



Wet Storage – ‘Lessons Learnt’

TS-FLOW™ Wet Storage JIP (UK North) Phase 1

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**TS-FLOW™ Temporary Storage –
UK North – Phase 1 Lesson Learnt**

Public Version

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1. TS-FLOW™ - The Temporary Floating Storage Solution

The **TS-FLOW™** temporary storage solution, devised by **Offshore Solutions Group** and developed in conjunction with **HR Wallingford** delivers a key component in FLOW project logistics to enable effective assembly & deployment of industrial scale FLOW developments. Not having a temporary storage site available leads to higher assembly & deployment costs, lower local content, limited schedule flexibility and therefore higher project risk.

The **TS-FLOW™** temporary storage solution is the most advanced delivery programme of a FLOW temporary storage solution in the floating wind industry today. It combines over three years of dedicated research, advanced assessment and extensive industry engagement and is backed by decades of offshore floating expertise. **TS-FLOW™** is also the only completed UK-wide independent assessment offering support and solutions to every floating wind development in ScotWind, INTOG and the Celtic Sea.

The **TS-FLOW™** phased approach to delivering a wet storage solution allows for a managed and lower risk outcome for all parties be they end-users (Developer), delivery partners (ports/facilities) or agencies and authorities. It is a highly transparent, inclusive, and proprietary process that continues to focus on the ultimate delivery of a safe and cost-effective provision of a working solution; wet storage sites that are readily available to Developers when needed.

To match the current floating wind licencing programmes, **TS-FLOW™** is geographically split into regional areas, Phase 1 studies have been completed for the 'Celtic Sea' and 'UK North'. Although split into defined study areas the coverage includes the entire coastline of the UK (England, Wales, Scotland, and Northern Ireland). Alongside the unique geographic coverage,

TS-FLOW™ industry engagement includes:

- Developers representing ~50% of all existing UK FLOW power (GW) under planning. **(60% of ScotWind Licences holders¹ engaged in UK-North JIP)**
- >80% of the major UK port authorities & operators planning to provide operational support to FLOW construction or delivery activity. **(89% of Scottish Ports² engaged in UK-North)**
- Every significant regulator and key agency involved in FLOW permitting or permissions across three home nations (England, Scotland, and Wales).
- Technical partners covering certification, classification, insurance, finance, and operational delivery (survey, security, surveillance, O&M etc.)

TS-FLOW™ UK-North was supported by 5 Developers/Projects (including Oceanwinds, Muir Mhór, & BlueFloat Energy Renantis Partnership) and 6 ports (including Montrose Harbour, Peterhead Harbour, Orkney Harbours & Inverness Harbour)

The UK North Phase 1 study was completed over a ten-month period in 2023 with final reporting in Q1 2024.

¹ 60% of participating developers in ScotWind either through partnerships on FLOW projects participating in the JIP, or direct participation in the JIP,

² Scottish Ports identified as Ports capable of providing fabrication, assembly, and/or integration capability within 5 years, as agreed with the JIP participants and in consultation with port authorities.

a. Rational for FLOW temporary storage

Without suitable temporary offshore storage, the technical and economic viability of local assembly of floating foundations and even local WTG integration could be significantly compromised or deemed too challenging. The risks of significant project delay or the potential of ‘downscaling’ of projects due to the associated logistical challenges of delivery without a floating storage option are evident. Temporary floating storage sites will enable multipoint strategies for delivery of FLOW projects whilst also enabling smaller ports to potentially be used for WTG integration in addition to providing support services for the fabrication and operation of the temporary storage sites.

The temporary storage locations can additionally be used for future repair and maintenance where a FLOW unit is required to be towed back to a sheltered location to enable significant repair work. Recent industry FLOW unit WTG repairs have demonstrated the requirement for repair and maintenance (R&M) locations to be located close to the installed offshore location to avoid long transits for R&M and therefore reduce overall operational through life costs. Insurers have indicated that having this facility reserved as part of the project operational planning may reduce insurance premiums as this potentially reduces the cost associated with major R&M activities.

