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TVU CCS Pre FEED Study

Outline Execution Strategy for delivery of SSI Anchor Project including CO_2 Transportation & Storage Infrastructure

Additional Information Regarding

The Implementation Programme

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Revision Changes Notice

Rev.	Location of Changes	Brief Description of Change

Changes within the document from the previous issue are indicated by a change triangle △

List of HOLDS

HOLD No.	Location of HOLD	Reason for HOLD

Table of Contents

Glossary of Terms

Abbreviation	Description
CCS	Carbon Capture & Storage
CO_2	Carbon Dioxide
CfD	Contract for Difference
DECC	Department of Energy & Climate Change
EPC	Engineering, Procurement & Construction
EPIC	Engineer, Procure, Install & Commission
ES	Environmental Statement
FEED	Front End Engineering Design
FID	Financial investment Decision
HDD	Horizontal Directional Drill
MWeHr	MW Hours - Electrical
MWthHr	MW Hours - Thermal
NGC	National Grid Carbon
PWA	Pipeline Works Authorisation
SSI	Sahaviriya Steel Industries

1.0 Introduction and Assumptions

This document provides an outline Project Execution Plan covering the activities required and the anticipated timescale, subsequent to a Financial Investment Decision (FID) being taken, to execute the 'anchor' full chain CCS Project which creates the Teesside Network as envisaged in the TVU study.

It is assumed here that the anchor project will require a material amount of CO_2, and hence involve capture from the SSI Redcar steelworks, so that the offshore pipeline investment can be justified, together with a second, inland capture source to enable the on shore network expenditure to be justified. It is assumed that the GrowHow ammonia plant at Billingham provides this second source of CO_2

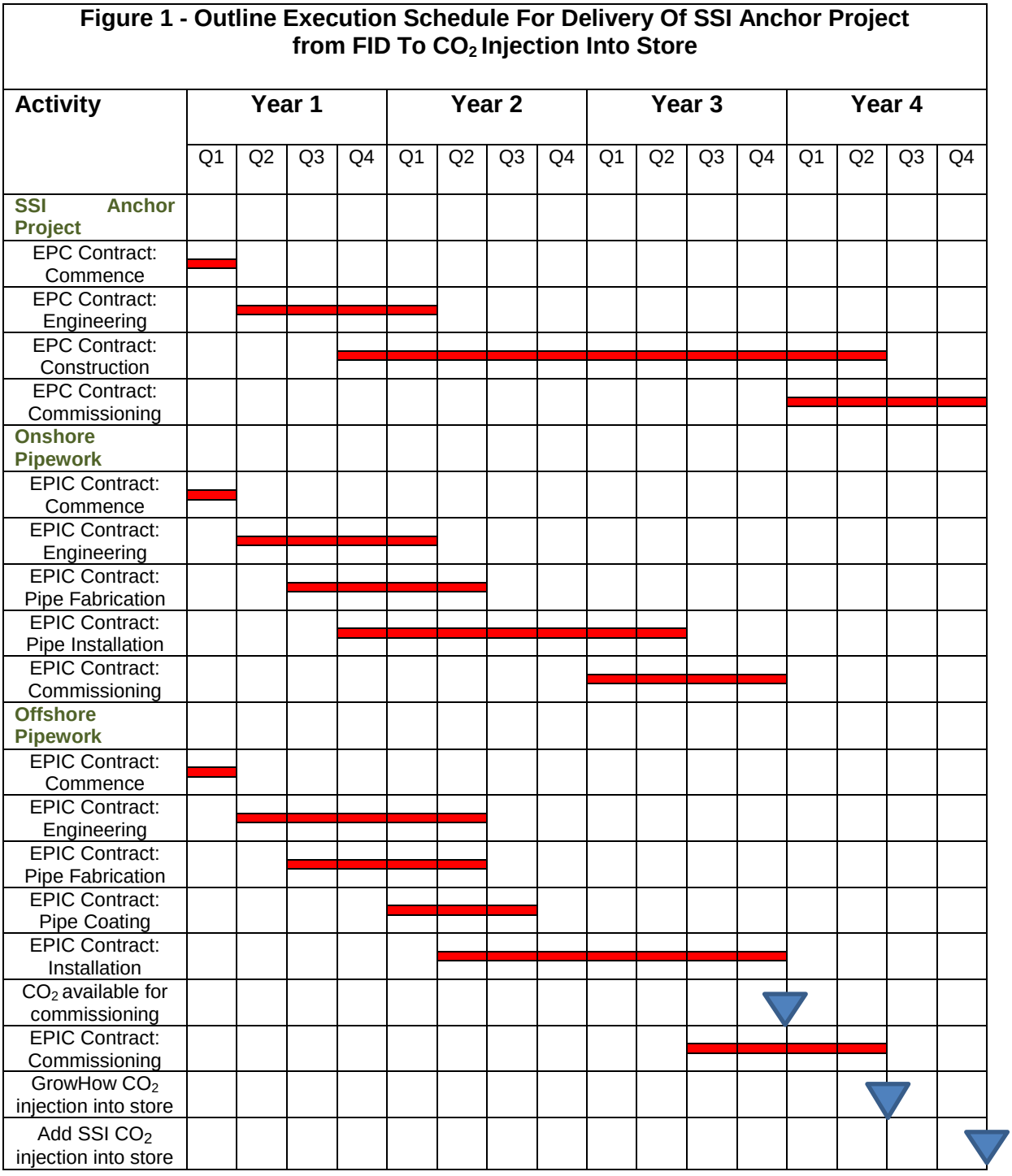
Hence the anchor project involves compression of CO_2 from the GrowHow ammonia plant, a pipeline to transport this CO_2 to a shore line booster pumping station, and a CO_2 capture plant at the steelworks with a short length of pipeline to the booster station. High pressure CO_2 is pumped offshore in a new pipeline for injection and storage in the aquifer to be used as part of the White Rose project (5/42)

