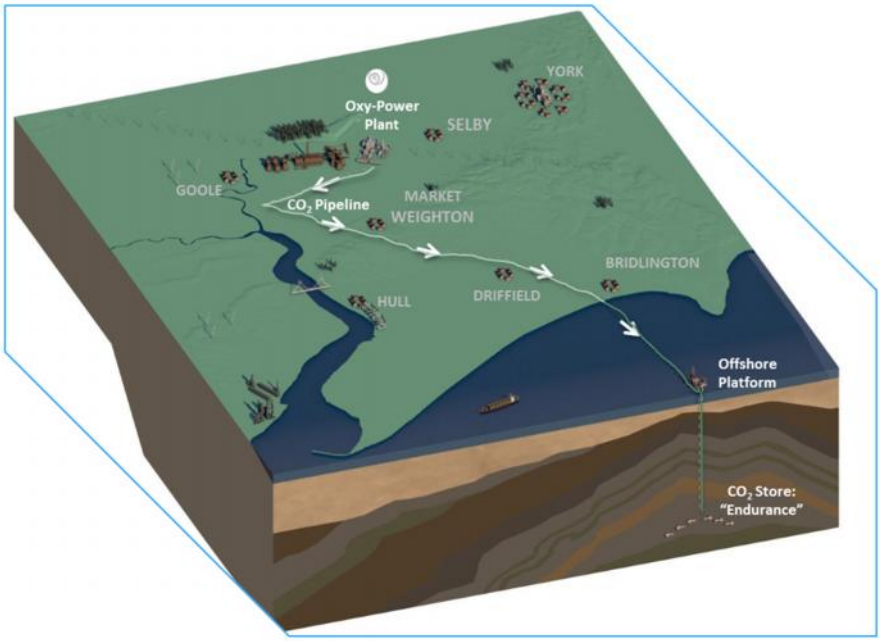
February 2016

WHITE ROSE

K.09 Full chain Project Programme

Project Management: Full Chain



CAPTURE POWER

drax

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Key Words

Key Word	Description
Air Separation Unit	A unit whose function is to separate oxygen from the air for use in the oxyfuel process
Air Separation Plant	Collective term for two ASU units
Carbon	An element, but used as shorthand for its gaseous oxide, Carbon Dioxide, CO_2.
Carbon Dioxide	A greenhouse gas produced during the combustion process, the chemical symbol for which is CO_2.
Carbon Capture and Storage	A technology which reduces carbon emissions from the combustion based power generation process and stores it in a suitable location
Capture	Collection of CO_2 from power station combustion process or other industrial facility
Gas Processing Unit	Unit in which the processing and compressing of CO_2 gas takes place before transportation to storage
Interconnections	Links for supply between existing Drax and OPP facilities
Implementation Phase	Stage of CCS project that covers construction
Notice to Proceed	The point at which, based on final investment decisions, the supply chain contracts for execution can be released
Operating Mode	The method of operation of the OPP, which can operate in air or oxy-firing mode
Oxyfuel	The technology where combustion of fuel takes place with oxygen replacing air as the oxidant for the process, with resultant flue gas being high in CO_2
Oxy Power Plant	A power plant using oxyfuel technology
Pipeline	The long pipe used for conveying CO_2 from the power plant to the storage facilities
Storage	Containment of CO_2 in suitable pervious rock formations located under impervious rock formations usually under the sea bed
Transport	Transfer of processed CO_2 from the capture and process unit by pipeline, to the permanent storage
White Rose	The White Rose Carbon Capture and Storage project

Executive Summary

The Full Chain Project Programme was generated as part of the Front End Engineering Design (FEED) contract with the Department of Energy and Climate Change (DECC) for White Rose, an integrated full chain Carbon Capture and Storage (CCS) Project. This document is one of a series of Key Knowledge Deliverables (KKDs) from White Rose to be issued by DECC for public information.

White Rose comprises a new coal-fired ultra-supercritical Oxy Power Plant (OPP) of up to 448 MWe (gross) and a Transport and Storage (T&S) network that will transfer the carbon dioxide from the OPP by pipeline for permanent storage under the southern North Sea. The OPP captures around 90% of the carbon dioxide emissions and has the option to co-fire biomass.

Delivery of the project is through Capture Power Limited (CPL), an industrial consortium formed by General Electric (GE), BOC and Drax, and National Grid Carbon Limited (NGC), a wholly owned subsidiary of National Grid.

This report includes a summary version of the detailed Implementation Phase programme developed during the FEED Phase and a description of the supporting basis and assumptions, and the critical path.

Her Majesty's Government (HMG) Autumn Statement and Statement to Markets on 25 November 2015 regarding the Carbon Capture and Storage Competition confirmed that the £1 billion ring-fenced capital budget for the Carbon Capture and Storage Competition was no longer available. This meant that the Competition could not proceed on the basis previously set out. A notice of termination of the White Rose FEED Contract was issued to CPL on 23 December 2015 and the FEED Contract was terminated on 25 January 2016; a date which was earlier than the expected completion date. The Government, CPL and National Grid are committed to sharing the knowledge from UK CCS projects, and this Key Knowledge Deliverable represents the learning achieved up to the cancellation of the CCS Competition and termination of the FEED Contract and therefore does not necessarily represent the final and completed constructible project.

Note that programme development was halted at the point at which CCS competition funding was withdrawn, and consequently certain elements of the programme have not been market tested, notably the T&S supply chain activities for which tendering for the anticipated Engineering, Procurement and Construction (EPC) work packages had not been completed.

This document should be read in conjunction with the following documents:

- K.20 Full Chain project execution plan

1 Introduction

The White Rose Carbon Capture and Storage (CCS) Project (White Rose) is an integrated full chain CCS project comprising a new coal-fired Oxy Power Plant (OPP) and a Transport and Storage (T&S) network that will transfer the carbon dioxide from the OPP by pipeline for permanent storage under the southern North Sea.

