Project Britannia: A National Strategic Blueprint

Offshore nuclear-powered hydrogen clusters delivering firm, 24/7 hydrogen to Teesside and the Humber

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Author's Statement & Disclaimer

This proposal is submitted by David Waugh, a retired Gas Engineer, as a concept-level contribution to UK Net Zero options and industrial decarbonisation. It is intended to support policy and engineering discussion and to encourage structured evaluation of offshore reuse pathways.

- **No financial stake:** The author holds no financial stake in any companies, technologies, or projects referenced and expects no financial benefit.
- **No formal affiliations:** The author has no formal links to OPRED, the North Sea Transition Authority (NSTA), the Office for Nuclear Regulation (ONR), the Health and Safety Executive (HSE), the IAEA, or named operators.
- **Concept-level only:** This document is not a substitute for operator data rooms, regulatory safety cases, environmental impact assessment, or formal Front-End Engineering Design (FEED).
- **Technology references are illustrative:** Any mention of vendors (e.g., Rolls-Royce SMR) is illustrative and not an endorsement or procurement recommendation; final technology choices would follow UK regulatory and commercial processes.

Why this matters (plain-language framing)

For millions of years Earth's climate and biosphere evolved without industrial-scale combustion. The industrial revolution brought unprecedented prosperity, but also large-scale greenhouse-gas emissions. Britannia is a proposal to help the UK "step back into balance" by stopping routine carbon combustion for hard-to-abate sectors and replacing it with firm low-carbon energy.

The core idea is simple: use low-carbon power to split water into hydrogen and oxygen; then use hydrogen as an energy carrier for industry, shipping, heavy transport, and power. After use, hydrogen returns to water. In practice, delivery requires rigorous engineering, environmental permitting, and a conservative safety case—especially offshore.

Key talking points (for stakeholders)

- **Safety by design:** Separate the nuclear "Power Hub" from hydrogen production platforms; apply defence-in-depth across nuclear, hydrogen, and

marine hazards; design for safe shutdown and heat removal under loss-of-power scenarios.

- **Field-cluster reality:** In many mature North Sea developments, installations can be only a few kilometres apart; short subsea cable runs can support a hub-and-satellite concept while still maintaining conservative hazard separation distances (to be defined by the safety case).
- **Circular economy & waste minimisation:** Desalination brine is managed deliberately (controlled discharge where required, and potential off-take to shore where economical); oxygen is a co-product that may be captured where there is local demand.
- **Just transition & jobs:** Retain and redeploy offshore skills into a new long-duration industry, supporting communities linked to Aberdeen, Teesside/Teesport, and the Humber—avoiding abrupt industrial decline of the kind seen in historical UK coal communities.
- **Not every asset is suitable:** Only a subset of installations will be economically and structurally viable for life extension; screening and integrity assessment are an early gate.
- **Optional upside, not a dependency:** Potential critical-mineral recovery (e.g., Direct Lithium Extraction) is treated as an optional R&D/industrial extension if and when technology is proven at scale—not the basis of the core business case.
- **Exportable blueprint:** If demonstrated, Britannia could become an exportable "reference design + regulatory playbook" for other basins (subject to licensing, treaties, and local constraints).

Terminology note: Public sources often mix terms. "Rigs" are typically drilling units; "platforms" are production installations. Publicly cited counts vary by scope (UKCS vs UK sector of the North Sea; platforms vs all subsea structures). This paper avoids asserting a single definitive "all-in" count without a referenced database.

1. Executive Summary

Project Britannia proposes a scalable, modular system of offshore energy hubs: each hub combines a 300–350 MWe Small Modular Reactor (SMR) "Power Hub" with a cluster of up to five repurposed offshore platforms hosting 24/7/365 Proton Exchange Membrane (PEM) electrolysis. Hydrogen is exported to shore primarily through re-use of existing export pipeline corridors, subject to hydrogen suitability testing and (if required) internal lining and component replacement.

The national strategy explicitly targets the UK's industrial heartlands:

- **Teesside (Teesport / Wilton chemical complex)** — a priority hydrogen hub with high-value chemical and shipping demand.
- **Humberside (the Humber industrial cluster)** — the UK's largest industrial emissions region, suitable for direct hydrogen offtake to refineries, chemicals, steel, and power.

The approach is designed as a circular, low-waste system:

- **Circular water loop:** seawater is abstracted for desalination; hydrogen use later returns to water. (Where it returns—industrial product water, atmospheric moisture, or marine return—depends on end use.)
- **Brine management:** brine is handled via permitting and engineering; where economical and environmentally beneficial, off-take pathways to shore can be evaluated rather than routine discharge.

2. Starting Point: Named Offshore Assets for Phase 1 (Test Bed)

Phase 1 uses a named cluster as a test bed to validate the engineering, safety case approach, and pipeline conversion methodology. The intent is to establish a repeatable blueprint that can be replicated into many more clusters of five platforms wherever feasible.

