Data Management Plan

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DEC	Websites, patent fillings, videos, etc.	
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ETHICS	Ethics requirements	
ORDP	Open Research Data Pilot	

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PU	Public	[X]
SEN	Sensitive, only for Members of the Consortium (including the EU Commission Services)	
EU	EU classified information. Submitted according to special procedures agreed with the Granting Authority	

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This document constitutes the data management plan for the sHYpS project, developed to search for solutions for decarbonizing the maritime sector.

1 TYPE OF STUDY

The type of project is summarized within the project abstract, which is provided here below.

> "*The general objective of sHYpS is to support the decarbonisation of the shipping industry, by leveraging on previous and on-going work and investment made by Viking and some consortium members. It will develop a hydrogen-based solution, which can be adapted to multiple types of vessels and in some cases can already achieve IMO's target for 2030 and 2050.*
>
> *The project will develop a (i) novel hydrogen storage intermodal 40' ISO c-type container, (ii) the complete detailed design of modular containerised powertrain based on optimised PEM Fuel Cells and (iii) their dedicated logistics. On one hand the project will define a logistic based on swapping pre-filled containers, on the other hand it will define a perspective scale-up of the storage capacity and the supply applied to the Port of Bergen use-case. This will allow to kick start a supply-chain without waiting for the full infrastructure to be in place. We show how this approach can already support a remarkable part of the vessels in the EU waters.*
>
> *The project will use the window of opportunity of 1 Viking's newbuilds Ocean Cruise vessel to install the storage system onboard with the complete gas handling and energy management system and test it during the shakedown cruise by 2026, with a limited power Fuel Cell. When the 6MW will be in place (pendent investment decision by Viking) this will allow to cut 50% of emissions in a 14 days fjord cruise. The midterm outcomes are remarkable, since Viking has a building program of 6 Ocean Cruise ships by 2030 and several river ships. With the right logistics in place the ISO container technology can develop in hundreds of units per year. In the meantime, the upscaled design of the container from this project will approach more segments in sea and IWW application and look to hundreds of vessels in the order book of commercial fleets. The value-chain include LH2 suppliers, giving the opportunity to speed up a supply of thousand tons of LH2 per year in the next 20 years.*"

The aim of this project consists in realizing a liquid-hydrogen-fuelled vessel with a solution suitable for future technological upscale. In order to achieve this result, three consecutive goals have been set:

(i) Design and realize a novel hydrogen storage intermodal 40' ISO C-type container which will be used for storing onboard the liquid hydrogen

(ii) Design and realize a modular containerised powertrain based on optimised PEM Fuel Cells to be installed onboard.
(iii) Handle the logistics relative to the onboard installation of (i) and (ii) onto a newbuild Ocean Cruise vessel

To achieve these objectives, the following methodology is going to be adopted:

- The intermodal 40' ISO C-type container will be designed and fabricated. Endurance tests are going to be run for evaluating and guarantee the robustness of the design.
- Overall ship and energy analysis and optimization.
- Design of the whole system. The C-type liquid hydrogen container will be integrated together with the on-board fuel gas handling system, hybrid auxiliaries, safety systems, electric infrastructure, and ancillaries. Realization and test.
- Design of PEM fuel cell powertrain. Realization and test.
- On-board installation and operative demonstration of both of the C-type container and PEM fuel cell powertrain.

After the realization of the system, a concept design and a business case are planned to be drafted to extend this technological application to different types of commercial vessels.

2 DATA DESCRIPTION AND COLLECTION OR RE-USE OF EXISTING DATA

2.1 PERSONAL DATA

No personal data are going to be recorded within this project.

2.2 NON-PERSONAL DATA

Different types of data are going to be generated and collected during the progress of the project.

During the design stages, generated data are going to store information concerning:

- the design and the validation of both the 40' ISO C-type container for liquid hydrogen
- the design and the validation of the PEM fuel cell powertrain.

These first datasets are going to store information concerning the design choices and the system composition (e.g. CAD 3D models, piping and instrumentation diagrams, detailed electrical drawings and mechanical arrangements, technical specifications of the selected components) with detailed specifications of the sub-system constituents (e.g. air locks layout, air supply system, inert gas and venting subsystems, ventilation and exhaust subsystems, gas and fire detection, fire extinction system, hydrogen leakage detection and protection,

oxygen detection). Moreover, results about material tests, preliminary tests (e.g. leak test), as well as developed (or referred) protocols, adopted for testing system security and safety are going to be stored. To fulfil these tasks, different software are going to be used; details are specified in *Table 1*, listed below.