There is now industry wide acceptance that temporary floating storage is required to enable project delivery, and to unlock the capabilities of UK ports and infrastructure to maximise the local content benefit of FLOW roll out. This is recorded in numerous published documents and presentations such as Renewable UK’s “Floating Offshore Wind Taskforce: Industry Roadmap 2040” report. Wet storage consenting is ranked in Scottish Renewables top 10 risks to successful roll out and delivery of local content for FLOW projects.

The UK wide TS-FLOW™ projects are the most advanced and therefore the fastest way to deliver on the wet storage requirement, further demonstrated by the support provided by government agencies and funding bodies.

2. TS-FLOW™ UK North Phase 1

This study scope, “**UK North Phase 1**”, covered the coastline from the North of England to Northern Ireland, encompassing all of Scotland and its islands, (Figure 2-1) the first phase of a unique, highly developed six-phase approach to the delivery of wet storage solutions and had several key objectives:

1. Identify a working **shortlist of potential wet storage locations** with high probability of progression to subsequent phases of development as wet storage sites.
 - a. Provide sufficient detail and rationale to support the site selection.
2. Provide commentary and insight into the likely **licencing, permitting and permissions** associated with and required for the delivery of operational wet storage sites.
 - a. Feedback interactions with key authorities, regulatory agencies on wet storage issues, considerations, and assessment approach
 - b. Outline potential legislative & practical considerations, blockers, and opportunities.
3. Provide a robust **Social Value Model** and **Sustainable Industry Rewards** assessment of activities related to the delivery of wet storage sites.
 - a. Provide robust summary data that can be incorporated into current project planning and authority interactions (licences, CfD, etc.)
4. Provide additional insights and perspectives of the **insurance community** regarding wet storage provision in context to the construction and operations of FLOW projects.
 - a. Ensuring that wet storage can be delivered as an integral part of a wider logistics, construction, and operations plan.

All the objectives were met or exceeded during Phase 1 and the data, knowledge, learnings, and unique experience will be carried over into Phase 2.



Figure 2-1: UK North Phase 1 Study Area

3. TS-FLOW™ UK North Phase 1 – Insights & Learning

The following are abridged notes, data, and information. The full report with detailed commentary, data and location information & assessment is available to purchase from Offshore Solutions Group.

The UK-North study developed into a more complex and challenging study than envisaged, even after carrying through the knowledge and learning from the Celtic Sea study.

On first impression the coastline and Islands around the North of the UK present significant opportunities for temporary storage locations, this was demonstrated in the initial screening that delivered 72 sites for potential use as temporary storage locations *Figure 3-1*.

The numerous complexities of the temporary storage requirement meant that only 9 sites have been identified as meeting the baseline criteria set by the JIP participants and are shortlisted to be taken into the next phase of the JIP.

The complex challenges of competing use (commercial, leisure, military, etc.) including from within the offshore wind industry, consenting, licencing, insurance, technical, & metocean etc. were all considered and evaluated. This increase in interaction and consultation meant that the detailed evaluation criteria used in the assessment **increased by 57%** over the similar Celtic Sea study, evidenced in the 450-page final report.

b. Locations

- #72 locations screened & assessed (Figure 3-1).
 - Assessment & evaluation was of greater complexity than originally envisaged (**57% increase** in the detailed evaluation criteria from Phase 1 Celtic Sea study)
- Short-list of #7 locations identified for both pre and post integration use as wet storage sites:
 - #2 sites suitable for pre-integration use as wet storage sites.
 - Of these #9 sites, #3 stand out as ‘premier’ locations:



Figure 3-1: Phase 1a potential temporary storage sites

Source: Aerial imagery: Earthstar Geographics SIO. Microsoft product screen shot reprinted with permission from Microsoft Corporation

c. Licence & Consenting

The consenting and permitting required for the site development can be considered more complex in work scope and timescales than the permanent floating offshore wind farm, on the grounds that the temporary storage concept is new and therefore there is no precedent or legislation in-place specifically for permitting/licencing a temporary storage site. The Marine licencing requirements and regulations applicable to temporary storage sites and the potential multiple uses of the storage site (e.g. commissioning, construction, turbine operations, repair & maintenance) are under consideration by MD-LOT, in discussion with the **TS-FLOW™** project.