The OPP is a new ultra-supercritical power plant with oxyfuel technology of up to 448 MWe gross output that will capture around 90% of carbon dioxide emissions and also have the option to co-fire biomass.

One of the first large scale demonstration plants of its type in the world, White Rose aims to prove CCS technology at commercial scale as a competitive form of low-carbon power generation and as an important technology in tackling climate change. The OPP will generate enough low carbon electricity to supply the equivalent needs of over 630,000 homes.

White Rose is being developed by Capture Power Limited, a consortium of GE, BOC and Drax. The project will also establish a CO_2 transportation and storage network in the region through the Yorkshire and Humber CCS pipeline being developed by National Grid Carbon Ltd (NGC).

The Full Chain Implementation Programme developed during FEED comprised Owner's activities, Enabling Works, OPP, Interconnections, T&S and Commissioning components up to and including completion of the Commercial Proving Phase (CPP). The Full Chain Implementation Programme was a fully logic linked critical path analysis undertaken in industry standard planning software, (Primavera P6), and contained approximately 1,200 activities and milestones.

This KKD is based on a summarised version of that programme and provides a description of the programme, critical paths and interfaces.

1.1 Programme Summary

The programme shows an execution critical path that runs through the construction of the OPP and then, following completion of oxy-mode commissioning and testing, through the CPP period which includes testing of the Full Chain. From Notice to Proceed (NTP) through to the end of Full Chain Testing is 62.5 months with first unabated power and first clean power available significantly earlier than this. This programme is predicated on undertaking twelve months of work pre-NTP which relate to the specific conditions at the site chosen for the project. From commencement of piling to the first capture of CO_2 is 48 months, and to end of Full Chain Testing is 58 months. The ability to undertake any work pre-NTP would necessarily be subject to the relevant pre-investment decisions being taken at that time.

1.2 Critical Path

The overall programme critical path, consistent with other solid fuel power plant projects, runs through OPP boiler installation as follows:

- Pre-NTP works including securing access to the site, relocation of the North Yorkshire County Council (NYCC) footpath followed by site raising starting with the Power Block area;
- NTP;
- Soil investigation, pile design, and piling;

- Civil works in the Boiler area which are followed by erection of the steel structure and Boiler pressure parts;
- Cold commissioning leading to 1st Boiler firing on Light Fuel Oil (LFO);
- Hot Commissioning leading to Energy Export in Air Mode;
- Completion of Oxy Mode Commissioning leading to OPP Commercial Operations Date (COD) Oxy Mode Completion;
- Filling the export pipeline and commissioning the T&S Storage system up to the offshore Wells;
- CPP starting at OPP COD Oxy Mode Completion.

Note the inclusion of the CPP means that the critical path from OPP COD, as defined by the programme, no longer lies with the commissioning and testing of the infrastructure.

2 Scope of Work

The White Rose Carbon Capture and Storage (CCS) Project (White Rose) is an integrated full chain CCS project comprising a new coal-fired Oxy Power Plant (OPP) and a Transport and Storage (T&S) network that will transfer the carbon dioxide from the OPP by pipeline for permanent storage under the southern North Sea.

The OPP is a new ultra-supercritical power plant with oxyfuel technology of up to 448 MWe gross output that will capture around 90% of carbon dioxide emissions and also have the option to co-fire biomass.

The power plant will be located adjacent to the existing Drax Power Station site near Selby, North Yorkshire, generating electricity for export to the National Electricity Transmission System (NETS) whilst capturing approximately 2 million tonnes of CO_2 per year, some 90% of all CO_2 emissions produced by the plant. The by-product CO_2 from the OPP will be compressed and exported via a pipeline for injection into an offshore saline formation for permanent storage.

The power plant technology, known as oxy-fuel combustion, burns fuel in a modified combustion environment with the resulting combustion gases having high CO_2 concentration. This allows the CO_2 produced to be captured without the need for additional chemical separation, before being piped for storage.

CPL has been formed by three companies, GE, Drax and BOC, to develop the White Rose CCS Project. CPL are responsible for provision of the OPP site and for the design, construction and operation of the OPP.

CPL are partnering with NGC who will be responsible for the construction and operation of the CO_2 transport pipeline and the permanent CO_2 undersea storage facilities in Endurance (formerly 5/42) in the North Sea.

GE will engineer, procure and construct the OPP up to the site boundary under a turnkey EPC Contract. Their scope will interface with Drax who will execute the Interconnections on Drax operating land between the existing Drax Power Station and the OPP, also under a turnkey EPC Contract. GE will be responsible for any interconnections scope within the OPP site.

GE will procure a heavy lift crane facility to be temporarily installed alongside the existing Drax Power Limited (DPL) jetty to enable abnormal indivisible loads of up to 500t to be delivered to the project site.

GE and Drax will coordinate a single contractor to design, procure and install the coal conveyors which cross the OPP boundary. GE scope includes construction of the coal conveyors up to the transfer towers adjacent to the site boundary and Drax scope includes construction of the conveyors on Drax operational land up to and including the final transfer tower, including the ground hopper for road off-loading. GE are responsible for the overall system.

GE will be responsible for the entire Fly Ash Disposal system, including that on Drax operational land which will be performed by Drax under a sub-contract to GE.

The 400kV cable connection to the NETS also crosses the OPP site boundary. GE will contract with National Grid Electricity Transmission (NGET) for the work in the NGET substation for the 400kV

connection. Drax will dig the trench on Drax operating land for the 400kV cable which will interface with the trench dug by GE on the OPP site. The 400kV cable and termination will be installed by GE including all non NGET works in the NGET sub-station.