A further dataset is going to be dedicated to:

- the automation software which is going to be created for monitoring and controlling the state of the system. This dataset is going to contain the history of the software development process and its final release.
  During the testing and operational stages of the plant and/or of its singular parts, data are going to be collected by the sensors and the transducers installed on the system. Here different types of raw data are going to be collected, related to:
  - thermodynamic physical quantities (e.g. pressures, temperatures, relative humidity, flow rates, …)
  - electrical physical quantities (e.g. currents, voltages, electrical impedances, …)
  - the state of the system actuators (e.g. pumps, compressors, blowers, ejectors, valves, …).

Additional information is being produced by the processing of these components. Both, raw data and processing outputs performed by the automation software are going to be stored in a dedicated dataset.

A final dataset is going to be created to host the outputs from produced numerical simulations, to fulfil the overall ship and energy analysis and management.

More details about data nature, ownership and storage are reported and summarized in the following table. Data subject to be shared are going to be stored in shared folders managed by the leading Party of the work package.

Table 1. Classification of datasets created within the project

WP	*Data type*	Data formats	Data owner	Instrumentation used	Collection method	Estimated data volume	Access policies	Data storage system / repository
WP 1	Output data from the analysis of the data measured and recorded during the on-land test campaign of the cryogenic storage system. Measured data are elaborated in order to obtain significant output on fluxes, consumptions and efficiencies.	.m .txt .xlsx .docx .pdf	CENERGY	Labview, Matlab, Excel	Data measured and recorded during the on-land test campaign are gathered and structured in Excel files and processed using Matlab. For determination of thermodynamic properties, databases will be used.	Up to 2 GB	Output of the analysis performed will remain under CENERGY property. These data are produced for the accomplishment of the Task 1.4 “Lab Testing with LH2”, in which CENERGY is the task leader. Project partners will have access to the files as sent by CENERGY and according to the Access Rights prescribed in the Consortium Agreement.	Files produced by CENERGY will be stored in the company’s internal storage system. Files produced by CENERGY and shared with Project partners will be loaded in the SHYPS intranet.
WP2	Output data from the design activities on fuel gas handling system that include hydrogen and other auxiliary systems. Output data from the risk assessment process	.dwg .docx .xlsx .pdf	NAVALPRO GETTI And LLOYD’S REGISTER for the risk assessment data	Multiple software licences from NAV	All NAV data are manged within own server. The project data are stored in WP folders which include tasks folders. Internally the data are organized by activity. Nav uses commercial software and licensees to calculate, analyse and to originate output data	Up to 5 GB	Results of the project will be not public, but will be available to all project partners. For the exploitation, access will be granted under fair and reasonable conditions	Data storage will be in the NAV servers located in the European territory. NAV and all its consultants are committed to ensure top quality during the delivery services. The NAV quality process incorporates the following reference document management principles: UNI EN ISO 9001:2015, Quality Management Standard
WP3	Output data from the analysis of the data shared by Fincantieri regarding electric and thermal energy consumptions of the overall ship. The energy analysis refers to the time window in which the fuel cell system will be in operation.	.m .txt .xlsx .docx .pdf	CENERGY	Matlab, Excel	Data elaborated are structured in Excel files.	Up to 2 GB	Output of the analysis performed will remain under CENERGY property. These data are produced for the accomplishment of the Task 3.5 “Overall Ship and Energy Analysis and Management”, in which CENERGY is the task leader. Project partners will have access to the files as sent by CENERGY and according to the Access Rights prescribed in the Consortium Agreement.	Files produced by CENERGY will be stored in the company’s internal storage system. Files produced by CENERGY and shared with Project partners will be loaded in the SHYPS intranet.

