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## D3.1 – Safety and regulatory requirements for integration of genset

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## Deliverable D3.1 –Safety and regulatory requirements for integration of genset

### Short summary:

This task deals with safety requirements for the on-board power generation and power distribution systems. For the integration of multiple modular genset units to achieve multi-MW scales for the different cruise ships designs this report will identify safety and regulatory requirements for the installation of largescale SOFC-systems on-board.

Relevant LR rules, regulations, and guidelines are reviewed with the focus on integration requirements. The analysis covers the storage and processing of the fuel, the fuel cells and batteries as well as the requirements for electrical power and heat generation and distribution. Results will be summarised and contributed to the compilation of a project report on safety and regulatory requirement for the integration of the genset system on-board.

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### Dissemination Level

<b>PU</b> Public	<input type="checkbox"/>
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## 1 Introduction

This report addresses safety requirements for the on-board power generation and power distribution systems. For the integration of multiple modular genset units to achieve multi-MW scales for the different cruise ships designs this report will highlight safety and regulatory requirements for the integration of largescale SOFC-systems on-board. This analysis addresses the storage and processing of the fuel, the Fuel Cells and batteries as well as the requirements for electrical power and heat generation and distribution.

From a rule perspective the current regulatory development for ocean going and inland water ships can be considered as quite dynamic. Various regulations for alternative fuels have been developed recently or are just in front of their official release. Typically, these rules address the fuel storage, fuel supply and the energy conversion with combustion engines or Fuel Cells. Although hydrogen regulations are still in development the use of hydrogen is considered for Fuel Cells.

Requirements for Fuel Cells will be introduced in the regulations for inland navigation with the upcoming 'European Standard laying down Technical Requirements for Inland Navigation vessels' ES-TRIN 2023. In June 2022, the IMO has released the Marine Safety Committee Circular MSC.1/Circ.1647 'Interim Guidelines for the Safety of Ships using Fuel Cell Power Installations'. Lloyd's Register has introduced requirements for Fuel Cells in the Rules and Regulations for Ships Part 5 Chapter 27 while requirements for the integration of electrical power sources are provided in Part 6. Various experiences from projects regarding Fuel Cell on board of ships have been collected in the past which have driven the current available set of rules for ships while the specific knowledge and experience on multi-MW Fuel Cell installation is available on a concept basis or on the level of a limited power range for non-essential service.

The structural integration of these Fuel Cell Installations is highly depending on ship type, ship size and for sure on the specific Fuel Cell dimensions and the required connections to e.g. fuel, air and heat supply. Depending on the integration concepts separate solutions e.g. where Fuel Cells have been integrated in a "container" room which is supposed to be installed on a specific ship deck have been realised. For multi-MW Fuel Cell installations on Long-haul Cruise Ships for partial or full replacement of conventional combustion engines it is expected that the location of installation will be the engine room below deck. While the Fuel Cell Power Installation needs to be integrated with a view on the room arrangement this electrical power source needs to be in addition well integrated in the ship electrical power supply system meeting relevant requirements applicable to main source of power.

Rules applicable to Fuel Cells are not limited to the specific chapters dealing with the Fuel Cell only as covered by the LR Rules for Ships in Part 5 Chapter 27. Reference is made in these requirements to more regulations and requirements to be considered. Due to the expected size and the required supply of air, fuel, etc. of a multi-MW installation these aspects must be considered to ensure a safe operation and a save supply of electrical energy. In order to provide the required fundament for integration this report will not touch every detailed requirement e.g. for the Fuel Cell components or the fuel supply system. This report will follow a balanced approach touching high level fundamental requirements and more detailed requirements applicable to an energy supply system for power supply for propulsion of a ship or other essential services. For the integration of a multi-MW Fuel Cell installation on Long-haul Cruise Ships reference is made to the current LR Rules. It is should