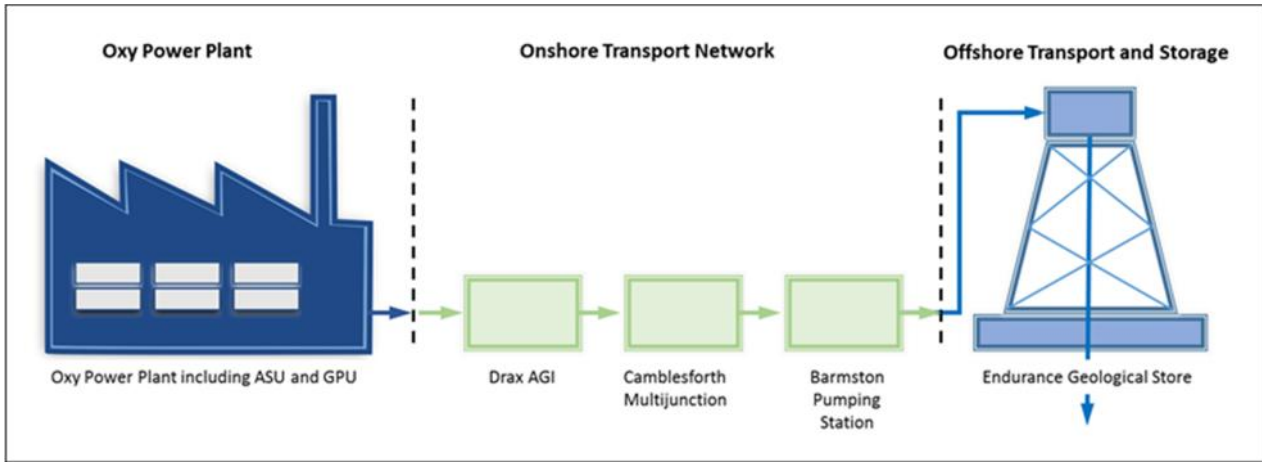
GE will contract with Yorkshire Water (YW) for mains water supply. Drax will install the water pipeline from the new YW main to the OPP site boundary and a spur to laydown area 5 for use during construction. GE will make the connections.

GE will also interface with NGC who will be responsible under the Transport and Storage Services Agreement (TSSA) for engineering, procurement and construction of the T&S system from the OPP to the offshore platform and storage facility. These interfaces include providing access and laydown areas for NGC to construct their Above Ground Installation (AGI) at the OPP site and the CO_2 pipeline, and subsequent connection to the pipeline for filling and commissioning of the system.

The overall integrated control of the T&S system will be by NGC and is anticipated to be similar to that of the National Grid natural gas pipeline network. Local operating procedures will be developed with individual parties to cover all operational aspects including start-up, normal and abnormal operation, controlled and emergency shutdowns. The procedures will include a hierarchy of operation, responsibility, communication procedures and protocols.

See Figure 2.1 for a schematic of the White Rose CCS Full Chain.

Figure 2.1: White Rose CCS Full Chain Schematic



Source: Capture Power Limited

3 Full Chain Programme

3.1 Programme Basis

The programme has been established by summarising and integrating supporting programme components provided by GE, Drax and NGC, aligned to the Project Work Breakdown Structure (WBS) to ensure consistency and alignment across interfaces.

The programme summarisation and integration work included the following:

- Validation of programme integrity versus the latest Division of Work (DoW);
- Reviews and clarifications with GE, Drax and NGC on individual programme components and the programme integration;
- Detailed review of logic with minimal use of hard constraints, (unless dictated by external interfaces), to ensure the programme flowed freely and responded as expected to changes;
- Identification of the programme interfaces between programme components. These interfaces were represented as a series of logically linked 'required by' and 'available by' milestones, rather than activity linking, to effectively separate the scopes of work and identify any programme misalignment;
- Consistent use of calendars, including seasonal calendars and work calendars aligned to OPP and T&S Development Consent Order (DCO) requirements;
- Critical path analysis of the overall programme considering the individual critical paths of the underlying schedules, to ensure sufficient float was available at the interfaces;
- Review of the Primavera Schedule Report to assure programme integrity and identify areas for investigation and rectification if required.

The major elements of the programme have been reviewed by CPL's Technical Advisor from a work content and technical programme perspective.

3.2 Work Breakdown Structure

Figure 3.1: Full Chain Programme Work Breakdown Structure

Full Chain Project Programme		
	Key Milestones	
	Owners Activities	
	OPP	
		Enabling Works and NTP
		Ground Preparation
		Boiler
		Turbine Hall
		Electrostatic Precipitator System
		Wet Flue Gas Desulphurisation
		Water Steam Cycle
		Air Separation Plant
		Gas Processing Unit
		Water Cooling
		Electrical and Control
		Coal and Fuel
		Hot Commissioning
	Interconnections	
		Bunkers & Conveyors
		Pipework
		Site Electrical
		400kV
	Transport & Storage	
		Onshore Pipeline
		Drax Pig Trap
		Camblesforth Multijunction
		AGIs
		Onshore - Barmston Pumping Station
		Beach Crossing
		Offshore Pipeline
		Offshore Topsides
		Jacket
		Jacket & Topsides Installation
		Wells
		T&S Control Centre
		T&S Offshore Control Centre
		ICSS Systems
		Test & Commissioning

Source: Capture Power Limited

3.3 Programme Calendars

The programme reflects the activity calendars shown in Table 3.1.

Table 3.1: Activity Calendars

Activity Calendar	Calendar Description
Standard Work Week 5/7	Standard five day working week with no work on Bank Holidays or the days between Christmas and New Year
7 Day Work Week	Seven day working week with no holidays; used for consents, procurement lead times, CPP, and T&S offshore work
Onshore Pipeline 6 Day Week	Six day working week with no holidays, no work from October to March inclusive; used for T&S onshore pipeline construction
6 Day Work Week	Six day working week with no holidays; used for T&S onshore Above Ground Installation (AGI) construction
Offshore Pipeline Season	Seven day working week with no holidays; no work from October to March inclusive; used for T&S offshore pipeline construction
Tree and Hedge Clearance	Five day working week with holidays, no work from March to August inclusive; used for seasonal tree and hedge clearance works
Badger Relocation	Five day working week with holidays, no work from December to June inclusive; used for badger relocation per environmental requirements

Source: Capture Power Limited

3.4 Integration Milestones

The interfaces between individual programme elements have been logically linked at defined Terminal Points (TP) via Interface Milestones. The linking, which reflects those interfaces currently defined with significant predecessors and successors, has been jointly reviewed and agreed with GE, Drax and NGC.