WP3	Jeumont Electric is supporting Ricardo in this task. Output data will mainly be in the form of reports of varying detail from summary only to very detailed, describing the fuel cell power plant control and electrical system development. Detailed outputs of the process may also be shared and could include spreadsheets, model input/output files, and specification data.	.xls .ppt .docx .stp .pdf	JEUMONT ELECTRIC	Excel, Simulink, NXP CAD, Matlab, See Electrical, FC test facility with specification to be defined	All simulation, design and reporting datasets will be generated by the respective computer software See Electrical, Matlab. This data will be exported to Excel, but may not be shared in detail	The data to be shared is expected to be multiple files of up to ~100GB	Raw and detailed analyzed outputs will be stored locally at Jeumont Electric and remain under Jeumont Electric control. Outputs associated with the progression of the project, interfacing with the partners and delivery of the Deliverables will be shared according to the access rights in the consortium agreement.	Files produced by Jeumont Electric will be stored in the company's internal storage system. Files produced by Jeumont Electric shared with the partners will be uploaded to the sHYpS website.
WP5 (lead)	Jeumont Electric is leader of this WP. Output data will mainly be in the form of reports of varying detail from summary only to very detailed, describing the fuel cell power plant control and electrical system development. Detailed outputs of the process may also be shared and could include spreadsheets, model input/output files, and specification data.	.xls .ppt .docx .stp .pdf	JEUMONT ELECTRIC	Excel, Simulink, NXP CAD, Matlab, See Electrical, FC test facility with specification to be defined	All simulation, design and reporting datasets will be generated by the respective computer software See Electrical, Matlab. This data will be exported to Excel, but may not be shared in detail	The data to be shared is expected to be multiple files of up to ~100GB	Raw and detailed analyzed outputs will be stored locally at Jeumont Electric and remain under Jeumont Electric control. Outputs associated with the progression of the project, interfacing with the partners and delivery of the Deliverables will be shared according to the access rights in the consortium agreement.	Files produced by Jeumont Electric will be stored in the company's internal storage system. Files produced by Jeumont Electric shared with the partners will be uploaded to the sHYpS website.
WP5 (supt)	Ricardo is supporting Jeumont Electric in this task. Output data will mainly be in the form of reports of varying detail from summary only to very detailed, describing the fuel cell power plant control and electrical system development. Detailed outputs of the process may also be shared and could include spreadsheets, model input/output files, and specification data.	.xls .ppt .docx .stp .pdf	RICARDO	Excel, Simulink, NXP CAD, FC test facility with specification to be defined	All simulation, design and reporting datasets will be generated by the respective computer software. Experimental data will be collated using the test facility automation system which may be Horiba STARS or AVL Puma. This data will be exported to Excel, but may not be shared in detail	The data to be shared is expected to be multiple files of up to ~100GB	Raw and detailed analyzed outputs will be stored locally at Ricardo and remain under Ricardo control. Outputs associated with the progression of the project, interfacing with the partners and delivery of the Deliverables will be shared according to the access rights in the consortium agreement.	Files that remain locally at Ricardo will be held: - On dedicated servers associated with the function (for specific analyses). - On the Ricardo Windchill PLM system for design data. - On the sHYpS project internal SharePoint project space. Files shared with the partners will be uploaded to the sHYpS website.

WP6	Output data from the analysis of the data measured and recorded during the on-land test campaign of the fuel cell electric generator system. Measured data are elaborated in order to obtain significant output on fluxes, consumptions and efficiencies.	.m .txt .xlsx .docx .pdf	CENERGY	Labview, Matlab, Excel	Data measured and recorded during the on-land test campaign are gathered and structured in Excel files and processed using Matlab. For determination of thermodynamic properties, databases will be used.	Up to 2 GB	Output of the analysis performed will remain under CENERGY property. These data are produced for the accomplishment of the Task 6.4 “On-land testing”, in which CENERGY is the task leader, and will be used to elaborate the deliverable D6.3 “On land tests campaign report” (Sensitive Dissemination Level). Project partners will have access to the files as sent by CENERGY and according to the Access Rights prescribed in the Consortium Agreement.	Files produced by CENERGY will be stored in the company’s internal storage system. Files produced by CENERGY and shared with Project partners will be loaded in the SHYPS intranet.
WP6	Output data from the design activities on lh2 storage ship integration. Output data from the testing activities	.dwg .docx .xlsx .pdf	NAVALPRO GETTI	Multiple software licences from NAV	All NAV data are manged within own server. The project data are stored in WP folders which include tasks folders. Internally the data are organized by activity. NAV uses commercial software and licensees to calculate, analyse and to originate output data.	Up to 5 GB	Results of the project will be not public, but will be available to all project partners. For the exploitation, access will be granted under fair and reasonable conditions.	Data storage will be in the NAV servers located in the European territory. NAV and all its consultants are committed to ensure top quality during the delivery services. The NAV quality process incorporates the following reference document management principles: UNI EN ISO 9001:2015, Quality Management Standard

