Project Britannia

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

Formal proposal document for UK Government consideration

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Submitted to	UK Government (for consideration), including: Department for Energy Security and Net Zero (DESNZ), HM Treasury, North Sea Transition Authority (NSTA), Office for Nuclear Regulation (ONR), Offshore Petroleum Regulator for Environment and Decommissioning (OPRED), Health and Safety Executive (HSE), Maritime and Coastguard Agency (MCA), and relevant environmental regulators.
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Status and intent: This is a *concept-level* proposal to enable structured policy and engineering evaluation. It is not a procurement specification, not a regulator-approved safety case, and not a substitute for operator data rooms, Environmental Impact Assessment (EIA), or Front-End Engineering Design (Pre-FEED/FEED).

Author's statement & disclaimer (summary):

- **No financial stake:** the author holds no financial stake in companies, technologies, or projects referenced and expects no financial benefit.
- **No formal affiliations:** the author has no formal links to OPRED, NSTA, ONR, HSE, the IAEA, or named operators.

Concept origin note: the just-transition emphasis reflects the author's experience of industrial job losses during the 1980s and a desire to avoid repeating similar outcomes as North Sea assets approach end of life.

1. Executive summary

> **Proposal in one paragraph:** Project Britannia proposes a modular offshore system that combines a **300–350 MWe Small Modular Reactor (SMR) "Power Hub"** with up to **four repurposed offshore platforms** hosting **24/7/365 PEM electrolysis**. The Power Hub remains a **purely electrical environment**; hydrogen production and compression occur on **physically separated satellite platforms** (typically **~2–5 km** apart), with power transferred by subsea cables. Hydrogen is exported to shore primarily by **re-using existing export pipeline corridors** (subject to hydrogen suitability testing and upgrades).

1.1 The strategic problem Britannia addresses

- **Net Zero delivery:** hard-to-abate industrial clusters require scalable, low-carbon hydrogen with high availability.
- **Energy security:** firm, 24/7 domestic supply reduces exposure to weather-driven intermittency and global commodity shocks.
- **Decommissioning liability:** UKCS decommissioning is a large, long-duration cost exposure (public NSTA estimate range **£44–£82 billion**, with public discussions of ~**£24 billion** taxpayer exposure via tax relief mechanisms).
- **Just transition:** the North Sea workforce and coastal supply chain require credible pathways into new energy industries.

1.2 What government is being asked to do (12–18 month actions)

Decision / ask	Purpose	Proposed lead
A1. Commission an independent Phase-0 screening study (6–9 months)	Identify a viable pilot cluster; screen candidate assets; define export corridor options; validate preliminary safety approach; set cost bands and data requests for Pre-FEED/FEED.	DESNZ + NSTA (with ONR/OPRED/HSE input)
A2. Establish a cross-regulator scoping group	Define an integrated regulatory pathway for an offshore SMR-adjacent industrial facility (nuclear licensing, offshore safety, marine environment, security, emergency planning).	ONR (with OPRED, HSE, MCA, devolved regulators)
A3. Instruct a pipeline suitability & conversion programme	Set the evidence plan for hydrogen service: metallurgy review, inspection history, pressure cycling, embrittlement risk controls (lining/ replacement where required),	NSTA + OPRED (with operators and integrity specialists)

Decision / ask	Purpose	Proposed lead
	monitoring and operations philosophy.	
A4. Launch an industrial offtake partnership track	Identify anchor offtakers for Teesside (Teesport/Wilton) and the Humber; define receiving infrastructure upgrades; align with hydrogen network development.	DESNZ + regional partners + industry
A5. Start a "Skills Passport" pilot design	Enable efficient transition of offshore roles into offshore hydrogen and adjacent nuclear-grade operations while preserving safety culture and competence assurance.	Industry + unions + DfE/ DESNZ

> **Key point on claims:** Quantities in this document are *order-of-magnitude* and derived from stated assumptions (e.g., PEM specific electricity consumption). Items that require FEED-grade verification are explicitly flagged.

2. Strategic case

2.1 Target regions and purpose

Britannia is framed around a first pilot serving the UK's industrial heartlands: **Teesside (Teesport / Wilton)** and **the Humber industrial cluster**, where high-volume hydrogen demand exists in chemicals, refining, industry, shipping and power.

2.2 UK offshore asset context (terminology clarified)

- **Production platforms (UK sector):** public summaries commonly cite approximately **~470** platforms in the UK sector of the North Sea (includes operating and non-operating installations).
- **Production platforms (whole North Sea basin):** approximately **~600**.
- **Wider offshore inventory:** larger figures (e.g., ~**1,500**) typically refer to **all installations and subsea structures** (platforms, wellheads, templates, manifolds, pipelines and other seabed equipment), not "platforms" alone.

