6 – Final report, Guidance, conclusions and recommendations

2.9.1 Objective and scope

In this Task the Final Report containing the Executive Summary, the results obtained in the previous tasks and the Guidance for ships using hydrogen as fuel and recommendations as appropriate.

The Final Report shall be organized in 3 documents as specified in the section below Deliverables.

2.9.2 Deliverables

D.6 – Deliverable D.6 shall be constituted of three parts contained in three separate documents:

PART 1 containing the Executive Summary of the project, and the results of Tasks 1 and 2.

PART 2 containing the results of Tasks 3 and 4.

PART 3 containing the results of Task 5 and on the basis of deliverables D.5.1 and D.5.2 (Guidance for ships using hydrogen as fuel and proposal for a goal-based structure of a *Guidance addressing the bunkering process*), the main Conclusions and Recommendations.

3. Contract management responsible body

EMSA – Unit 2.1, in charge of Safety & Security, will be responsible for managing the contract.

The contractor shall appoint a dedicated contact point who will establish and maintain direct communication with EMSA regarding any technical or contractual issues. Such contact point shall be clearly defined in the tender.

4. Project Planning

4.1 Deliverables and Report

The deliverables and the final report shall respect the layout as provided in Appendix IV.

The deliverables and the final report shall comprise the parts as required in sections 2.4 to 2.9 of these tender specifications. These shall be delivered in electronic form.

These shall be written in clear, concise and correct English. It should be noted that the reports might be submitted to IMO as information papers and shall therefore be drafted accordingly.

The report and the deliverables shall be fully proof checked by the contractor and presented in the style / layout described below.

As regards the editorial features of the report and deliverables, the contractor shall adhere to the following:

A. The text font shall be ‘Arial’; font style regular; size 10.
B. Bold font shall be avoided as far as possible.

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C. The cover sheet of the report can be formatted as per contractor design but shall be subject to approval by EMSA. The rest of the report text shall be delivered in the font as described above.

These shall include:

D. a contents page that links to the relevant sections.
E. a page with the table of contents for the figures and links to the relevant figures.
F. a tables page that links to the relevant tables.
G. an abstract of no more than 200 words and an executive summary of maximum 6 pages.
H. the following standard disclaimer:

"The information and views set out in this study are those of the author(s) and do not necessarily reflect the official opinion of EMSA. EMSA does not guarantee the accuracy of the data included in this study.."

Note: If the submitted deliverables and the final report are not of a standard deemed by EMSA to be sufficient, they will be returned to the contractor with appropriate comments, who will be responsible for their revision or rewriting.

4.2 Meetings

The contractor shall hold a kick-off meeting with EMSA at the beginning of the Contract, at the contracting authority premises (meeting by videoconference can also be accepted). The Contractor is responsible for setting up all logistical aspects, sending out invitations, in compliance with the Timetable in Section 5.

At the completion of each Deliverable the contractor shall organise a meeting, assuming videoconference as default, to present to EMSA, and discuss in detail the results.

At the end of each month of the study (every four weeks starting from the signing of the contract) web-meetings shall be arranged in order to report on the status of the study. If the completion of reports shall coincide, there is no need to hold two separate meetings.

The contractor may be requested to hold a Maritime Stakeholders' Workshop at the completion of the Task 3.

At completion of the study the contractor shall also be called to present the results of the study at:

A. Stakeholders Workshops to present the draft Guidance (this is the same Workshop specified in Task 5).

If during the execution of the contract the need arises, EMSA may request the contractor to present:

B. EMSA Workshop (in Lisbon, presential, one day event).
C. Participation to Experts Groups of the European Commission in Brussels.
D. IMO presentation (in London, presential, one day event, typically pre-lunch-time presentation) during CCC sub-committee or MSC committee meeting.

The contractor shall cover all expenses in relation to these presentations within the price of the provided service.

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5. Timetable

The estimated date for signature of the contract is Q1 of 2024.

The contract is concluded for a period of 24 months.

