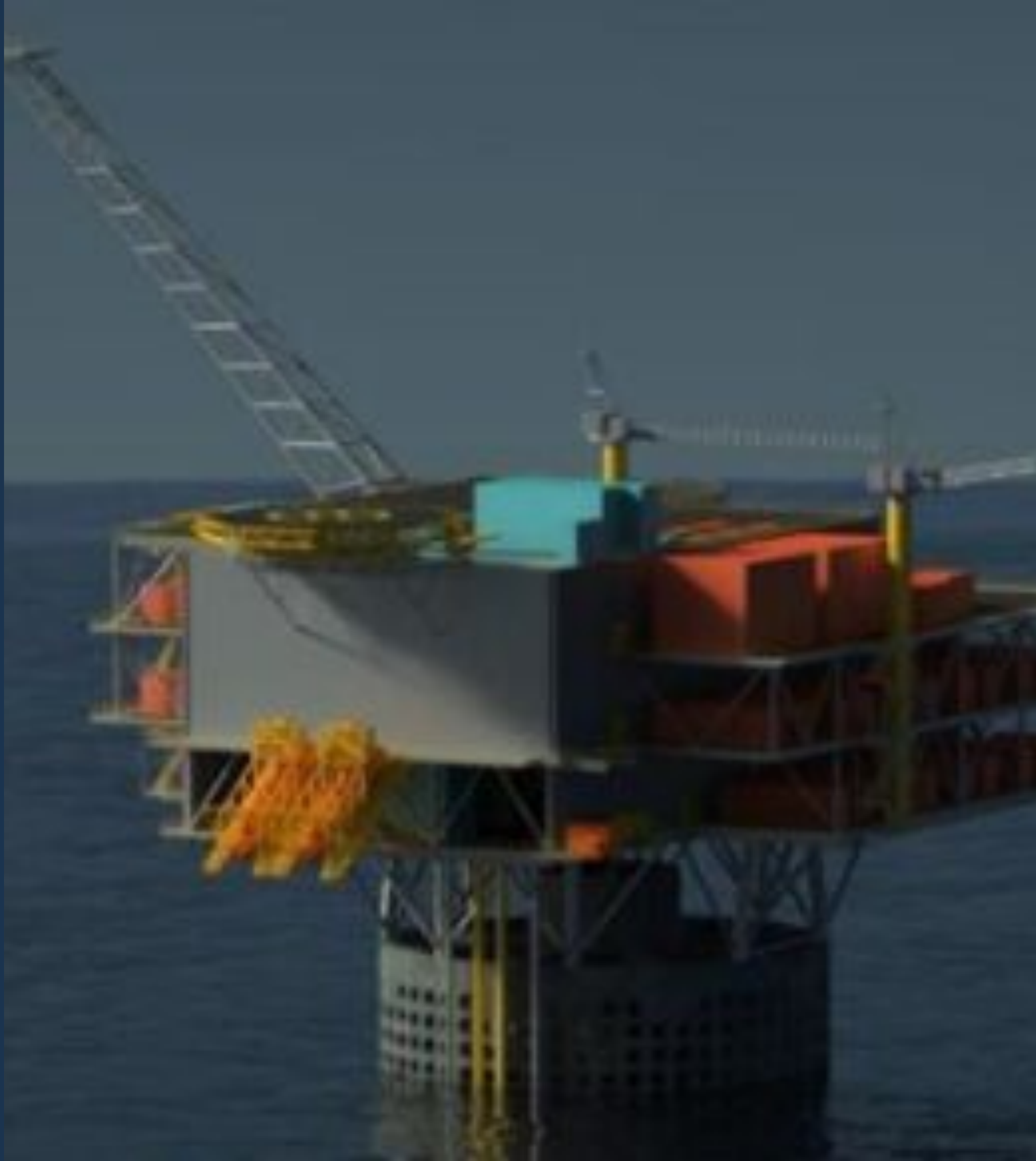
Hydrogen Offshore Production (HOP2)

Michelle Hitches
Project Manager – Sustainable Infrastructure

Introduction

- The Hydrogen Offshore Production Project (HOP2), is a Net Zero Technology Centre Project funded by the Scottish Government's Just Transition Fund

