Explanatory notice
Guidelines on competence requirements for the operation of craft using gaseous hydrogen as a fuel

1. Context

The CESNI Working group on professional qualifications drew up guidelines for competences for the operation of craft using gaseous hydrogen as a fuel. At this stage, only compressed hydrogen (gaseous form) is addressed.

The guidelines are intended to address first the training institutes and schools that train students in new technologies. They can also address craft owners, who are responsible for ensuring that the crew is trained in new technologies. They can also serve a useful source of information for insurance companies, which insure the crew against work-related accidents and are therefore likely to set requirements for crew members. The CESNI Secretariat worked out an explanatory notice for the guidelines on competence requirements for the operation of craft using hydrogen as fuel. This notice is for documentary purposes only and intends to provide details and background information about the elaboration of the guidelines.

2. Methodology

CESNI/QP has chosen to elaborate guidelines at this stage for the following reasons:

- it may be premature, due to the absence of substantial feedback and experience with new technologies, to determine competence standards with a long-term and stable vision;
- a risk-based approach enabled experts to determine a list of minimum requirements for competences to ensure a safe handling of the technology for a safe navigation of the vessel and for crew members;
- in addition, also considering that experts and stakeholders alike advocate a simple system from a regulatory point of view, experts tend to believe that it is not desirable to require 1 expert per new technology. This would make crew compositions very complex, all the more so in a context of shortage of personnel. However, to meet all safety requirements, further reflections are necessary before deciding upon such a generalist approach, given the distinct differences in the characteristics of the alternative fuels;
- it may be preferable, at this early stage, to leave flexibility to the market to choose the appropriate approach and in particular to determine which person on board and/or on-shore is most appropriate to fulfil a specialist function, including instructing others involved;
- this tailor-made approach also makes it possible to anticipate the multi-development of new technologies, that will probably be based on a combination of technologies on board the same vessel;
- guidelines provide for flexibility: they can be updated over time to take into account the feedback from the practice.

To work out the guidelines, experts identified the following main risks linked to the operation of craft using hydrogen as a fuel:

- **High flammability and high explosivity**: a simple match with a small quantity of hydrogen may generate an explosion. The risk of fire and explosion is higher than with methanol for example, especially in enclosed spaces or inadequately ventilated areas.
- **Electrostatic risk**: equipment that handles or transports hydrogen can accumulate electrostatic charges. These charges can discharge suddenly, creating sparks that can trigger an explosion if the gas is present in sufficient concentration.
- **Important risk of leaks**: the molecule of gaseous hydrogen (H_2) is small and can leak more easily. Hydrogen is *colourless, odourless and non-toxic* so it cannot be identified without a dedicated detector. In slow combustion, the flaming leak is almost invisible.
- **Acoustic risk:** the noise generated by a hydrogen leak is very significant, due to the size of the molecules, of the immense pressure under which it is stocked (350 bar) and the speed of leak. For example, a hydrogen leak at a pressure of 200 bars can easily reach 140 decibels.
- **Material embrittlement** (steel, piping, components) can cause damage to the vessel structure and components. It creates new specific needs for maintenance.
- **Use of rack of bottles of compressed hydrogen**: their handling can cause damage and requires therefore specific knowledge.

Other elements have been considered during the elaboration of the guidelines:

- An application-oriented and coherent approach has been applied for this guideline. It is intentionally formulated in an open manner to enable the examination commissions of the Member States to adapt the content of examinations to the latest legal and technical framework.

3. Content of the guidelines

The guidelines provide a list of minimum competence requirements for specialised persons (on board and/or on shore) who will have to

1) be familiar with the specific risks associated with the new technology they will be handling;
2) familiarise other persons involved (on land or on board), in an instructive function;
3) detect situations likely to result in an accident;
4) detect when an incident has occurred and assess the risks for the vessel and the crew;
5) take immediate protective measures in the event of an incident
6) use the personal protective equipment.

Regarding the holder of the competence, the generic term “specialised person” has been used. This designation does not prejudge whether the holder will be a crew member or not. It also avoids confusion with existing terms such as "expert" or "competent person". It also does not prejudge if and how the legislator will decide how this will be integrated into the legal framework.

The competence table is copied below, with more detailed explanations in blue writing regarding the content and objectives of the targeted competence:

1. The specialised person shall be able to identify the characteristics of compressed hydrogen and ensure safe handling

The specialised person shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. identify possible hazards of compressed hydrogen; Knowing the characteristics of this gas is the basis to understand its hazards and hence to guarantee safe handling and to take appropriate measures in case of an emergency	1. Knowledge of physical and chemical properties of both, hydrogen in its natural form and as a compressed gas. This might include: properties (colourless, odourless and non-toxic gas), brittle effect, highly volatile substance, boiling temperature, … 2. Knowledge of possible hazards of compressed hydrogen (such as high flammability, pressurized gas, embrittlement, …). This might include: hazards due to the pressure system (expansions due to temperature, bursting, noises generated from leaks, …), high flammability, nearly invisible flame possible, possible ignition by electrostatic charges, … 3. Knowledge of measures to mitigate risks presented by compressed hydrogen and its storage. This might include: personal protection (personal protective equipment, use of mobile gas detectors, familiarizations, …), structural protection (detectors, ventilation, safety zones, …) regular inspections by authorized maintenance companies, Safety Data Sheet (SDS), … 4. Ability to raise awareness of other crew members regarding the properties and possible hazards of compressed hydrogen.
2. ensure safe handling of compressed hydrogen and related equipment. This must be the top-priority for every crew member	1. Knowledge of storage systems for compressed hydrogen. This might include: layout, key figures, safety measurements, … 2. Knowledge of issues that can arise on a compressed hydrogen storage systems component. This might include: embrittlement, leakages, high pressure, mishandling of the system, and how to deal with those issues … 3. Knowledge of emergency procedures. This might include: how to deal with overpressure or a release of gas, … 4. Knowledge of safe bunkering procedures. This might include: bunkering methods (Bottle racks, pressure hose, …) Checklists, safety measurements while bunkering, technical procedures, … 5. Ability to implement and monitor safe working procedures. 6. Ability to take appropriate actions in case of a leakage of compressed hydrogen.

2. The specialised person shall be able to ensure compliance with legislation regarding the use of compressed hydrogen as a fuel.

The specialised person shall be able to:

COLUMN 1 COMPETENCE	COLUMN 2 KNOWLEDGE AND SKILLS
1. identify hydrogen-relevant regulations and ensure compliance with it.	1. Knowledge of relevant technical standards. This might include: basic specifications applicable to vessels using compressed hydrogen as fuel (e.g. according to ES-TRIN), … 2. Knowledge of relevant police regulations. This might include: guidelines and requirements applicable to vessels using compressed hydrogen as fuel, … 3. Knowledge of relevant health and safety regulations. This might include: Safe work exposure values, safety distances, and/or national regulations … 4. Ability to instruct and monitor crew member operations in order to ensure compliance with relevant regulations.

4. Impact on inland navigation

These guidelines enable a harmonised approach to competence requirements for the operation of craft using hydrogen as fuel.

They contribute to the safety of crew members and navigation as they permit to counter the risks associated with the emergence of new technologies used for propulsion thanks to a well-trained crew.

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