The Tenderer shall submit with its quotation a project plan, including a timetable with the main milestones corresponding to the deliverables identified, in consistency with the project plan below.

Milestones	Week	Payments
Kick-off Meeting	Week 1	
TASK 1		
Draft Deliverable	Week 5	
Interim Meeting	Week 6	
D.1	Week 7	
Approval process for D.1	Weeks 7 - 11	The contractor may claim an interim payment of 20% of the value of the contract, upon approval of D.1
TASK 2		
Meeting	Week 7	
Draft Deliverable	Week 21	
Interim Meeting	Week 21	
D.2	Week 22	
Approval process for D.2	Weeks 22 - 26	The contractor may claim an interim payment of 25% of the value of the contract, upon approval of D.2
TASK 3		
Meeting	Week 23	
Draft Deliverable	Week 38	
Interim Meeting	Week 39	
D.3.1	Week 40	
Interim Report	Week 38	
Interim Meeting	Week 39	
D.3.2	Week 40	
Approval process for D.3	Weeks 40 - 44	The contractor may claim an interim payment of 25% of the value of the contract, upon approval of D.3
TASK 4		
Meeting on decision on the two specific ship's configurations	Week 41	
Draft Deliverable	Week 55	
Interim Meeting	Week 58	
D.4	Week 60	
Approval process for D.4	Weeks 60-64	

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TASK 5		
Draft Deliverable	Week 70	
Interim Meeting	Week 71	
D.5	Week 75	
TASK 6 - FINAL REPORT		
Draft Final Report	Week 80	
Final Meeting	Week 81	
Final Report	Week 82	
Approval process for Final Report	Weeks 82 - 86	The contractor may claim the balance payment, after full approval of the remaining deliverables

6. Estimated Value of the Contract

The maximum budget available for this contract is EUR 450,000.00 excluding VAT.

7. Terms of payment

Payments shall be issued in accordance with the provisions of the **draft contract** available under the dedicated section of the procurement procedure on the e-Tendering platform at http://simap.ted.europa.eu/ .

8. Terms of contract

When drawing up a tender, the tenderer should bear in mind the terms of the draft contract. The successful tenderer(s) shall take the appropriate measures to be compliant with the e-invoicing conditions as set out in the draft contract.

EMSA may, before the contract is signed cancel the award procedure without the tenderers being entitled to claim any compensation.

9. Financial guarantees

Tenderers shall include in the tender a letter of commitment[11] by a Guarantor (e.g. bank or financial institution) to issue a performance guarantee **in case of award**, according to the template included in the procedure documentation.

The suitability of the Guarantor will be assessed during evaluation of the tenders against the following criteria: the Guarantor's Long-Term credit rating must be above or equal to BBB- (S&P or equivalent) with at least two registered or certified rating agencies (of which at least one should be S&P, Moody's or Fitch) at the time of the submission of the offer.

The signature of the contract with the awarded tenderer(s) will be subject to receipt by EMSA of the performance guarantee.

[11] Please refer to Appendix III to these Tender Specifications "Letter of commitment for performance guarantee".

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Tenderers shall include in the tender the Legal Entity Form of the Guarantor - completed, along with the requested accompanying documentation. This document is available on the Procurement Section (Legal Entity Form) of EMSA's website (www.emsa.europa.eu).

10. Subcontracting

If the tenderer intends to either subcontract part of the work or realise the work in co-operation with other partners it shall indicate in its offer which part will be subcontracted, as well as the name and qualifications of the subcontractor or partner. It should be noted that the overall responsibility for the work remains with the tenderer.

The tenderer must provide required evidence for the exclusion and selection criteria on its own behalf and, when applicable, on behalf of its subcontractors. The evidence for the selection criteria on behalf of subcontractors must be provided where the tenderer relies on the capacities of subcontractors to fulfil selection criteria[12]. The exclusion criteria will be assessed in relation to each economic operator individually. Concerning the selection criteria, the evidence provided will be checked to ensure that the tenderer and its subcontractors as a whole fulfil the criteria. However, the selection criteria may apply individually where it is relevant in view of their nature.