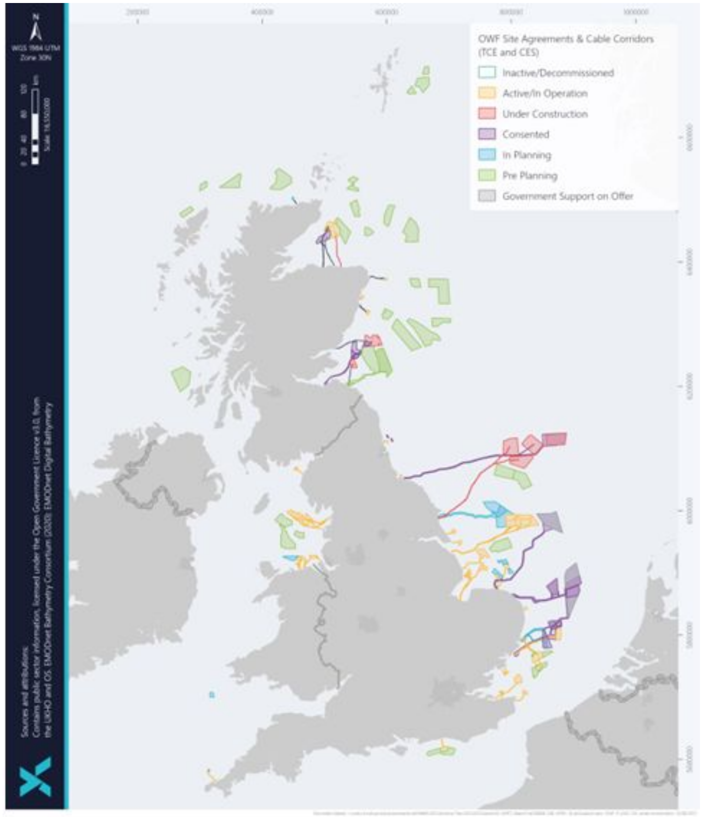
- HOP2 explores repurposing existing oil and gas platforms and developing new offshore facilities for large-scale green hydrogen production, tackling technical, safety, and economic challenges.



Setting the Scene

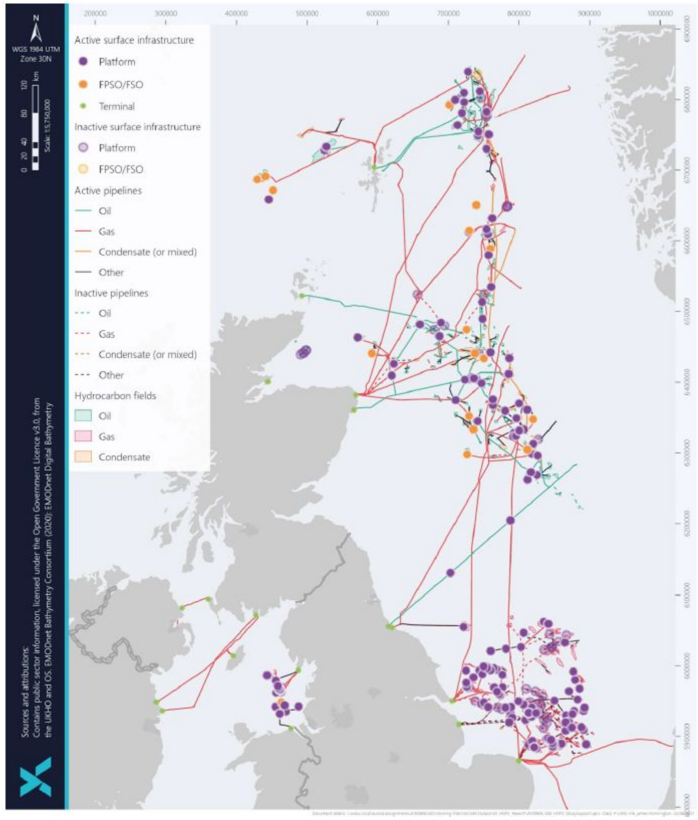
These maps show:

- The extent of the offshore infrastructure which could be used in the future giving basis to the potential for repurposing as opposed to decommissioning.
- The potential of green energy that could power the creation of green electrons.