> **Implication:** Britannia is a *selective* repurposing programme. Many assets will still require conventional decommissioning; the proposal is to identify the best candidates where repurposing materially improves value, safety and deliverability.

3. The Britannia proposal (concept architecture)

3.1 The "1+4" cluster model

Element	Description
Rig 1 – Power Hub (SMR)	A dedicated offshore SMR installation providing firm electricity. Design intent is a **clean, purely electrical environment**, with stringent nuclear safety/security controls.
Rigs 2–5 – Hydrogen satellites	Repurposed platforms hosting seawater intake, desalination, PEM electrolysis, drying, metering, compression and associated safety systems.
Physical separation	Typical separation of **~2–5 km** between the Power Hub and hydrogen satellites to reduce common-cause risk and simplify hazard zoning and emergency response access.
Electrical transfer	Power transfer by subsea cables; hydrogen processing is kept off the nuclear platform.
Hydrogen export	Primary route is re-use of existing export pipeline corridors, subject to: (i) hydrogen suitability testing; (ii) upgrades such as lining/partial replacement; and (iii) monitoring/operational controls.

3.2 Order-of-magnitude outputs (derived from stated assumptions)

Parameter	300 MW net-to-PEM case	350 MW net-to-PEM case
Hydrogen output (SEC ~55 kWh/kg)	~131 t/day	~153 t/day
Indicative annual hydrogen	~45,000–50,000 t/year	~55,000+ t/year
Purified make-up water (12–15 kg/kg H_2)	~1,600–2,000 m^3/day	Higher proportionally
Brine volume (concept range; depends on RO recovery)	~1,600–3,000 m^3/day	Higher proportionally
Oxygen co-product (theoretical, ~8 kg O_2/kg H_2)	Order-of-magnitude ~1,050 t/day O_2	Higher proportionally

Notes on the output table:

- Hydrogen output is calculated directly from net electrical input to PEM and assumed system-level specific electricity consumption (SEC).
- Gross SMR electrical rating must exceed net-to-PEM if compression/export and platform utilities are included on the same power budget.
- Oxygen capture is an *option*; it requires purity specifications, compression/liquefaction choices, offtakers and safe handling design.

4. Safety, security, and regulatory pathway (high level)

4.1 Safety-by-design principle: the "safety firewall"

- **Hazard isolation:** hydrogen high-pressure and explosion hazards are physically separated from the nuclear Power Hub.
- **Clean zone:** the Power Hub is designed to remain a purely electrical environment, supporting a clearer safety case boundary.
- **Defence in depth:** layered prevention and mitigation measures for hydrogen release/fire/explosion, marine collision, extreme weather, and loss-of-cooling scenarios.

4.2 Regulators and consenting (indicative)

Body	Indicative role
ONR	Nuclear safety and security licensing (including safeguards, security requirements and emergency planning expectations).
OPRED	Offshore environmental regulation and decommissioning programme interface; EIA expectations for offshore works and discharges.
HSE	Offshore major accident hazards; hydrogen process safety; workforce safety.
NSTA	Stewardship, asset transfer, and decommissioning cost/ regulatory context; pipeline and infrastructure oversight in the wider UKCS framework.
MCA	Marine safety and navigation aspects; interaction with shipping; emergency response planning interfaces.
EA/SEPA/NRW	Environmental permitting interfaces (as applicable) and standards expectations for any onshore receiving facilities.

First-of-a-kind (FOAK) posture: Offshore nuclear deployment is FOAK in the UK context. Britannia assumes a conservative approach: early regulator engagement, explicit demonstration of ALARP, and progressive maturation from Phase-0 screening to Pre-FEED/FEED before any commitment to construction.

5. Environmental approach and circular-economy design intent

5.1 Water loop framing

Britannia positions hydrogen as a means to “borrow molecules”: seawater is temporarily abstracted and purified; hydrogen use later returns water to the environment through the hydrological cycle. This framing does not remove the need for robust offshore environmental assessment of intake/outfall design, brine handling, thermal loads, and any routine discharge.

5.2 Brine: “minimum to no routine discharge” (design intent)

- **Core intent:** treat desalination brine as a co-product where practical, exporting to shore for de-icing and/or chemical feedstock use, thereby minimising routine marine discharge.
- **Reality check:** this requires storage, specification, logistics, offtakers, and permitting; any residual discharge must be engineered and permitted with environmental controls.
- **Mineral recovery:** direct lithium extraction (DLE) and similar processes are positioned as *optional upside* only, to be piloted and validated; the core business case should not depend on mineral revenue until proven at operational scale.