11. Requirements as to the tender

Tenders can be submitted in any of the official languages of the EU. However, as the main working language of the Agency is English, tenders should preferably be submitted in English and should in particular include an English version of the documents requested under points 15.5 and 16 of these Tender Specifications.

The tenderer must comply with the minimum requirements provided for in these Tender Specifications. This includes compliance with applicable obligations under environmental, social and labour law established by Union law, national law and collective agreements or by the international environmental, social and labour law provisions listed in Annex X to Directive 2014/24/EU of the European Parliament and of the Council.[13]

The tenderer shall complete the Tenderer's Checklist.

If the tenderer intends to either subcontract part of the work or realise the work in co-operation with other partners (Joint Offers) it shall indicate it in its offer by completing the form "Statement of Subcontracting / Joint Offer". This document is available on the Procurement Section / Calls for Tenders (Documents for tenderer) of EMSA's website (www.emsa.europa.eu). The role of each entity involved in a tender must be clearly specified in the e-Submission.

12. Submission via the e-Submission application

Tenderers shall submit tenders electronically via e-Submission in one of the official languages of the European Union through the e-Tendering website and before the closing date for the tenders' reception as described in the Invitation to tender.

[12] To rely on the capacities of a subcontractor means that the subcontractor will perform the works or services for which these capacities are required.

[13] Directive 2014/24/EU of the European Parliament and of the Council of 26 February 2014 on public procurement and repealing Directive 2004/18/EC (OJ L 94, 28.3.2014, p. 65).

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The detailed steps on how to access and use e-Submission are provided in Appendix I – *E-Submission Guidelines*, attached to these Tender Specifications.

The tenderer must provide the following information using e-Submission:

A. **Cover letter** indicating the name and position of the person authorised to sign the contract, including up-to-date proof of that authorisation, the bank account to which payments are to be made and the email address to be used for contacts during the procurement procedure. The cover letter shall be accompanied by Appendix II – *Authorised Signatory Form* duly completed and signed.
B. **The Financial Identification Form** - completed. This document is available on the Procurement Section (Financial Identification Form) of EMSA's website (www.emsa.europa.eu).
C. **The Legal Entity Form** - completed, signed by the person authorised to sign the contract, along with the requested accompanying documentation, including up-to-date proof of that authorisation. This document is available on the Procurement Section (Legal Entity Form) of EMSA's website (www.emsa.europa.eu).
D. All the information and documents required by EMSA for the appraisal of tenders on the basis of the points **10, 14, 15.2 and 15.6** of these Tender Specifications (part of the exclusion criteria).
E. All the information and documents required by EMSA for the appraisal of tenderers on the basis of the **Legal and Regulatory capacity** (part of the selection criteria) set out under point **15.3** of these Tender Specifications.
F. All the information and documents required by EMSA for the appraisal of tenderers on the basis of the **Economic and Financial capacity** (part of the selection criteria) set out under point **15.4** of these Tender Specifications.
G. All the information and documents required by EMSA for the appraisal of tenderers on the basis of the **Technical and professional capacity** (part of the selection Criteria) set out under point **15.5** of these Tender Specifications.
H. All the information and documents required by EMSA for the appraisal of tenders on the basis of the **Award Criteria** set out under point **16** of these Tender Specifications.
I. Setting out **prices** in accordance with **point 13** of these Tender Specifications.

Tenderers are exempt from submitting the Legal Entity Form and Financial Identification Form requested if such a form has already previously been completed and sent to EMSA. In this case the tenderer shall simply indicate on the cover letter the bank account number to be used for any payment in case of award.

In e-Submission please fill in all mandatory fields (marked with a star *) and other fields as appropriate. All tenders must be clear, complete and consistent with all the requirements laid down in the Tender Specifications including the above instructions. The documentary evidence/documents required in the Tender Specifications must be uploaded in e-Submission. Tenders not uploading the necessary documents may be rejected.