Mapping of Offshore Wind Areas on the UKCS

Image credit: Xodus

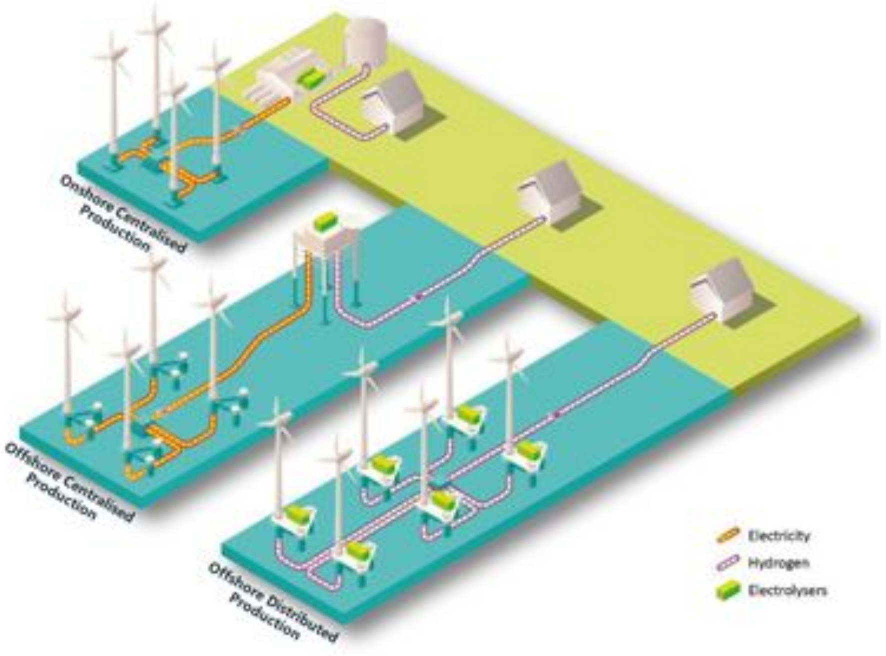


Mapping of Oil & Gas Infrastructure on the UKCS

Image credit: Xodus

Hydrogen Production Scenarios

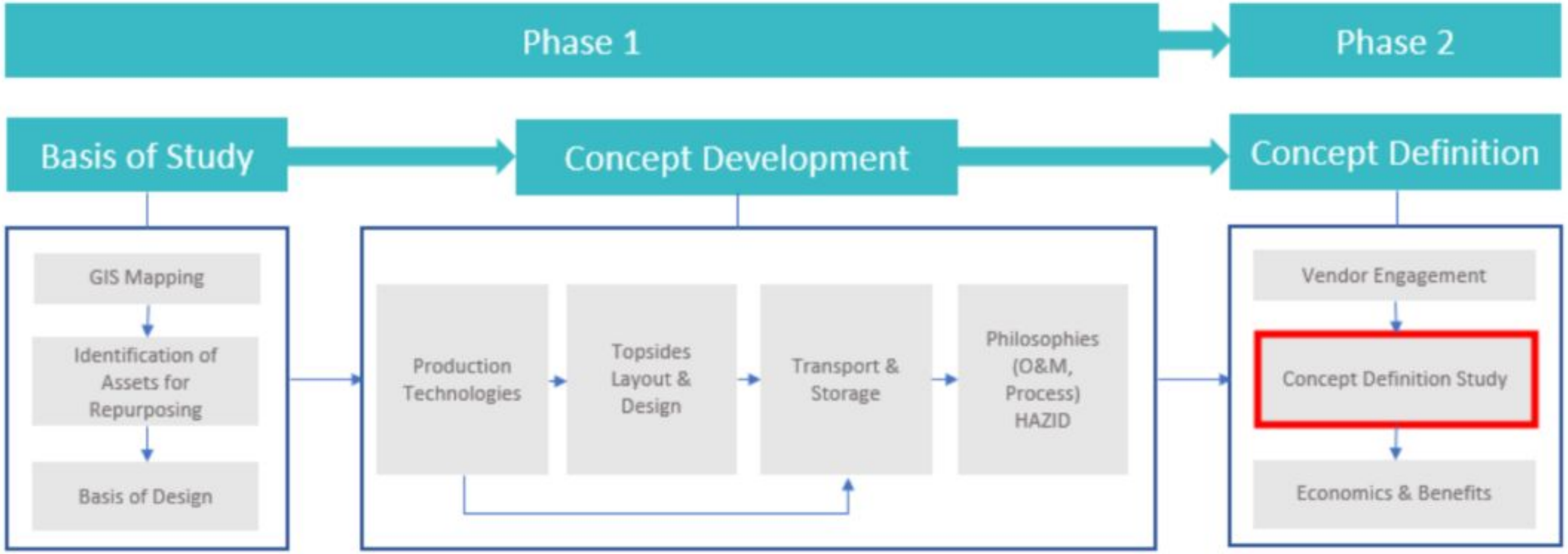
- Onshore, nearshore and offshore
- Centralised and decentralised – for offshore production
- Repurposed and new-build – for offshore production



	Onshore	Nearshore	Offshore
Advantages	• Greater maturity of technology • Installation and operations • Ease of access • Fresh Water source	• Installation and operation. • East of access • Case utilise seawater in otherwise fresh water constrained environments	• Pipelines less expensive than cables • Power grid alleviation • Public acceptance • Artificial reefs • Brine disposal
Challenges	• Stakeholder conflicting interests (e.g land availability)	• Corrosive environment • Brine disposal	• Novel concept • High cost • Corrosive environment • Offshore operation and accessibility • Black start requirements • Safety aspects and engineering for ALARP • Space and weight constraints

Study Objectives

The objective of the HOP2 studies was to further develop the concept of the centralised offshore hydrogen production facility according to the project phasing shown below:



Phase 1 – Basis of Study Objective

Phase 1 BoS of the project was delivered by NZTC, Xodus, Wood and Apollo.

The overall objective of the Basis of Study was to define the project basis for subsequent project phases and includes:

- Outline Basis for the Concept Development and onwards project phases.
- GIS mapping overview and identification of suitable assets.
- Cluster analysis and identification of suitable assets for Concept Development
- Offshore hydrogen production scenarios for different volumes of hydrogen produced and different methods of production.
- Definition of indicative energy balances for each production scenario. Outlining of appraisal for re-use of oil & gas infrastructure versus building of new infrastructure.
- Detailing advantages and disadvantages of onshore hydrogen production versus offshore hydrogen production.

Basis of Study Report: Hydrogen Offshore Production Project (HOP2) - Net Zero Technology Centre

Phase 1 – Basis of Study Conclusion

- The HOP2 study concluded that repurposing existing offshore assets for hydrogen production is feasible but requires careful consideration of structural integrity, safety, and operational efficiency.