Candidate Platform	Operator (as publicly listed)	Public status pages / sources (indicative)	Indicative export corridor / landing area
To be confirmed	*To be confirmed*	*To be confirmed (links inserted when final assets are selected)*	*Teesside / Humber (concept)*

4. Technical Overview (Concept-Level)

4.1 SMR power block and operating mode

- **SMR size:** 300 MWe (base), 350 MWe (upside case if available).
- **Operating philosophy:** baseload electricity to ensure electrolyzers run 24/7/365 (subject to maintenance schedules and grid/industrial constraints).
- **Architecture:** Power Hub + five “Electrolysis Satellites” (repurposed platforms), connected by subsea electrical cables.
- **Potential UK vendor example:** Rolls-Royce SMR (UK) is one example of an SMR programme relevant to UK supply chain discussions; any selected design would need ONR licensing and an offshore safety case.

4.2 Hydrogen output (order-of-magnitude)

Using a conservative PEM system electricity intensity of 55 kWh/kg H_2:

- **300 MW net to PEM** — ~131 t/day hydrogen.
- **350 MW net to PEM** — ~153 t/day hydrogen.

4.3 Water and desalination

- Pure water demand is driven by electrolysis (order-of-magnitude: 12–15 kg water per kg H_2 allowing for losses and quality control).
- For ~131 t/day hydrogen, purified water is on the order of ~1,600–2,000 m³/day for the cluster.

- Desalination electrical load is small relative to PEM (generally sub-MW to low-MW at this scale).

4.4 Brine strategy: “zero-to-minimum waste”

Britannia treats brine as a managed stream rather than an unexamined waste stream:

- **Optional mineral recovery:** evaluate Direct Lithium Extraction (DLE) and other mineral recovery only where pilot economics and environmental performance support it.
- **Off-take pathway screening:** assess whether any brine off-take to shore is practical (seasonal de-icing, chemical feedstock, aquaculture, construction uses), recognising logistics and market constraints.
- **Marine protection:** where discharge is required, design it (diffusers, blending, monitoring) and permit it properly.

5. Skills Passport & Just Transition

Britannia is designed to retain and redeploy the UK’s offshore workforce as oil and gas winds down. The project proposes a Skills Passport approach that recognises the close match between offshore oil & gas competencies and offshore hydrogen/nuclear-adjacent operations:

- Process and control operations, high-pressure systems, rotating equipment, electrical systems.
- Subsea operations, marine operations, maintenance planning, safety leadership.
- Offshore emergency response culture and permit-to-work discipline.

A structured passport accelerates retraining, reduces unemployment risk in coastal communities, and supports a just transition by using the skills already present in the North Sea.

6. Safety & Risk Management (High Level)

- **Hazard separation:** physical separation between nuclear Power Hub and hydrogen production satellites.
- **Defence-in-depth:** layered safety systems for nuclear, hydrogen, and marine hazards (to be developed into an offshore-specific safety case).
- **Pipeline integrity management:** hydrogen compatibility testing; lining or partial replacement where required; continuous monitoring.

7. Phased Delivery Plan & Timeline to First Hydrogen (2029–2032)

Phase	Years	Key Outputs
0	2026	Asset screening; confirm Phase-1 cluster; begin OPRED/ONR/HSE/NSTA engagement; define Teesside/Humber landing concepts; initiate Skills Passport stakeholder design.
1	2026–2027	Pre-FEED; pipeline testing plan; brine pathway concept; environmental scoping.

Phase	Years	Key Outputs
2	2027–2028	FEED and FID preparation; procurement strategy; confirm pipeline conversion route (as-is vs lined vs partial replacement).
3	2028–2030	Fabrication; platform modification; subsea power distribution works; pipeline conversion and onshore receiving modifications.
4	2029–2032	SMR delivery/commissioning sequence (as licensed); integrated commissioning; First Hydrogen to Teesside and/or Humber landing points.

8. Scalability: From Phase-1 Test Bed to Many Clusters

Phase 1 is explicitly a test bed. The end goal is a long-term UKCS programme with multiple clusters of five platforms wherever suitable infrastructure exists. The cluster model is modular and repeatable, enabling a system fit for the future: firm low-carbon power, 24/7 hydrogen, minimal waste, and maximum reuse of UK offshore assets.

Sources referenced in this white paper

- David Waugh, *Project Britannia: A New Horizon for the North Sea* (uploaded proposal text file; includes decommissioning liability framing).
- *brine use.txt* (uploaded notes on brine uses and integrated “circular economy dividend” approach).
- Public operator pages and UK OPRED guidance pages linked in the Phase-1 asset table (platform-specific citations to be inserted once final assets are confirmed).

End of document.