Table 3.2: Full Chain Programme Interface Milestones

Activity	Activity Name	Total Float (Days)
INT1310	TP8c Temporary Rain Water Discharge	61
INT1340	TP06 - Drinking Water	40
INT1410	TP12 Trench Work for 400kV [1]	18
INT1330	TP05 – Cooling Water	86
INT1430	NGET Connection Complete for Back-Energisation	233
INT1360	TP09 - Sanitary Sewage Network	298
INT1370	TP10a - Fly Ash Disposal by Conveyor	27
INT1390	TP12b - High Voltage Connection at NGET Switchyard	108
INT1400	TP12c/d - 11kV Connection at GE Distribution Board	157
INT1130	TP01 - Coal Supply	123
INT1350	TP08a - Cooling Water Purge	42
INT1440	TP16f - Access to NGC's Drax AGI (Pig Trap) Compound	48
INT1420	NGET Connection Complete for Energy Export (Air Mode)	124
INT1450	Release of Laydown Areas 1 & 4 for Pipeline Installation	110

Source: Capture Power Limited

[1] Trench work for the 400kV connection is constrained only by the desire to close the trench as soon as possible, not by preceding activities. The actual start date will be determined after a comprehensive buried services investigation.

4 Owner's Activities

4.1 Compliance and Consents

Compliance and consents includes the discharge of any residual consenting obligations associated with the OPP DCO, use of the Jetty and other consents. The responsibility for discharge of DCO requirements and other consenting obligations will be assigned to the relevant parts of CPL's supply chain but CPL will prepare and subsequently maintain a detailed register to monitor all consenting activities by responsible party.

The Internal Drainage Board (IDB) granted a number of consents from 11th August 2016 associated with work near to / across Carr Dyke on the OPP site. Each consent requires annual renewal until the relevant work covered by that consent has been started.

4.2 Owner's Establishment

CPL will establish a corporate office in the vicinity of the OPP site including all office facilities and services. Personnel will be progressively mobilised to that location in accordance with the agreed staffing plan to be defined by the end of the FEED phase.

4.3 Full Chain Engineering

CPL are responsible for the performance of full chain engineering including oversight and assurance of the detailed design by the OPP EPC Contractor, the Interconnections EPC Contractor and that performed under the TSSA.

A duration of 18 months has been assumed starting at NTP.

4.4 Visitor Centre Fit-Out

The OPP EPC Contractor will construct the Visitor Centre building and complete basic fit-out of services. CPL will design, procure, install and commission the Visitor Centre exhibition experience.

4.5 Consumables Procurement

CPL are responsible for the procurement of fuel and consumables for commissioning of the OPP and subsequent operations. CPL will procure coal via its coal supplier and for commodities CPL will receive technical datasheets from the OPP EPC Contractor as the basis of a tendering exercise to be completed in sufficient time for the orders to be placed and the first deliveries to be received for the start of cold commissioning. Deliveries are then assumed on a continuous call-off basis as required until the OPP COD Oxy Mode Completion.

4.6 Operational Readiness

CPL's operational readiness includes the recruitment of operating personnel through its Operations and Maintenance (O&M) Contractor in sufficient time for a period of classroom training by the OPP EPC Contractor and to allow the operators to assist in commissioning of the OPP.

The ramp-up of operations personnel has been assumed as follows:

- Operations management in place five months prior to the start of cold commissioning;
- Operations team in place three months prior to the start of cold commissioning;
- Maintenance team in place on the start of cold commissioning.

4.7 Grid Connection Management

Although the OPP EPC Contractor will install the 400kV connection to the NETS, CPL are responsible for the management of this connection with NGET. Three formal notifications are required as follows:

- Energisation Operational Notification (EON), required for first energisation of a new connection;
- Interim Operational Notification (ION), required for first export to the National Electricity Transmission System (NETS) of a new generator connection;
- Final Operation Notification (FON), issued when all compliance issues have been resolved.

4.8 Commercial Proving Period

The CPP is from the start of the Contract for Difference (CfD) for a period of three years. Full chain tests and a reliability run are planned to start immediately after completion of the T&S Plant Proving Stage (PPS), which marks the operational acceptance of the T&S system.

For the early stages of plant operation planned outages are programmed each year, commencing twelve months from the COD Oxy Mode Completion.

Two extended flexibility runs are planned, each of four weeks, one in the winter of the second year of operations and one in the summer of the third year of operations.

Commercial Proving Tests are programmed immediately prior to the end of the CPP.

5 Enabling Works

5.1 Scope of Work and Programme Summary

Enabling works are required to ensure the OPP site is handed over by the OPP EPC Contractor free from obstructions and constraints to facilitate efficient mobilisation and start of construction activities.

5.1.1 Pre NTP

Vacant Possession of the OPP Site

Vacant possession of the OPP site will be gained under the terms of the OPP site lease between DPL and CPL. CPL will be required to provide a notification to DPL of its intention to execute the OPP lease within a certain period. This notification period, currently scheduled for 60 calendar days and a critical path activity, will include sufficient time to allow DPL to serve legal notice to their existing land tenant to vacate the site.

Discharge of Planning Conditions

The pre NTP activity is clearance of conditions, to Local Authority satisfaction, required for the works starting on NTP.

Hedgerow and Tree Clearance

Hedgerow clearance work is seasonal and can only be carried out from September to February inclusive. Although tree clearance is not seasonal, prior to removal each tree must be checked for nesting birds and therefore this work is planned on the same calendar as hedge clearance.

NYCC Footpath Relocation

The scope includes installation of temporary and permanent fencing of the footpath and main site, and erection of a timber/steel footbridge. Note external fencing to laydown areas 1 and 2 will be completed as part of this scope.

Badger Sett Closure

Relocation of identified badger setts on the OPP site, including laydown areas, is seasonal and can only be carried out from July to November inclusive.