- While new-build platforms offer optimal design and performance, they come with higher economic and environmental costs.

- Reusing existing offshore substructures will significantly reduce the CAPEX cost for a hydrogen production platform. This is achieved by avoiding fabricating and installing new jackets and pipelines and their associated enabling costs. For instance, based on a 120m water depth and 500MW topside capacity, the jacket would be 19,600 tonnes, representing a 52% saving in steel fabrication. Similarly, the environmental impact is considerably reduced by reusing these substructures.

- The study's findings support the strategic development of offshore hydrogen production, contributing to Scotland's decarbonisation goals and creating opportunities for job creation and skills development in the region.

- The study's structured approach provides a clear path to produce hydrogen offshore, ensuring it can be scaled up sustainably and safely.

Basis of Study Report: Hydrogen Offshore Production Project (HOP2) - Net Zero Technology Centre

Phase 1 - Concept Development Insights

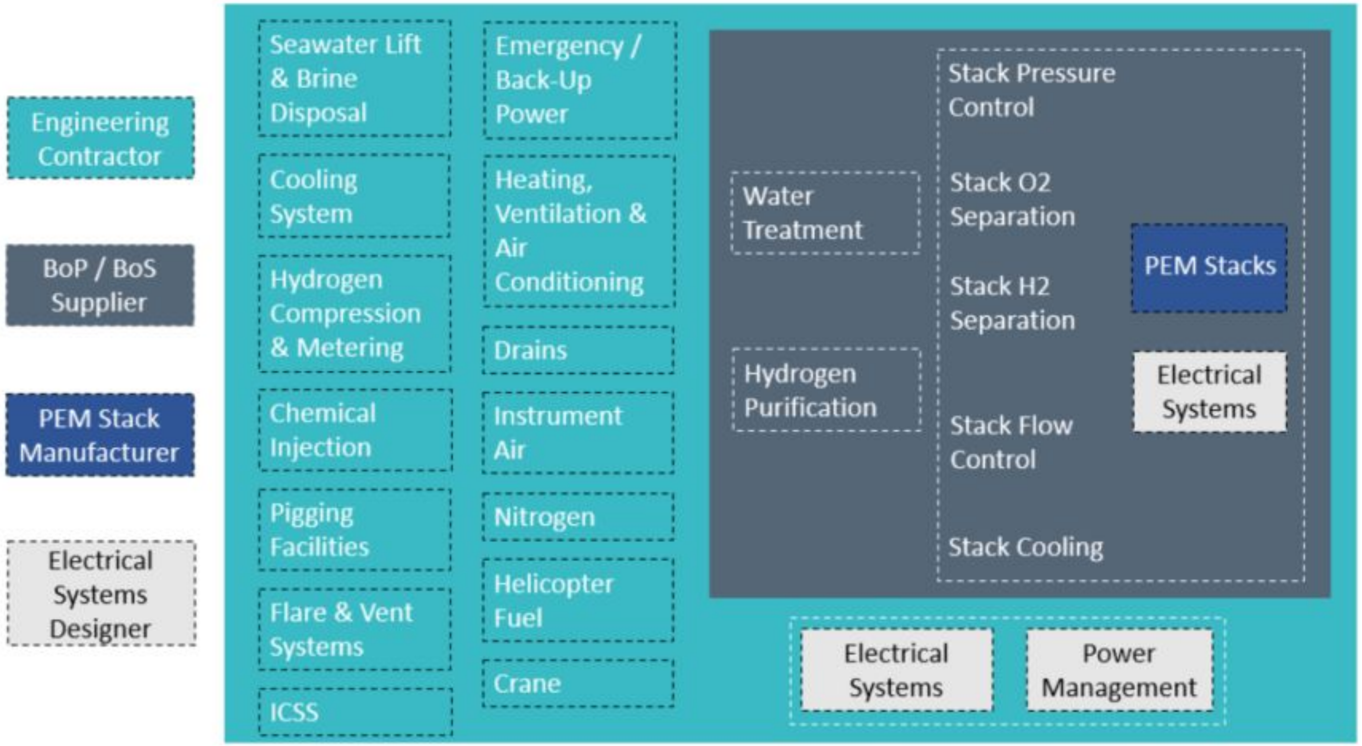
Phase 1 Concept Definition Report was delivered by NZTC.

- **Infrastructure repurposing is technically viable:** The project has demonstrated that a 500MW offshore hydrogen production system could be developed using existing offshore assets. Twelve platforms and three associated pipelines were found to be strong candidates for reuse, offering a practical way to reduce capital costs and avoid early decommissioning.
- **Electrolyser technology needs further development:** Current electrolyser stacks and supporting systems are not designed for the space constraints or harsh conditions of the marine environment. Offshore deployment will require innovation in system design, with greater focus on resilience, compactness and integration of supporting operations.
- **Offshore hydrogen offers strategic value:** While hydrogen produced offshore may not yet be cost-competitive with onshore alternatives, it presents important wider benefits. These include reduced decommissioning costs, lower environmental impact and potential socio-economic gains for coastal and offshore communities.
- **Legislation is still evolving:** UK regulation has begun to adapt to accommodate hydrogen production, but gaps remain. HOP2 found that this is not unique to the UK, with similar legislative challenges in countries like Australia and across Europe. Addressing these gaps will be critical for offshore hydrogen deployment.
- **Timelines will need to be flexible:** Although the project was initially aligned to the early 2030s, revised expectations for wind and hydrogen project buildout mean a longer development window is likely. These updated timeframes will be reflected as the project progresses.