At FID it is assumed that a full Project Definition has been secured including:

- A mechanism or mechanisms for support have been put in place and a contract or contracts agreed to enable each element of the Project to be funded
- Investment for each part of the Project has been agreed by the Project collaborators/partners.
- An appropriate pre-FEED and subsequent FEED involving each element along the CCS chain has been completed
- All planning consents and environmental approvals have been obtained
- A contract for CO_2 storage which allows the upstream capture and pipeline investments to be bankable has been agreed
- All commercial contracts involving, and between, the parties along the CCS chain have been negotiated and finalised, including EPC, O&M, and Project interface contracts as well as specific contracts for each sub-element of the chain.

2.0 Execution Plan

Figure 1 - Outline Execution Schedule For Delivery Of SSI Anchor Project from FID To CO_2 Injection Into Store



An indicative schedule is shown in figure 1 above.

Within 1 month of FID an Instruction to Proceed will be given for the required Engineering Procurement and Construction (EPC) Contracts for the SSI and GrowHow CO_2 capture plant, and the Engineering, Procurement, Installation and Commissioning (EPIC) Contracts for the onshore pipeline and offshore pipeline out to the NGC store at 5/42, covering the complete CCS Project.

This includes

- Steelworks CO_2 capture plant EPC, including tie-ins and onshore pipeline to booster station,
- Booster station EPC,
- Offshore Pipeline EPIC to NGC store at 5/42 and fabrication of linepipe,
- On-shore pipeline EPIC between Billingham to shore line booster station, and
- GrowHow EPC including tie ins and equipment ordering.

Dependent on the quality of the FEED work undertaken prior to FID the Detailed Engineering for the CO_2 capture plant at SSI will be completed within 12 months of notice to proceed. Procurement of the long lead equipment items such as the CO_2 compressors and booster station pumps are critical activities. It is anticipated sufficient work will have been undertaken during FEED to produce duty specifications and have identified preferred suppliers to enable an order to be placed within the first 3 to 6 months of detailed Engineering, in order to support the delivery schedule.

Mechanical completion of sub elements of the SSI CO_2 capture plant, compression plant are expected to be achieved between 21 to 24 months after the end of engineering, enabling these to be commissioned using CO_2 from the GrowHow site. Full mechanical completion is expected around 27 months after the end of engineering with an additional 3 to 6 months to carry out the whole system commissioning, Operator training, and undertaking the necessary performance and reliability tests before the plant is accepted and taken over by the owner.

In parallel with the construction of the SSI CO_2 capture plant, the work required at the GrowHow plant to condition and compress the CO_2 produced by the current facility will be progressed to ensure that there is a suitable supply of CO_2 for commissioning the SSI plant and the onshore and offshore pipelines. The critical path for this work is related to the timely ordering of the long lead items as noted above, and installation of the onshore pipeline from Billingham to the booster station.

Consequently, it is necessary to install that part of the onshore transportation system identified in WP5 to connect the SSI anchor project and GrowHow site to the booster station, for onward transportation.

The critical path for the onshore pipework depends on obtaining fabricated pipe in a timely fashion and it is anticipated that enough work has been completed during FEED to place an order for pipe supply and fabrication within 3 months of notice to proceed on the onshore pipeline EPIC Contract.