13. Price

A. Prices for Study investigating the safety of hydrogen as fuel on ships shall include all the expenses related to the provision of the services as described and referenced in this document.
B. Prices must be quoted in Euro.
C. Prices must be fixed amounts, non-revisable and remain valid for the duration of the contract.
D. Under Article 3 and 4 of the Protocol on the privileges and immunities of the European Union, EMSA is exempt from all duties, taxes and other charges, including VAT. This applies to EMSA pursuant to

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the Regulation (EC) No 1406/2002. These duties, taxes and other charges can therefore not enter into the calculation included in the tender. The amount of VAT must be shown separately.

14. Joint Offer

Groupings, irrespective of their legal form, may submit tenders. Tenderers may, after forming a grouping, submit a joint tender on condition that it complies with the rules of competition. Such groupings must specify the company or person heading the project and must also submit a copy of the document authorising this company or person to submit a tender.

Each member of the group must provide the required evidence for the exclusion and selection criteria. The exclusion criteria will be assessed in relation to each economic operator individually. Concerning the selection criteria, the evidence provided by each member of the group will be checked to ensure that the group as a whole fulfils the criteria. However, the selection criteria may apply individually where it is relevant in view of their nature.

If awarded, the contract will be signed by the person authorised by all members of the group. Tenders from groups of service providers, contractors or suppliers must specify the role, qualifications and experience of each member or group.

15. Information concerning the personal situation of the tenderer and information and formalities necessary for the evaluation of the minimum economic, financial and technical capacity required

15.1 Legal position – means of proof required

When submitting their tender, tenderers are requested to complete and enclose the **Legal Entity Form** and requested accompanying documentation, available in the Procurement Section (Legal Entity Form) of EMSA's website (www.emsa.europa.eu).

15.2 Grounds for exclusion - Exclusion criteria

To be eligible to participate in this contract award procedure, a tenderer must not be in any of the exclusion situations listed in the Declaration of Honour.

For this purpose, the Declaration of Honour available on the Procurement Section of EMSA's website (www.emsa.europa.eu) shall be completed and signed.

15.3 Legal and regulatory capacity – Selection criteria

15.3.1 Standards / Prerequisites

The tenderer must have the legal and regulatory capacity to pursue the professional activity needed for performing the contract.

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15.3.2 Evidence

For this purpose, the Declaration of Honour must be completed and signed as per section 15.2 above.

15.4 Economic and financial capacity – Selection criteria

15.4.1 Standards / Prerequisites

A. The tenderer must be in a stable financial position and must have the economic and financial capacity to perform the contract.
B. The tenderer must not be subject to EU restrictive measures adopted under Article 29 of the Treaty on the European Union (TEU) or Article 215 of the Treaty on the Functioning of the EU (TFEU) substantially affecting the performance of the contract (e.g., asset freezes and/or a prohibition on making funds or economic resources available). The prohibition applies throughout the whole performance of the contract.

15.4.2 Evidence

A. Financial statements or their extracts for the last three years for which accounts have been closed.

B. Self-declaration that the tenderer is not subject to restrictive measures (e.g., asset freezes and/or a prohibition on making funds or economic resources available) substantially affecting the performance of the contract.

   Tenderers are exempt from submitting the documentary evidence if such evidence has already been completed and sent to EMSA for the purpose of another procurement procedure and the provided documents are up to date. In this case the tenderer should simply indicate on the cover letter the procurement procedure where the evidence has been provided.

   If, for some exceptional reason which EMSA considers justified, a tenderer is unable to provide one or other of the above documents, it may prove its economic and financial capacity by any other document which EMSA considers appropriate. In any case, EMSA must at least be notified of the exceptional reason and its justification in the tender. EMSA reserves the right to request at any moment during the procedure any other document enabling it to verify the tenderer's economic and financial capacity.

15.5 Technical and professional capacity – Selection criteria

15.5.1 Standards / Prerequisites

The tenderer shall have at least 3 years of experience performed in the last 5 years, in at least 4 of the subjects below:

A. safety, hazards and risk analysis and reliability analysis,
B. IMO’s FSA procedures;
C. systems for the processing, storage and transport of hydrogen;
D. design/integration/verification of fuel cells, reformers for consumption of hydrogen;
E. safety design and management of highly explosive chemicals;
F. using equipment reliability data.