Wood Yard Area Relocation

The scope includes the relocation of buildings in the existing wood yard area and erection of a single security fence between DPL operating land and the OPP site, in parallel with the first site raising activities elsewhere on the site by the OPP EPC Contractor. This is not a critical path activity. Scope also includes the relocation of remaining timber from the Interconnections laydown areas.

Highway Works

The work includes:

- Establishment of access to the South end of laydown area 3;
- Establishment of a new crossroad junction between New Road and laydown areas 2 and 3;
- Establishment of emergency access/egress from laydown area 4.

The work is scheduled in the programme in parallel with OPP site raising works for which access is possible via 2 alternative routes.

5.1.2 Post NTP

11kV Diversion Works

The work involves re-routing the existing 11kV line which crosses a small area on the periphery of laydown area 4 to the East of the OPP site. The re-routing will be undertaken by Northern Powergrid, the line's owner, into an easement that will be agreed prior to NTP.

5.2 Key Assumptions

For the work to be started immediately on NTP, a three month preparation time has been assumed for discharge of LA planning conditions, (currently associated with use of the Jetty and the OPP DCO), followed by a nine week review and approval period (no appeal process is assumed), finishing on NTP.

No additional DECC approval of designs or inspections has been allowed for in programme durations.

6 OPP

6.1 Programme Summary

Refer to Figure A.1, at Appendix A, which shows the anticipated site construction zones.

OPP work commences with engineering for site raising and for long lead (primarily manufactured) equipment. Engineering then continues by main plant area i.e. Boiler, Steam Plants, Flue Gas Desulphurisation (FGD), Steam Turbine and Generator, Electrostatic Precipitator (ESP) and Gas Processing Unit (GPU).

Site raising and consolidation will commence with Zone 1 (to release the critical path power block area for the start of civils construction), followed progressively by Zone 2 (to release the ASP/GPU area), Zone 3 (to release the Cooling Water area), and Zones 4 and 5 (to release the Non-Process Buildings and Utilities area).

Site raising consists of vegetation / hard surface strip followed by removal and temporary storage of top soil. Temporary drainage and silt settlement systems will be installed to protect the site. The site will then be levelled, vertical band drains and a drainage layer installed on top of the sub-soil, and raised with locally available clay (treated with lime) and/or imported limestone engineered fill and capping layers. Approximately 437,000m3 of imported material will be required. Following raising, each section of the site will be surcharged and consolidated by construction zone, starting with Zone 1. As only 190,000m3 of topsoil is available and approximately 450,000m3 of surcharge material is required in total, topsoil will be moved from area to area.

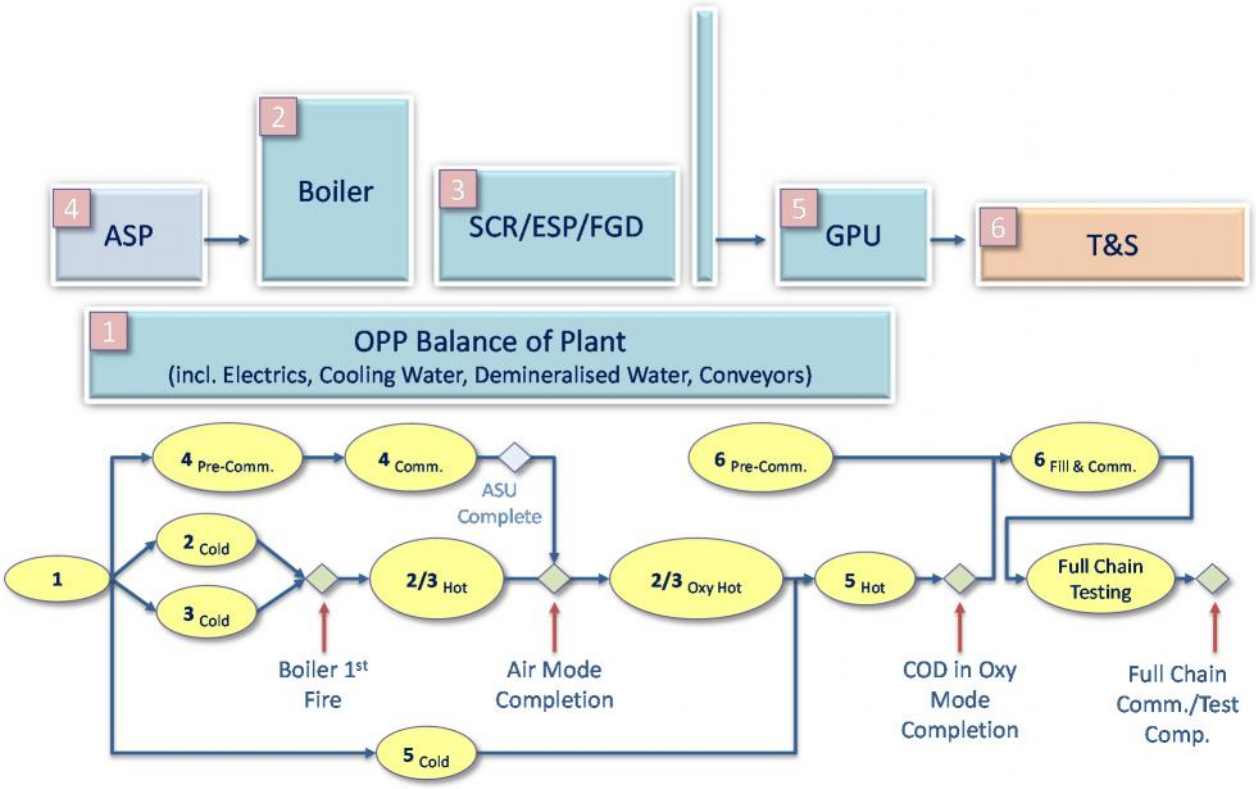
Civils construction starts with soil investigation beginning in Zone 1 and then progressively through Zones 2 to 5 to verify soil geotechnical characteristics and determine pile sizing and quantities. The interpretive report is confirmed at the end of the consolidation period including pile test data as a precursor to piling in Zone 1 followed by piling in the remaining areas.