Hydrogen Offshore Production (HOP2): Phase 1 Concept Development - Net Zero Technology Centre

Phase 2 Project Scope

- Phase 2 is delivered by NZTC, Veolia, Petrofac and Apollo.
- Apollo's scope are the teal areas.
- Exclusions from Apollo's scope include the electrolysis packages, water treatment, hydrogen purification and the primary electrical systems which have been undertaken by others.

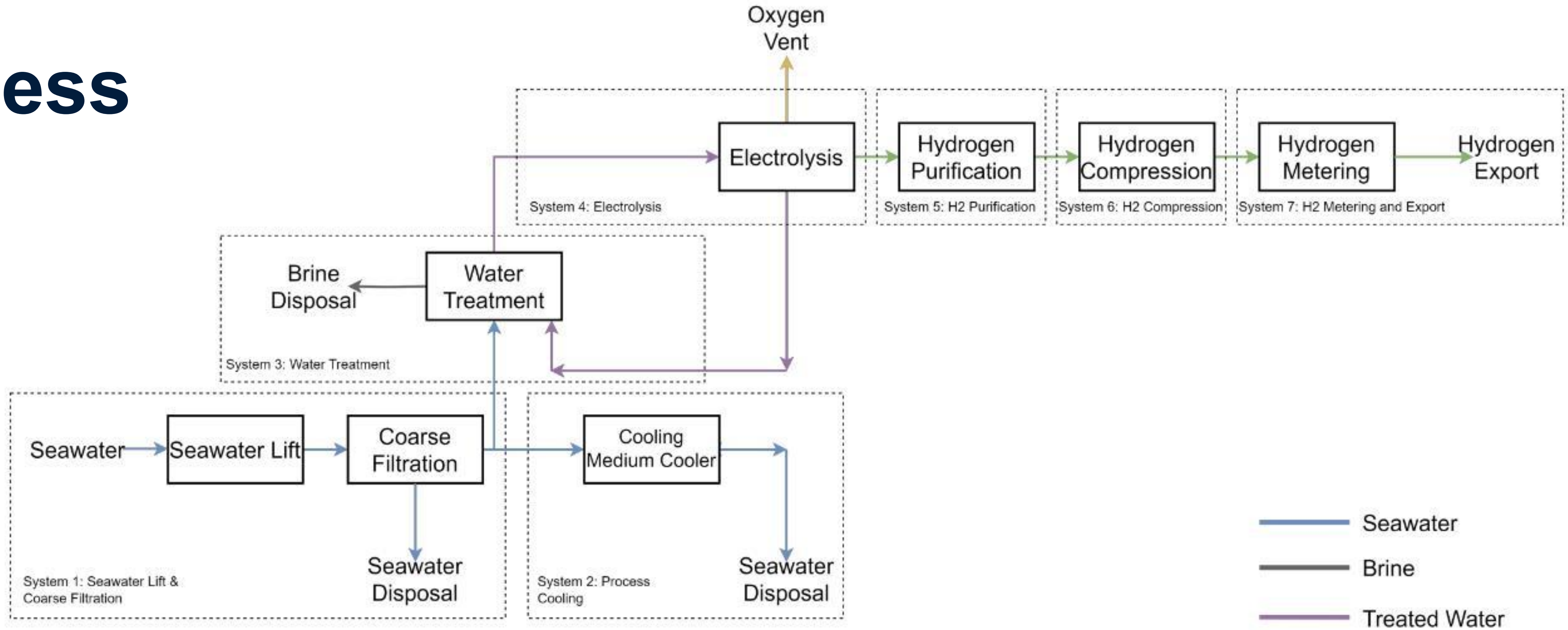


Study Approach

The Concept Definition study (the subject of this report) comprised multi-disciplinary design of new topsides for the Ninian Central Platform (NCP) based on revised concepts for the electrolysis, water treatment, hydrogen purification and primary electrical systems. The Concept Definition study was undertaken by a multi-disciplinary team comprising:

- Process
- Mechanical (including Heating, Ventilation & Air Conditioning (HVAC), as well as Operations & Maintenance (O&M))
- Electrical
- Structural (including Piping, Layout and Construction)
- Controls & Instrumentation
- Technical Safety
- Environmental
- Estimating (cost and schedule)