It is assumed all sites will require some form of an Environmental Impact Assessment to be conducted whether in areas owned by 'Crown Estate Scotland' or under Port Authority jurisdiction. This is in addition to the time frame required for obtaining a seabed lease or rights of use from Port Authorities (although both may be progressed concurrently).

- Applications must be clear on final use/activities during first application as retrospective changes may not be approved.
- Due to time, cost, complexity of evaluation, and limited availability of suitable sites, a multi-party use site is likely to be considered more favourably.
- Considerable complexity remains in the qualification of permits and permissions.

d. Social Value

The inshore coastal nature of wet storage activities combined with the technical requirements creates a significant local value opportunity. Above average ratios of local value and local jobs can be supported by the provision of wet storage sites, bringing long-term sustainable and tangible value to deprived/assisted areas. Wet storage sites are 'literally' anchored in their community and the local community directly benefits from this.

A robust and detailed qualification and quantification of activities has indicated the potential to deliver above average potential to deliver value to deprived/assisted areas.

The provision of **TS-FLOW™** wet storage sites deliver tangible social and local value and an assessment under the Social Value Model and Sustainable Industry Reward guidance produced the following key data points.

- The site 'lifetime expenditure' is noted at £126m (per site):
 - ~94% of this expenditure within the UK and ~85% UK content/GVA retained in the UK.
 - 61% of the UK content/GVA is delivered locally or regionally.
- 1,655 FTE years ('jobs') supported through the project lifetime:
 - 75% of these jobs are delivered locally.
 - >83% (1,374) of these jobs can be in deprived/assisted area.

e. Insurance & Risk

The risk & insurability of the temporary storage site and the FLOW units whilst being moored and on-station is a key consideration in both selection of the sites and their operability. This adds complexity into an already challenging technical problem. As demonstrated in other aspects of the **TS-FLOW™** process the insurance industry is now catching up with the needs and requirements that have been highlighted by **TS-FLOW™** and are keenly engaged in the proactive approach being taking by **TS-FLOW™** to identify and address the issues relating to insurability.

A key focus is on demonstrating that the use of the temporary storage site is of lower risk than other operations conducted during the full build and install activities for the FLOW project. This involves a detailed interaction between insurers, designers, classification societies and developers to ensure that all parties contribute to lowering the risk (and therefore lowering insurance premiums), and to provide a deliverable temporary storage solution for the benefit of the developers and wider industry. This can then be used as a benchmark/template that can be exported worldwide.

Key changes/consideration required following consultation with insurers.

- Space between each moored FLOW units has **increased by 50%** from the previous Celtic Sea study, to enable safe and clear access and reduce risk in the event of a FLOW unit breaking free,
- **Permanent anchors** (piles, suction buckets, etc) will be used therefore avoiding drag embedded anchor (DEA) slippage and/or repositioning, including a permanent exclusion zone.
- **Site must be accessible (1 day in 5)** for required maintenance whilst in storage,
- Build in extra contingency for insurers, requirement of extensive emergency moorings for systemic failures (ensure correct license and permitting) as later changes will be timely and expensive.
- Liability and insurance (for the FLOW units) is outside of the existing ports coverage and therefore requires to be addressed together with the **TS-FLOW™** site operator, developer, and project insurers.

f. Technical

The system design of the securing points for the floating units, whether mooring or fixed dolphins, will be challenging and complex requiring the input of insurance, licencing, and classification societies. The seabed anchoring point and elements of the moorings system will be designed for 20years+ use.