The critical path through construction runs through Boiler main foundations leading to main and secondary steel structure erection, piping and equipment installation, and electrical and instrumentation installation. Hydrotesting is followed by installation of the balance of Boiler refractory works and insulation, in parallel with cold commissioning which leads to Boiler 1st firing on LFO.

The balance of construction is non-critical and is phased starting with the Steam Turbine and Generator, Water Treatment, ESP, FGD, Water Steam Cycle (WSC), Central Electrical Building and Transformers, ASP and GPU.

Refer to Figure 6.1 which shows the anticipated OPP commissioning sequence.

Figure 6.1: OPP Commissioning Sequence



Source: Capture Power Limited

Hot commissioning in air mode commences with Boiler 1st firing on LFO, followed by commissioning of the FGD and Boiler 1st firing on coal, leading to 1st steam from the Boiler into the turbine. This is followed by 1st synchronization, which requires connection to the NGET substation, and Boiler and WSC tuning leading to Energy Export in Air Mode. Completion in Air Mode is marked by the end of load and functional testing.

Hot commissioning in Oxy Mode immediately follows completion in Air Mode, starting with Boiler ramp-up to provide on-spec. flue gas for hot commissioning of the GPU. Approximately 6 weeks into hot commissioning of the GPU, on-spec. but partial flow CO_2 is available to be able to ramp the boiler up to full flow CO_2. COD Oxy Mode Completion is marked by the completion of functional and performance tests, and reliability run leading to on-spec. continuous full flow CO_2 which is required by the T&S Contractor to fill the pipeline and commission the Transport system.

6.2 Key Assumptions

The following assumptions reflect the status of commercial negotiations with GE at the time CCS competition funding was withdrawn.

6.2.1 General

- Programme reflects 48 work hours per five day week allowable under current UK regulations with no work on Public Holidays;
- Key personnel have been identified and appointed to carry out pre-site activities, planning and local authority clearances;
- All works will be done under the OPP DCO, requirements have been discharged and any mitigation works have either been completed (e.g. European Protected Species surveys) or do not interfere with construction activities;
- No additional DECC approval of designs or inspections has been allowed for in programme durations;
- Seasonal work within the site i.e. badger sett relocation and tree/hedge removal can be accommodated without impact on the construction programme;
- Temporary fire protection concept is available with the local fire authority;
- Work on the OPP site by third parties to be coordinated with the OPP EPC Contractor and there is no impact on OPP activities;
- No unusual/unforeseeable geological considerations have been considered;
- No allowance has been included in the programme for downtime due to extreme weather events, for e.g. Force Majeure events;
- No constraint on the availability of skilled labour;
- All interconnections at the TP are completed per programme requirements. Connection to the CO_2 Export Pipeline (TP13) is assumed by NGC;
- Full-chain commissioning activities will take place after the COD Oxy Mode Completion.

6.2.2 Site Raising

- All necessary planning consents are in place to support the programme and that discharge procedures have been agreed with the necessary stakeholders;
- Archaeological studies are complete and a Written Scheme of Investigation is agreed with the Local Authority, and execution of this Scheme does not delay construction activities;
- Seasonal work within the OPP site i.e. badger sett relocation and tree/hedge removal can be accommodated without impact on the construction programme;
- The wood yard has been relocated by the Enabling Works EPC Contractor;
- The OPP site is divided into 4 areas for the purposes of site raising and consolidation; Power Block (Zone 1), GPU/ASP (Zone 2), Cooling Water (Zone 3) and Non-Process Buildings and Treatment Area (Zones 4 & 5);
- Soil consolidation is considered without additional drains;
- Site raising durations assume topsoil bulk can be transported into site at a rate of 2,400m^3 bulk material (2,000m^3 consolidated) per day and moved within the site a rate of 5,000m^3 per day;
- Sufficient topsoil for consolidation is available from Barlow Mound and from laydown areas.

6.2.3 Civils

- Initial temporary services and utilities (including water and power) for the start of site raising to be provided by the OPP EPC Contractor;
- All connections for temporary services and utilities for main OPP construction to be installed by the Interconnections EPC Contractor shall be available per programme required dates;

- The OPP EPC Contractor will contract with YW for mains water for construction;
- First main construction activity is in the Power Block area (Zone 1) to secure the critical path through Boiler erection and commissioning;
- Main construction in the Power Block area (Zone 1) commences on satisfactory consolidation of the site raising in that area.

6.2.4 Procurement and Transport

- Lead time for customs clearances is included in transport durations;
- Any modifications or improvements to access roads to the Power Plant area to be performed as enabling works by others are available in time for materials and equipment deliveries ;
- Jetty unloading facility available for all abnormal load deliveries (modules for OPP and ASP, transformers and generator).

6.2.5 Erection

- Acceptable access to the OPP site and laydown areas 1 and 2 is provided to the T&S Contractor for installation of the pig trap and pipeline;
- Assumed that piping erection and installation for T&S works on the OPP site will be sequenced and coordinated with the OPP EPC Contractor without impact on the programme;
- Any access to the jetty required by third parties will be coordinated with the OPP EPC Contractor without impact on the programme.

6.2.6 Commissioning

- Access to the 400kV High Voltage (HV) grid for back-energization and power export will be available per the programme;
- All utilities, (e.g. raw water, back-feed electricity, communications), for commissioning are available as required;
- All consumables for commissioning are available as required;
- The Drax AGI and pipeline are available at OPP completion in air mode to avoid disruption to subsequent OPP Oxy-mode commissioning;
- Reliable on-spec. full flow CO_2 is available at the completion of Oxy-mode commissioning i.e. at the COD Oxy Mode Completion;
- Client operators are available for Operations support to commissioning and for familiarisation and training prior to the start of cold commissioning.