WP8	Output data from selecting funded projects, patents and commercial projects in relation to the ammonia production and hydrogen transportation. Aim of the analysis is the identification, classification and positioning of the most relevant actors (including innovators, investors and business drivers) within the ships value chain. Multiple databases (such Lens.org or Patent Inspiration) and PNO's own search tools such as Wheesbee are used to perform this analysis. Output data from market analysis. The approach for the Market value identification is based on secondary sources and data triangulation.	.xlsx .pdf	PNO, based on data provided by specific software licenses and aggregated public database	Multiple software licences from PNO and third parties.	Data gathered are structured in an Excel file. The file contains a table of content in the first sheet which describes the content of all the other sheets of the file. In each sheet, there is also a description that introduces and presents the content of the given sheet. Ciaotech uses proprietary software and licenses to gather and analyse multiple data related to innovation performances of different organizations, based on structured queries by analysts. Some information (e.g. funded projects, patents) is clustered, but, in principle, obtainable by public sources (e.g. CORDIS), other information is collected by using strategic intelligence licenses and databases. Data aggregation and analysis, such as networking analysis, Market and Innovation Mapping and other elaborations are realised according to specific PNO methodologies and tools which are not shared.	100MB	Output of the analysis performed will remain under Ciaotech property and will be used to elaborate the deliverables *Innovation eco-system and stakeholder map* and *Technology Market Outlook report* (both having SEN – sensitive Dissemination Level). Project partners will have access to the datasets as sent by PNO and according to the Access Rights prescribed in the Consortium Agreement	Data storage will be in the Ciaotech intranet in servers located in the European territory. Ciaotech and all its consultants are committed to ensure top quality during the delivery services. Ciaotech's consultants rely on the quality PNO level maintained over the years. The PNO quality process incorporates the following reference document management principles: UNI EN ISO 9001:2015, Quality Management Standard in Consultancy for organizations related to the development of processes and strategies for research and technological innovation (EA 35).
WP9		.docx .pdf	Consortium	Microsoft Office	All NAV data are manged within own server. The project data are stored in WP folders which include tasks folders. Internally the data are organized by activity. NAV uses commercial software and licensees to calculate, analyse and to originate output data	Up to 1 GB	Consortium/ Public	Data storage will be in the NAV servers located in the European territory. NAV and all its consultants are committed to ensure top quality during the delivery services. The NAV quality process incorporates the following reference document management principles: UNI EN ISO 9001:2015, Quality Management Standard

3 METADATA AND DATA QUALITY

3.1 METADATA.

Metadata are not considered to be used for data referred to system and software design, as well as from files generated from simulations.

On the contrary, due to the large amount of data which is expected to be produced by the operative system, and to the interest which can be generated by the novelty of the project, the use of metadata is required to guarantee the compliance to the FAIR (Findable, Accessible, Interoperable, Reusable) principle of the data produced. In case of metadata reuse, no boundaries have been considered to be set. Metadata standard is going to be selected in agreement with the Dublin Core Metadata Element Set, in compliance with the guidelines defined by Horizon Europe and the FAIR (Findable, Accessible, Interoperable, Reusable) principle.

Digital Object Identifiers are going to be used to guarantee persistence and interoperability. The possibility to conform to the ISO/IEC 19506 is going to be evaluated when designing the system management software.

3.2 DATA QUALITY

According to the different nature of the datasets created within this project, data quality can be guaranteed by following two separate approaches.

- Concerning data referred to the system and software design, data quality will be guaranteed by adopting a clear and understandable layout.
- Concerning data collected from the installed plant, data processed by the automation software and data produced by simulations, data quality is going to be guaranteed by managing data recorded/generated within a defined statistical significance. Data coherence is guaranteed by calibrating the used instrumentation and by experimentally validating models used for simulation.

For both these data types, and under request of the data owner, the internal policies of data naming from all the project partners can be agreed with the personnel of University of Trieste. If the data naming system is not going to be compliant with the data findability principle, the personnel of University of Trieste will discuss with the Party the new nomenclature system to be adopted.

4 DATA MANAGEMENT AND CURATION

4.1 DATA STORAGE AND SECURITY

Each project party is entitled to adopt its own internal policies and resources for ensuring safe and secure data storage. Data storage on a safe and secure server is strongly recommended in order to guarantee data recovery in case of failures.

The University of Trieste licenses Microsoft OneDrive, allowing for secure and controlled sharing of data among the research team. Microsoft OneDrive encrypts data both in transit and at rest and is approved against the University's Handling Restricted Data Policy. The service provides several layers of automatic back up and, in a disaster scenario, files can be recovered. Access to data stored in MS OneDrive is via secure log-in with multi-factor authentication. Concerning data safety, University of Trieste is compliant to the standard ISO 27001.

The personnel able to access to data shared among the partners involved is going to be agreed among the partners for any task of the project.