Process



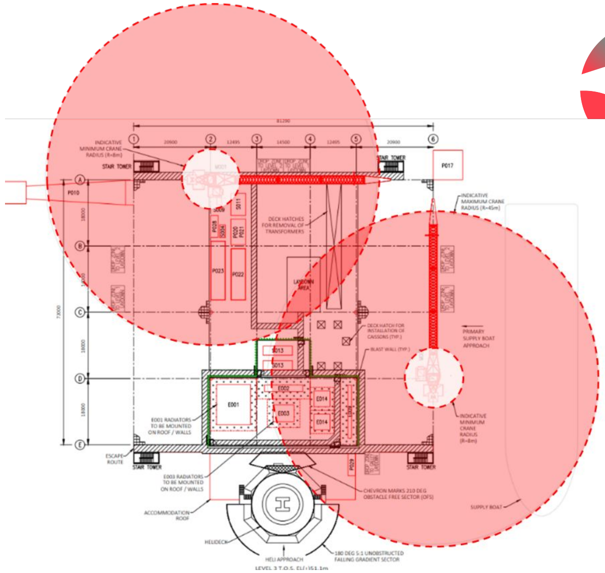
The process design during the Concept Definition stage of HOP2 has been based on the revised electrolyser concept comprising 12 overall arrays, hydrogen purification to reduce water content to pipeline specifications.

The battery limit pressure for the hydrogen export was given as 100 barg at the interface with the pipeline riser.

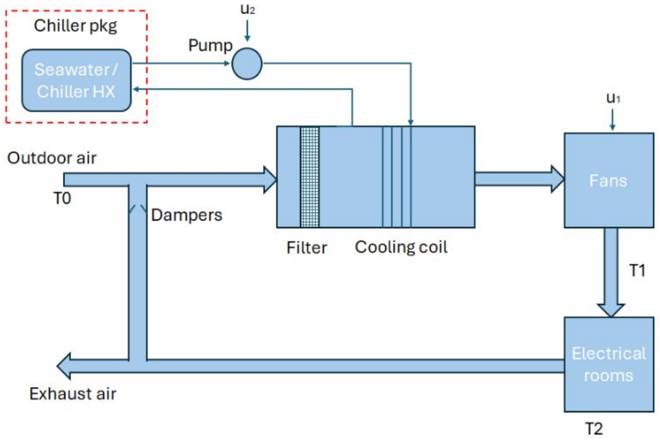
Mechanical

The concept includes the specification of major mechanical systems including lifting equipment, HVAC, compression systems, and operability and maintenance studies. The major equipment and systems were designed as follows:

- The crane design is defined through detailed structural analysis to ensure safe handling of heavy equipment under offshore conditions.
- The HVAC system has been designed to meet the cooling demands of heat-generating electrical modules, with capacity, airflow, and ducting based on thermal load assessments.
- The compressor system specification defines the operating conditions and integration approach for the hydrogen compression units.
- The operations and maintenance strategy is supported by a Failure Modes and Effects Analysis (FMEA) and a Reliability, Availability, and Maintainability (RAM) study, which together identify critical failure points and optimise the system's uptime throughout the facility's lifecycle.



Crane's operating area

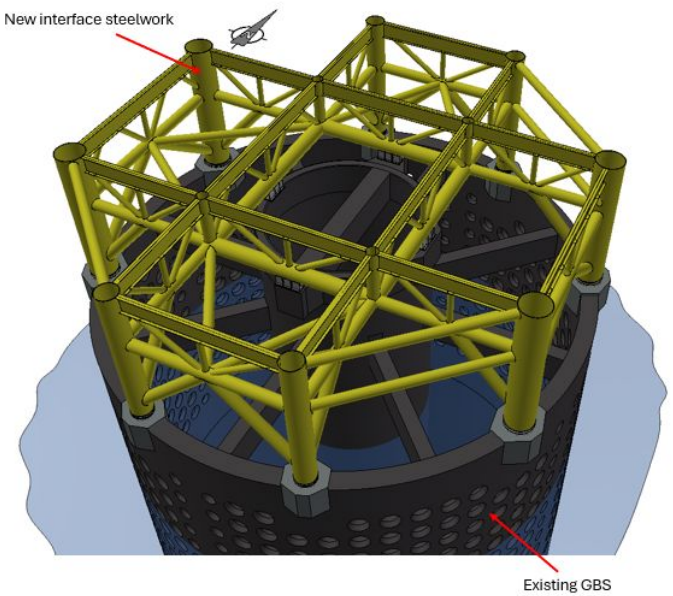


HVAC Block flow diagram

Structural (including Piping, Layout and Construction)