7 Interconnections

7.1 Programme Summary

The Interconnections programme is governed by the OPP EPC construction programme as all site services are required for commissioning. The programme meets the commissioning dates required by the OPP EPC Contractor. See Table 3.2.

7.2 Key Assumptions

The following assumptions reflect the status of commercial negotiations with Drax at the time CCS competition funding was withdrawn.

The key assumptions are as follows:

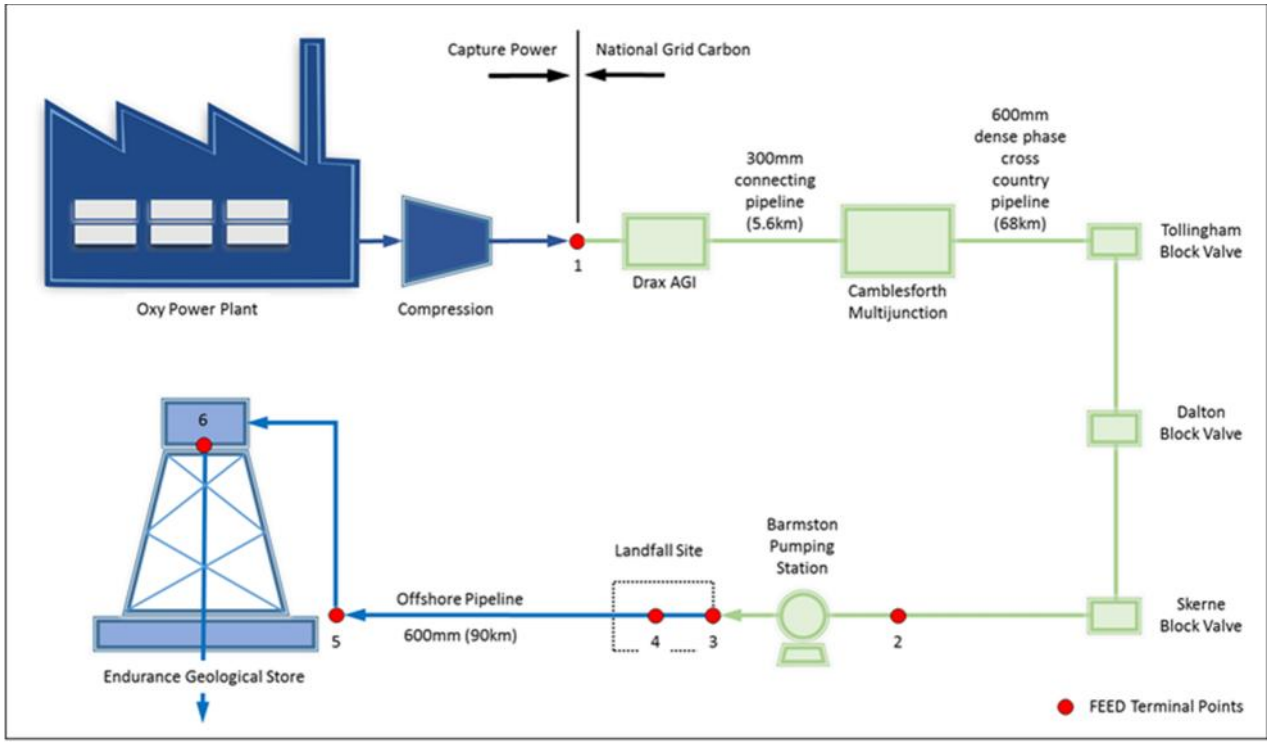
- All consents are in place to support the programme;
- All supply chain activities are complete, contracts have been awarded and contractors are mobilised ready for start on site for first construction activity;
- No additional DECC approval of designs or inspections has been allowed for in programme durations;
- Industrial Relations (IR) strategy agreed and in place for project workers on the DPL site;
- Full unrestricted access is available across the DPL site;
- The OPP EPC Contractor does not interfere with access to agreed laydown areas for Interconnections;
- No issues arise concerning buried services or ground works disturbances. It should be noted that there is float within the Interconnections programme to mitigate these issues should they arise, see Table 3.2. As noted below Table 3.2, trench work for the 400kV connection is constrained only by the desire to close the trench as soon as possible, not by preceding activities. The actual start date will be determined after a comprehensive buried services investigation;
- Construction (Design and Management) Regulations (CDM) related preparation does not delay progress;
- The Jetty is available for use (if required);
- TPs have been agreed and there are no late changes leading to delay;
- OPP tie-in and commissioning programmes have been reviewed with Drax and are aligned with shutdowns / turnarounds of the operating plant.