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And preferably experience in:

G. design of internal combustion engine using hydrogen as fuel.

15.5.2 Evidence

A list of the relevant projects, designs, studies, technical reports substantiating the minimum of 3 years of experience (as referenced in the previous section) performed in the past 5 years, which shall include:

A. description of relevant services (studies/projects) with indication of the objectives,
B. contracting parties,
C. duration and
D. budget.

15.6 Declaration of Honour (DoH)

Please note that the tenderer shall provide information with regards its situation and on the natural or legal persons that are members of the administrative, management or supervisory body or that have powers of representation, decision or control and beneficial owners.

Upon request and within the time limit set by EMSA, the tenderer shall provide the following evidence concerning itself, the natural or legal persons as listed under the first paragraph, and concerning the natural or legal persons which assume unlimited liability for the debt of the tenderer:

For the exclusion situations described in points (a), (c), (d), (f), (g) and (h) of the Declaration of Honour, production of a recent extract from the judicial record is required or, failing that, an equivalent document recently issued by a judicial or administrative authority in the country of establishment of the tenderer showing that those requirements are satisfied.

For the exclusion situations described in (a) and (b) of the Declaration of Honour, production of recent certificates issued by the competent authorities of the country of establishment is required. These documents must provide evidence covering all taxes and social security contributions for which the tenderer is liable, including for example, VAT, income tax (natural persons only), company tax (legal persons only) and social security contributions. Where any document described above is not issued in the country concerned, it may be replaced by a sworn statement made before a judicial authority or notary or, failing that, a solemn statement made before an administrative authority or a qualified professional body in its country of establishment.

The successful tenderer must provide the documents mentioned as supporting evidence before signature of the contract and within the deadline given by EMSA. This requirement applies to each member of the group in case of joint tender.

If the tenderer already submitted such evidence for the purpose of another procedure, its issuing date does not exceed one year and it is still valid, the person shall declare on its honour that the documentary evidence has already been provided and confirm that no changes have occurred in its situation.

16. Award criteria

The contract will be awarded to the tenderer who submits the most economically advantageous tender (the one with highest score) based on the following quality criteria and their associated weightings:

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1. **Quality criterion 1** ($W1$ = 15%): Quality of the proposal concerning **Task 1** with respect to:

   How the tenderer proposes to execute the Task 1, in respect to the intended sources (the scientific and technical documents/studies/scientific papers/medical papers/industrial technical reports), hazards considered and how such hazards are mitigated in the existing rules and regulations, and correspondence of the proposed table of content with the activity to be undertaken under this task as described in Section 2.4.

2. **Quality criterion 2** ($W2$ = 25%): Quality of the proposed methodology for safety, hazards, risks assessment and reliability analysis concerning **Task 2**

   This criterion shall be evaluated based on the following elements: intended standards to be used for the reliability analysis, details, designs, schemes, data sheets, provided for the analysis of the equipment, systems and systems of systems, proposals, justifications, identification of the critical equipment, systems and systems of systems, suitability of the methodology to address the matter at stake and correspondence of the proposed table of content with the activity to be undertaken under this task as described in Section 2.5.

3. **Quality criterion 3** ($W3$ = 20%): Quality of the proposed methodology for HazID and risk assessment in respect to **Task 3 and Task 4.**

   The overall description of how the tenderer proposes to perform the Task 3, in respect of the matter at stake:

   - intended sources that will be used,
   - details on how the risk analysis will be performed (including the: intended number and areas of expertise of HazID experts selected for the HazID workshop, the methodology for the HazID workshops, the identification of hazardous scenarios and use of risk analysis techniques (in compliance with FSA Guidelines), as well as the identification of the ships' systems and general arrangements (tanks configuration, type of hydrogen consumer, fuels preparation system, fuel cell systems with reformers etc.)), and
   - correspondence of the proposed table of content with the activity to be undertaken under this task as described in Section 2.6 and 2.7.