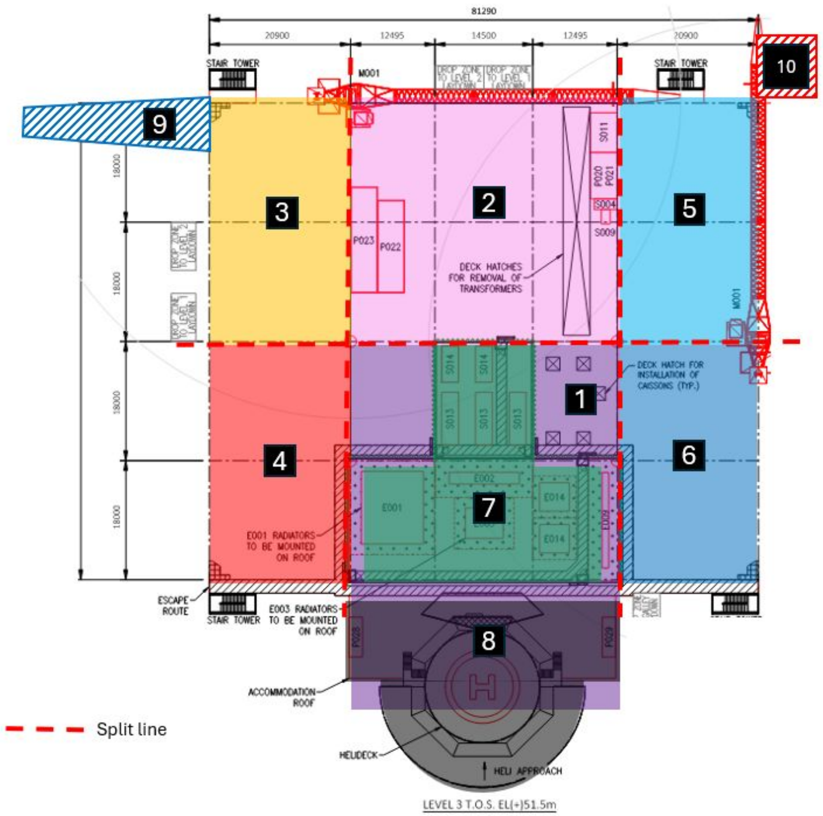
The study addressed:

- Primary framing for the new HOP2 topsides;
- Conceptual development of the interface steelwork between the new topside and the existing GBS structure of NCP;
- Conceptual design for appurtenances;
  - Electrical supply cables;
  - Hydrogen export riser;
  - Control and telecoms umbilical;
  - Seawater lift caisson/s;
  - Seawater and brine disposal caisson/s.
- Weight estimating for the new topside;
- Potential installation methods for the new topside.
  - Base case considered as single lift of integrated deck
  - Alternative modular installation method considered to assess high level impact on design