4.2 DATA PRESERVATION STRATEGY

Each project partner is entitled to comply data preservation strategies to the internal policies. As a main guideline, the storage of datasets relative to systems design and validation shall be granted for at least five years after the conclusion of the project. Data violating industrial secret or under intellectual property are going to be internally stored by the data owner.

On contrary, data collected from the system are planned to be long term stored for increasing the statistical significance of the data analysis and for conserving evidences of occurred failures for at least ten years, in compliance with the policies of the data owner. Such a time frame could be later changed, if needed. Long-term data storage is essential to reuse data for statistical long-term analysis of system performances.

Data subjected to publication on peer-review journals and data which can be stored after Open Access conditions could be deposited on a certified repository and stored for at least two years after project conclusion.

4.3 PERSONAL DATA STORAGE AND SECURITY

No personal data are expected to be generated within this project.

5 DATA SHARING AND ACCESS

5.1 SELECTION OF DATA TO BE SHARED

As a main approach, data sharing is going to be promoted, respecting the boundaries previously defined in detail and undersigned by the Parties involved in the Consortium Agreement. In compliance with the Attachment 1 of the Consortium agreement, access to the background data from other project parties is going to be guaranteed. In addition, datasets generated from simulation are going to be released under open access conditions after related results will have been published on peer reviewed journals. On contrary, data subjected to patenting, data under industrial secret or violating intellectual property are not going to be published.

Open data are going to be issued by adopting Creative Commons Attribution International Public Licence (CC BY) licenses for metadata, enabling free circulation of documents while safeguarding authors' (and the project's) Intellectual Property Rules (CC BY-NC, CC BY-ND).

Project parties are entitled to request access to commonly shared information upon request carried out by fair and reasonable conditions and under the approval of the data owner, while, the access rights to results for internal research and for teaching activities shall be granted on a royalty-free basis, as specified and agreed within the Addendum N.1 of the Consortium Agreement of September 2022.

5.2 METHODS, SOFTWARE AND TOOLS

Data sharing methodologies have been already agreed within the Consortium Agreement. As a main principle, data sharing is going to be limited in between the partners to the strictly required information. The Consortium Agreement also defines the conduct to be adopted when dealing with classified information.

Data which can be stored under Open Access policies, are going to be deposited after publication onto an OpenAIRE compliant repository, which is going to be selected after the volume of the produced data is going to be quantified. The access to this database is going to be promoted by means of a Persistent Identifier (PID), such as a Digital Object Identifier (DOI).

In all of these cases, in order to guarantee data accessibility and interoperability, data are going to be stored and shared by using data formats that are able to guarantee accessibility with different software and promote data reuse. Data findability is going to be promoted by the adoption of keywords to metadata for simplifying data findability and promote data reuse.

Further details about data composition and formatting are going to be defined once systems and software design will be completed: related details are going to be added at this document later during the project evolution.

6 LEGAL ISSUES

6.1 INTELLECTUAL PROPERTY AND LEGAL RIGHTS

Data sharing. The data owner will retain principal legal rights to the intellectual property developed under this grant in compliance with University of Trieste's Policy with respect to intellectual property. When requested, the data will be made available by the supervisor as long as the request does not interfere with publication, compromise intellectual property interests, or precede data analysis. Shared data will include all the raw data and metadata requested. Data will be made available for access as soon as reasonably possible.

Legal rights. The supervisor will retain the legal rights to the intellectual property developed through this project. Others, such as academic audiences, public policy practitioners, and government are welcome to re-use or re-distribute the data with the only caveat to sign an appropriate agreement. Data will also be made available through requests made to the supervisor. The supervisor will request appropriate acknowledgment in all publications or other use of data.

6.2 ETHICAL ISSUES AND CODES OF CONDUCT

No remarkable ethical issues arise in this project. All activities developed within the project will be aimed to safeguard individuals' fundamental rights. The main pillars of the relevant EU legal framework will be adopted with reference to ethical and legal issues during the project life cycle. The research proposed will be compliant with ethical principles as outlined by the ESRC Framework for the 2015 Updated Research Ethics.

7 RESPONSIBILITIES

University of Trieste is entitled to lead data management and stewardship for this project. In this framework, University of Trieste is going to discuss with project Parties the actions internally taken to guarantee data quality and availability. Then, each data owner is going to be responsible for the generation and storage of data produced. Policies about data sharing among the parties were defined and approved within the Consortium Agreement.

Up to date, nor legal neither technical counselling has been made for long-term data management and storing and it is not foreseen.

8 RESOURCES

Costs related to long-term storage of generated data are going to be evaluated once the effective data volume of the operational plant is going to be defined.