5.3 OSPAR and decommissioning context

Britannia should be assessed within applicable international and domestic frameworks for offshore installations. OSPAR Decision 98/3 sets strong expectations against dumping/abandonment; however, its framework includes *derogation routes* for certain installations under defined conditions. Any repurposing approach must therefore be built to meet regulatory expectations and demonstrate environmental benefit and integrity.

6. Delivery plan (indicative pathway to first hydrogen)

The current concept schedule targets **first hydrogen 2029–2032**, contingent on licensing and consenting outcomes, supply chain readiness, and completion of Pre-FEED/FEED with robust evidence.

Phase	Years	Key outputs
Phase 0	2026	Confirm pilot cluster; initiate regulator pre-application engagement; define landing concepts for Teesside/Humber; initiate Skills Passport design; define pipeline testing plan scope.
Phase 1	2026–2027	

Phase	Years	Key outputs
		Pre-FEED studies; environmental scoping; brine export pathway concept; offtake mapping; preliminary safety case architecture; data requests to operators.
Phase 2	2027–2028	FEED and FID readiness; confirm pipeline conversion solution (as-is vs lined vs partial replacement); onshore receiving integration engineering; offtaker MoUs.
Phase 3	2028–2030	Fabrication and platform modifications; subsea electrical works; pipeline conversion; onshore receiving modifications.
Phase 4	2029–2032	SMR delivery/commissioning (as licensed); integrated commissioning; first hydrogen to Teesside and/or Humber landing points; operational handover.

7. Anticipated benefits (headline)

7.1 Strategic & system benefits

- **Firm 24/7 hydrogen** for industrial decarbonisation in Teesside and the Humber.
- **Domestic energy security** using an offshore asset base and UK supply chain capability.
- **Replicable blueprint** for selective repurposing across UKCS where assets are suitable.

7.2 Economic & workforce benefits

- **Just transition pathway** for the North Sea workforce (Skills Passport concept).
- **Value preservation** by extending the productive life of select offshore assets.
- **Port and fabrication activity** with potential uplift to Teesside/Humber and wider UK supply chains.

> **Note:** This document avoids asserting specific national revenue or savings totals without FEED-grade project economics. A Phase-0/Pre-FEED programme should explicitly quantify costs, benefits, and distributional impacts.

8. Principal risks and how the proposal de-risks them

Risk	What could go wrong	De-risking approach (early actions)
Regulatory and licensing risk	FOAK offshore nuclear application increases uncertainty, duration and evidence burden.	Cross-regulator scoping group; phased progression (Phase-0 → Pre-FEED → FEED); conservative safety

Risk	What could go wrong	De-risking approach (early actions)
		case boundaries via hazard separation.
Pipeline hydrogen suitability	Embrittlement/leak risk; unknown condition; constraints on pressure/flow; receiving terminal modifications.	Structured integrity programme: metallurgy/records review; inspection/testing; define conversion choices (lining/partial replacement); monitoring and operating envelope definition.
Offtake and market risk	Insufficient or delayed industrial demand; offtaker uncertainty affects financing.	Early industrial partnership track with Teesside/Humber; staged offtake MoUs; alignment with hydrogen support mechanisms.
Brine logistics and permitting	Unable to secure continuous offtakers; storage or handling constraints; discharge permit challenges.	Define brine specification, storage and logistics in Pre-FEED; treat "no routine discharge" as design intent; include engineered/permit-compliant discharge fallback.
Security and resilience	Physical/cyber threats; marine access; extreme weather; collision.	Design to ONR security requirements; marine coordination and safety zones; redundancy in access/evacuation; design for extreme weather loading.

9. Recommended next step

> **Recommendation:** Authorise and fund a **Phase-0 independent screening study** and a **cross-regulator scoping group** in 2026, to convert this concept into an evidence-based Strategic Outline Case suitable for government decision-making.

Submitted by: David Waugh (Retired Gas Engineer)

This document is provided for consideration and does not represent government policy or commitment.

Appendix A — Public sources referenced for alignment

- UK Hydrogen Strategy (policy papers): https://www.gov.uk/government/publications/uk-hydrogen-strategy
- NSTA decommissioning cost estimate: https://www.nstauthority.co.uk/regulatory-information/decommissioning/cost-estimate/
- OSPAR offshore installations and Decision 98/3 context: https://www.ospar.org/work-areas/oic/installations
- IAEA SMR topic overview: https://www.iaea.org/topics/small-modular-reactors
- Petroleum Act 1998: https://www.legislation.gov.uk/ukpga/1998/17/contents
- Nuclear Energy (Financing) Act 2022: https://www.legislation.gov.uk/ukpga/2022/15/contents

> **Verifiability note:** Where project-specific numbers cannot be independently verified from public sources (e.g., platform-specific integrity details, pipeline metallurgy records, site-specific oceanographic data), they should be treated as estimates to be tested and refined during Pre-FEED/FEED.