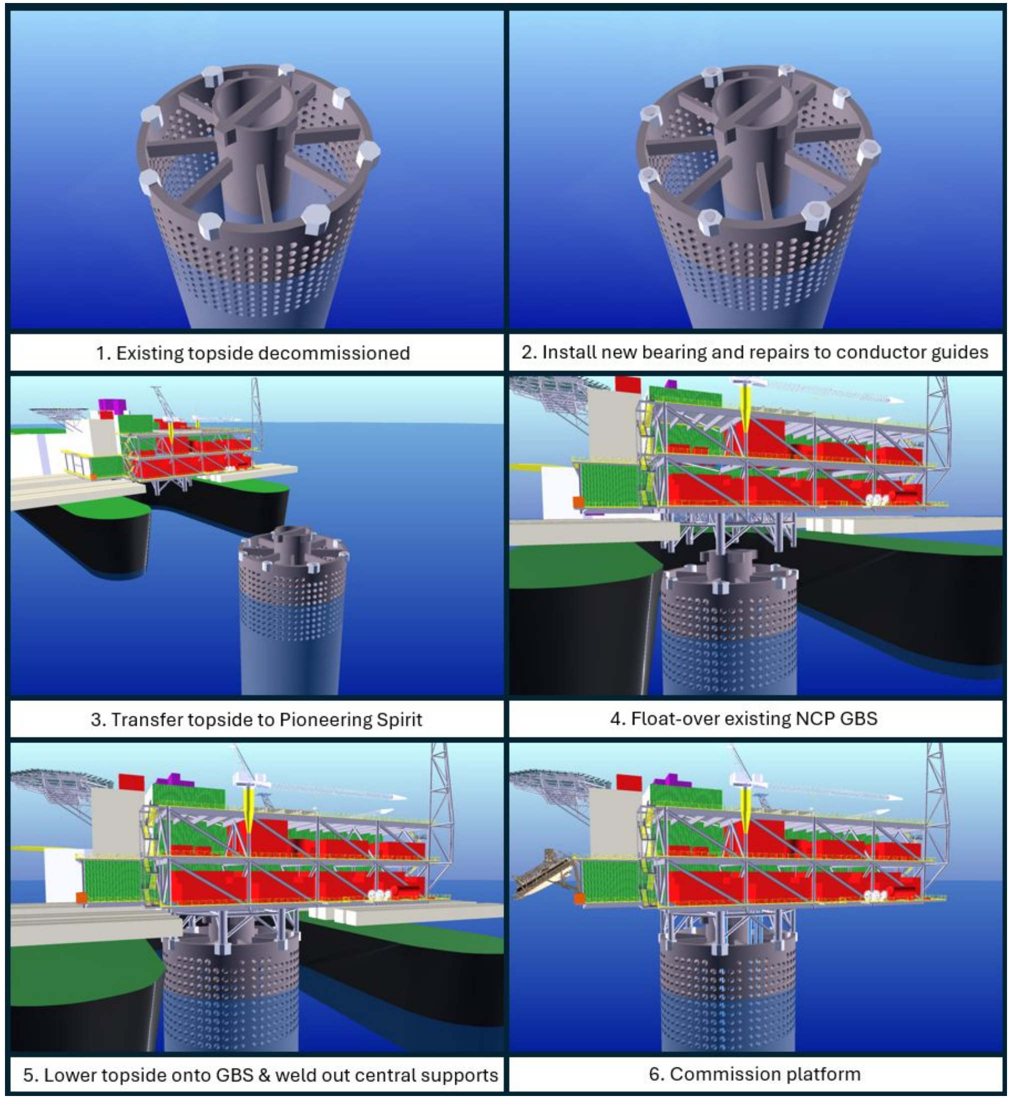


Proposed HOP2 topside / GBS interface steelwork

Structural

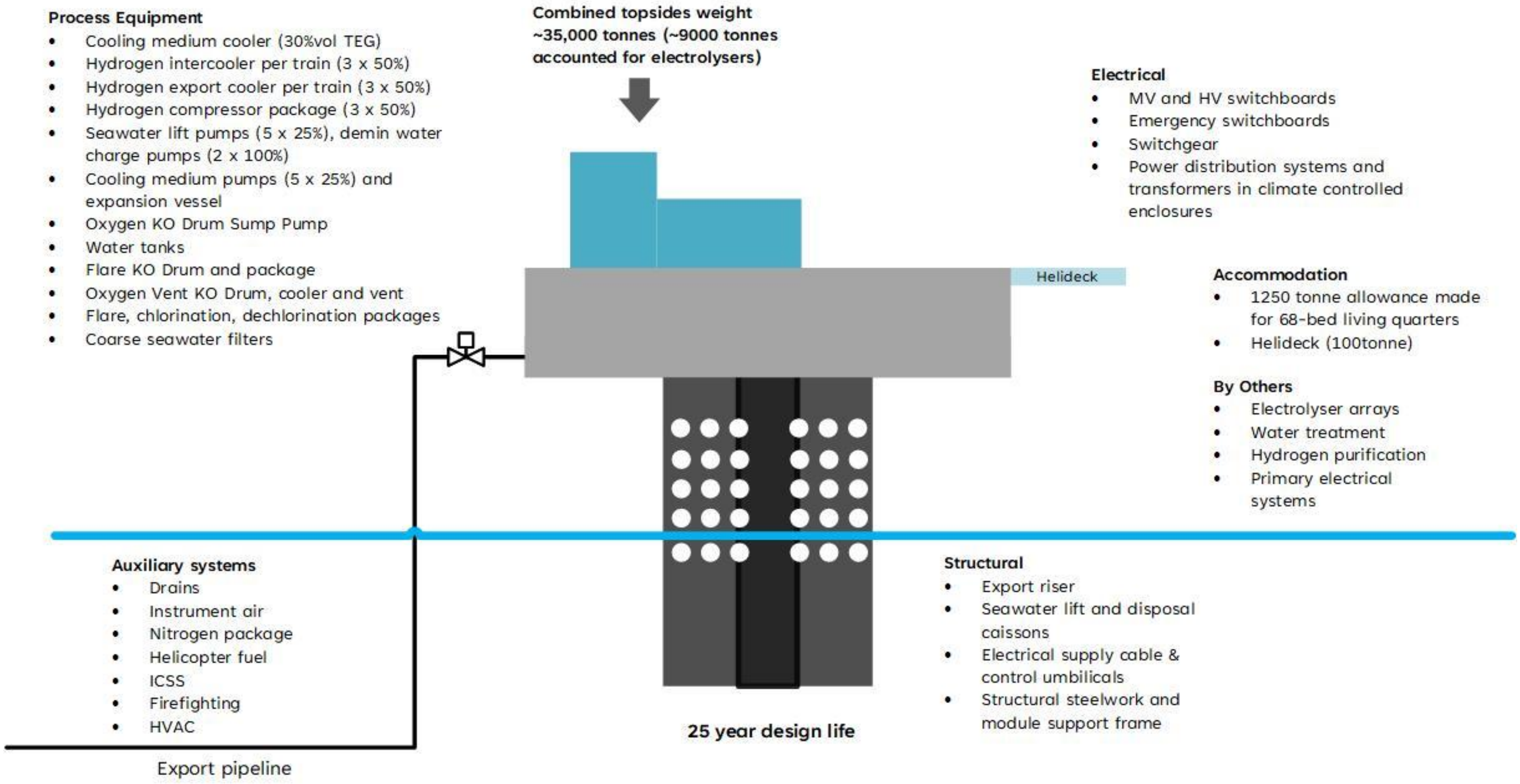


Proposed breakdown of topsides for modular installation



High level installation sequence for the installation of an integrated deck with the Pioneering Spirit

Project Outputs



Phase 2 Report it due to be published by end 2025 by NZTC.

Next Steps

- Economic Studies
- Impact of unplanned Hydrogen Release
- Art of the Possible Facility Design

apollo

Any Questions?

Michelle.hitches@apollo.engineer