The FLOW units will be moored in significantly shallower water than their final in-field location and therefore specific mooring design and analysis is required, including the interface with the FLOW units. Key challenges and considerations that need to be overcome for the temporary storage site to be multi-use (developers and FLOW design types)

- Varying seabed conditions between different sites and within the same location for different mooring and anchoring systems or fixed dolphins.
- Mooring system definition to support as wide a range of FLOW platform types and sizes as possible, which may lead to the need for multiple sites to cater for specific FLOW unit types.
- Design factors and metocean return periods used within the design of the temporary mooring system, agreed in consultation with insurers,

4. UK North Phase 2

a. Overview

After extensive discussions with developers, ports/facilities, governments, and regulatory agencies the following Phase 2 approach is two-step with options as illustrated below.

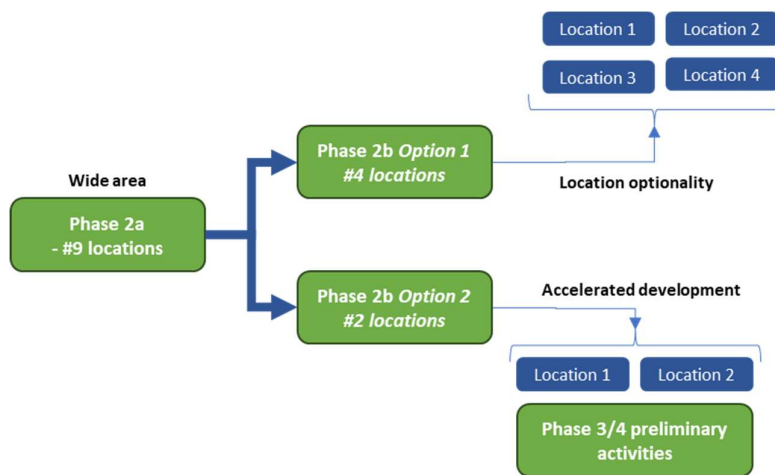


Figure 4-1: Phase 2b options.

As the 2a process will influence and inform 2b decisions, assessment of the results will combine with consultation with participants, agencies, and Governments to determine the preferred option to progress into phase 2b.

1. Phase 2a (**wide area**):
 - Phase 2a for **#9** screened location.
2. Phase 2b – Option 1 – **Location** optionality:
 - Phase 2b activities on **#4** locations.
3. Phase 2 b - Option 2 - **Accelerated** development:
 - Phase 2a for the **#2** ‘premier’ locations;
 - Initiate long-lead Phase 3 & 4 preliminary activities.

The costs of the two options are comparable and both follow the **TS-FLOW™** phased development approach:

- Option 1 maintains the current ‘wide area’ coverage and maintains the most flexibility for progress through to Phase 2b with Phase 2a data & analysis on the top #4 locations.
- Option 2 focuses on only #2 locations but initiates some Phase 3 & Phase 4 activities earlier and reduces the schedule risk for later phases:
 - Option 2 does not preclude the opportunity to revisit the other locations at a later date or if any of the ‘premier’ locations fail to progress at the desired speed or suitability.

For further details of the Phase 2 activities and to join the JIP, contact **Offshore Solutions Group**.

b. JIP Phases (overview)

The JIP is being progressed in the following Phases with the objective of this Phase 1 study being to provide a screening of potential sites and lay out the permitting framework along with an outline of site selection considerations.

TS-FLOW™ JIP Phases

| | |
|--|---|
| Phase 0 - Preparation | Securing local partner, signing up Developers, preparing study proposals |
| Phase 1 – Site selection | Conduct area wide search for suitable sites, site owner/manager contact, site evaluation and prioritisation |
| Phase 2 – Detailed evaluation | Advanced site evaluation, consultation with key stakeholders, on-site geophysical investigation, concept mooring design, navigation simulation, navigational risk & logistics assessment, metocean predictions. |
| Phase 3 – Engineering, environmental & studies | Detailed Engineering Design, On-site environmental studies and consultations. |
| Phase 4 – Permit & permissions to operate | Conduct and secure permits and permissions required to install and operate temporary storage site |
| Phase 5 – Procurement & operations set-up | Temporary storage site build and installation |
| Phase 6 - Operations | Fully licenced operational temporary storage site |