It is also important that the work associated with any crossing required, particularly road, river and potentially hazardous and/ or dangerous plant, is prioritised to ensure that there is some float in the schedule in the event unexpected issues arise.

The detailed engineering for the onshore transportation system will be completed approximately 9 months from notice to proceed, with the fabrication of the pipe expected to be completed approximately 2 months later. Construction will commence with enabling works associated with any road, river or other services crossings. Once installed the pipe-line will be sequentially commissioned as sections and/ or systems become available, which includes pressure testing and drying out the pipeline. A post lay route survey is required and an internal PIG survey will be conducted to establish a base line for future investigations. Finally, the pipeline will be filled with nitrogen and then filled gradually using CO_2 from the GrowHow facility. This will enable the pipeline to be commissioned on CO_2 in advance of the other capture facilities completing construction and commissioning.

Notwithstanding the assumptions noted above it is expected that the onshore pipeline system from the GrowHow and SSI sites to the booster station will be completed within 36 months of notice to proceed.

There were four alternatives considered in the WP6 Concept Report for the Offshore transportation infrastructure. The steps required for each of them is the same, but there is a difference in the overall time required to install them, based on the length and complexity of the pipeline, and the associated size of the pipe segments to be fabricated. For clarity this outline schedule is based on the assumption that the offshore infrastructure will tie into the NGC's 5/42 Storage Complex.

Within 3 to 6 months of FID, it will be necessary to place a contract for pipe supply, and line-pipe fabrication, including the concrete coating as part of an overall EPIC Contract. This is a critical path item and it is necessary on a project of this magnitude to schedule the fabrication time within the factory for the linepipe and ensure slots for lay barges are reserved way in advance of the detailed engineering being completed. If possible it would be preferential if these activities were progressed through FEED to a point where factory time could be reserved, and pipe suppliers identified, however this could involve a reservation fee and may not be possible.

Detailed engineering will take approximately 12 to 15 months from notice to proceed. Fabrication of the linepipe will be undertaken in parallel and take approximately 12 months, such that it is finished at the same time as the Engineering is completed, with a further 3 months required to complete the concrete coating. Prior to installation of the offshore pipeline commencing it is desirable to stockpile the fabricated and coated linepipe ready for installation, so that it is all on site once the installation of the pipeline begins, as delays in the availability of fabricated pipe can be very costly once offshore barges and laying rigs are mobilised.

The installation of the pipeline commences with a pre-lay survey and a route clearance, in parallel with the onshore construction of the horizontal directional drill (HDD) line from the booster station to the beach, the beach preparation works and shore approach pre-dredging activities. Linepipe will be assembled offshore on the lay barge and floated through the pre-dredged area to be connected to the HDD line and the remainder of the pipeline will be installed off the rear of the lay barge. Pipeline and cable crossings will be erected ahead of the lay barge so that they can support the laid pipeline. Final connections will be completed at the selected storage complex. Weather conditions will influence the pipe laying operation and winter months should be avoided wherever possible, as bad weather could cause the installation to be delayed.

The commissioning activities include pressure testing of the installation and drying out the pipeline through the use of pigs, air drying and slugs of methanol between two pigs. A post lay route survey will be completed and an internal PIG survey will be conducted to establish a base line for future investigations. Finally, the pipeline will be filled with nitrogen and then filled gradually using CO_2 available from the GrowHow facility. This will enable the pipeline and the storage complex to be commissioned on CO_2 in advance of the other capture facilities completing construction and commissioning. Overall, this de-risks the chain risk associated with the onshore and offshore pipelines and the storage complex in advance of completion of all the project capture facilities comprising the Teesside CO_2 cluster.

While the duration of the pipeline installation will be dependent upon the length of the route selected, the entire EPIC duration should be within forty two months from notice to proceed, with SSI coming on stream three to six months later.

In summary the overall schedule required from FID to commercial operation of the SSI anchor project including injection of CO_2 into the offshore store is around 48 months.

It is dependent on early placement of orders for long lead equipment items such as CO_2 compressors and pumps, the fabricated and coated linepipe, and reserving times for lay barges to install offshore pipe.

The construction schedule depends on the onshore pipeline system being installed from Billingham to the booster station approximately 36 months after FID to ensure a supply of CO_2 is available for commissioning the SSI anchor plant and offshore infrastructure, including the CO_2 storage complex as necessary. It is envisaged that the offshore infrastructure could be commercially operational after approximately 42 months utilising CO_2 from GrowHow with the CO_2 from the SSI anchor project coming on line 6 months later.