4. **Quality criterion 4** ($W4$ = 10%): Quality of the proposal concerning **Task 5,** with respect to the quality of the intended planification and methodology of the stakeholder's consultation during the preparation of the Guidance document as requested in section 2.8 and of the fitness of the Project plan (Section 4) to achieve the expected results.

   Total Weight for Quality 70%

   and the price criterion and associated weighting:

5. Price of the tender ($W_{Price} = 30\%$) = the overall price quoted as per Section 13.

For all tenders, evaluators will give marks between 0-10 (half points are possible) for each quality criterion.

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The score is calculated as

$$S = SQ + SP$$

where:

The average quality for quality criterion i is

$$Q_i = \frac{1}{number\ of\ evaluators} * \sum_{evaluator} mark\ of\ the\ evaluator\ for\ quality\ criterion\ i$$

The overall weighted quality is

$$Q = \sum_i Q_i * W_i$$

The score for quality is

$$SQ = \frac{Q}{Q\ of\ the\ bid\ with\ highest\ Q} * 100 * \sum_i W_i$$

The score for price is

$$SP = \sum_i \frac{lowest\ Price_i\ of\ all\ bids}{Price_i} * 100 * W_{Price_i}$$

Only tenders that have reached a minimum 60 % for each Quality Criteria will be taken into consideration when calculating the score for quality SQ, score for price SP and score S.

Only tenders that have reached a minimum of 60 % for the score S will be taken into consideration for awarding the contract.

17. Evaluation and award

The evaluation of the tenders that comply with the conditions as per Invitation to tender will consist of the following elements:

- Check if the tenderer is not subject to restrictive measures and has access to procurement;
- Verification of non-exclusion of tenderers on the basis of the exclusion criteria;
- Selection of tenderers on the basis of selection criteria;
- Verification of compliance with the minimum requirements specified in the procurement documents;
- Evaluation of tenders on the basis of the award criteria.

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- EMSA will evaluate the above-mentioned elements in the order that it considers to be the most appropriate. The successful tenderer(s) must pass all the above-listed elements to be awarded the contract.

18. Rejection from the procedure

Contracts will not be awarded to tenderers who, during the procurement procedure, are in one of the following situations:

A. are in an exclusion situation;
B. have misrepresented the information required as a condition for participating in the procedure or have failed to supply that information;
C. were previously involved in the preparation of procurement documents used in the award procedure where this entails a breach of the principle of equality of treatment, including distortion of competition that cannot be remedied otherwise.

19. Intellectual Property Right (IPR)

Please consult the contract for IPR related clauses.

If the results are not fully created for the purpose of the contract this shall be clearly pointed out by the tenderer in the tender. Information shall be provided about the scope of pre-existing rights, their source and when and how the rights to these rights have been or will be acquired.

In the tender all quotations or information originating from other sources and to which third parties may claim rights have to be clearly marked (source publication including date and place, creator, number, full title etc.) in a way allowing easy identification.

20. Special negotiated procedure under point 11.1(e) of Annex I to FR

EMSA may at a later stage exercise the option to increase the estimated value of the contract via negotiated procedure with the successful tenderer in accordance with the provisions of point 11.1 (e) of Annex I to the Financial Regulation.

21. List of acronyms and abbreviations

Acronym	Explanation
BLEVE	Boiling Liquid Expanding Vapor Explosion
CCC	Sub-Committee on Carriage of Cargoes and Containers
FMEA	Failure Modes, Effects Analysis
FMECA	Failure Modes, Effects, and Criticality Analysis
FSA	Formal Safety Assessment
FTA	Fault-Tree Analysis
GBS	Goal Based Standard

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GHG	Green House Gases
HazID	Hazard Identification
ICE	Internal Combustion Engine
IGF	International Code of Safety for Ship Using Gases or Other Low-flashpoint Fuels
IMO	International Maritime Organization
LNG	Liquefied Natural Gas
MSC	Maritime Safety Committee
PPE	Personal Protective Equipment

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