8 T&S

8.1 Programme Summary

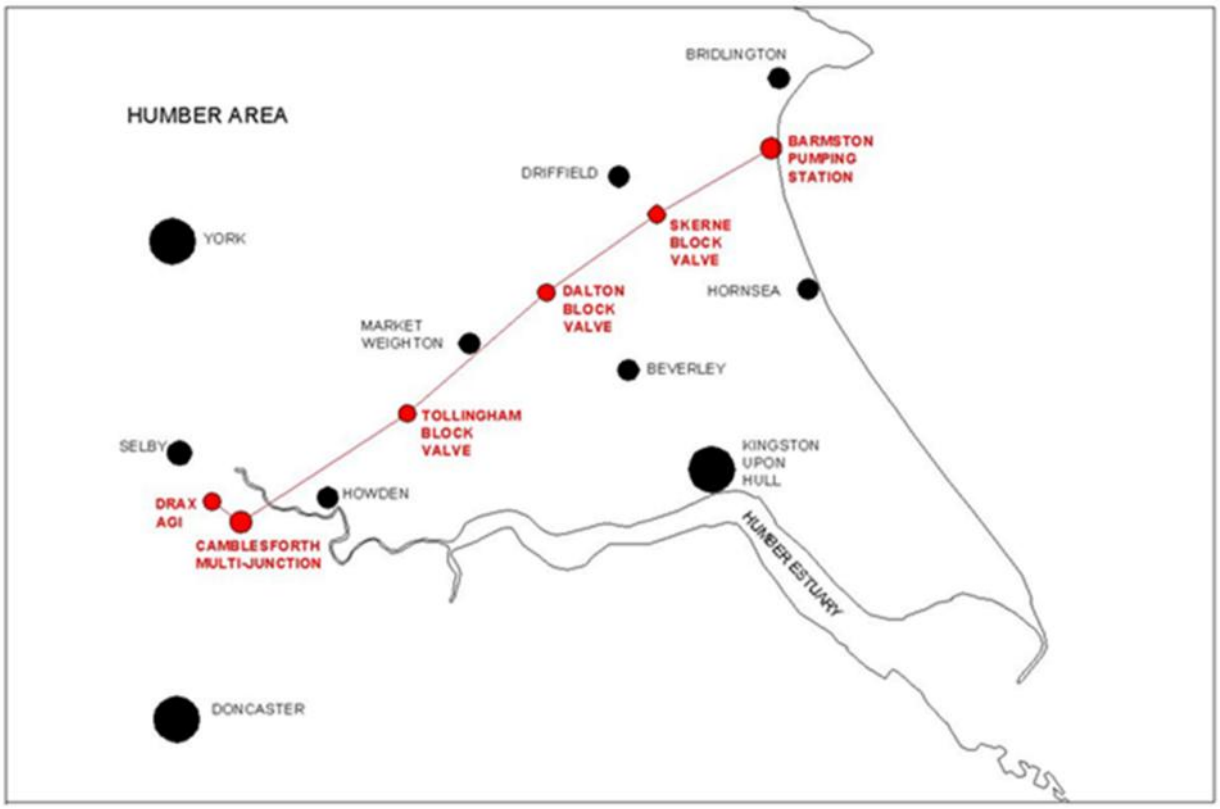
Refer to Figure 8.1 and Figure 8.2 for an overview of the T&S programme elements.

Figure 8.1: White Rose CCS Full Chain Schematic – T&S Detail



Source: Capture Power Limited

Figure 8.2: Onshore Transportation Schematic



Source: Capture Power Limited

Onshore pipeline engineering, (from the OPP to Barmston Pumping Station), starts with Process Flow Diagrams (PFDs) and Process and Instrument Diagrams (P&IDs) followed by datasheets, material specifications, valve index and piping line list, equipment list and finally piping isometrics. After requisitioning, procurement commences with valve manufacture followed by pipeline and bends in parallel with cathodic protection equipment. Construction leads with enabling works, including road widening and site set-up, and welding qualification. Pipeline installation and mechanical completion, (excluding that from the OPP to Camblesforth Multijunction), will be executed by three teams working largely in parallel. The first team will execute the section from Camblesforth Multijunction to Tollington, and then on from Tollington to Dalton. The second team will execute the section from Barmston Pumping Station to Skerne, and from Skerne to Dalton. The third team will execute the section from Barmston Pumping Station to the beach crossing. The OPP to Camblesforth Multijunction will be executed last, constrained by access to the OPP site. The timing for installation of the onshore pipelines is seasonal, governed by the T&S DCO.

The onshore pipeline programme contains discrete activities for archaeological investigation, comprising of trial trenching and excavations followed by a watching brief to identify any areas of mitigation.

The AGIs at Tollingham, Dalton and Skerne (all block valve stations), and at Camblesforth Multijunction and Barmston Pumping Station (containing pig traps) will be installed in parallel with onshore pipeline installation. The Drax AGI will be installed later constrained by access to the OPP site.

Integrated Control and Shutdown/Safety System (ICSS) equipment will be engineered, procured and delivered for installation in the NGC and Offshore Control Centres. The last delivery is that for the Drax AGI.

Engineering and procurement for the offshore pipeline, (from the Barmston Pumping Station to the Platform), follows the same general sequence of activities as the onshore pipeline. Construction starts with near-shore dredging, backfilling and rock placement to protect high voltage cable crossings. The timing for installation of the offshore pipelines is seasonal (weather dependent). The platform location will be swept to shave the peaks off local sand waves. A Diving Support Vessel (DSV) will install the tie-in spools, lay concrete mattresses (to protect the installed pipelines) and provide survey support. The near-shore pipe will be laid by a flat-bottomed barge while further away from the shore the rigid pipelines will be laid by a Fourth Generation S-Lay Vessel.

On completion of offshore pipeline pre-commissioning the offshore pipeline will be flooded and preserved. The duration that the pipeline is shown as preserved in the programme is to bridge the intervening period between the pipeline being completed and the latest possible start of de-watering and drying activities to align with the availability of on spec. CO_2 from the OPP for filling of the pipeline. This represents, in effect, the free float on the construction of the T&S system, which in this programme is three months.

The beach crossing, including micro-tunnelling, is constructed in parallel with offshore pipeline installation.

A borehole survey of the jacket location will be procured immediately on NTP and carried out prior to the start of jacket design. Analysis of the resulting borehole data will be carried out by the jacket EPC contractor during design. Typical engineering activities include development of Material Take-Offs (MTO) for structural steel and cathodic protection to support bulk procurement and fabrication. On completion of fabrication, the jacket is loaded-out and sea-fastened prior to sail-away for installation in the field.

Topsides engineering is planned to start immediately on NTP with development of P&IDs, mechanical datasheets, piping line list and piping MTOs, instrument and electrical design, main and secondary steel drawings to support requisitions for equipment and MTOs for bulk material procurement. Construction commences with structural steel for the cellar, lower and upper mezzanine and weather decks, followed by progressive installation of equipment, piping, electrical and instrumentation to each deck. Onshore mechanical completion is followed by load-out and sea-fastening prior to sail-away. Sail-away is a seasonal activity (weather dependent). The same installation spread will be used for both the jacket and topsides. After installation and weld-out to the pre-installed jacket, the topsides are mechanically completed and hooked-up offshore.

A field survey of the drilling location will be tendered, awarded and executed prior to commencing market survey, tendering, and award of the Jack-Up Drilling Rig. Award is planned significantly ahead of mobilisation during which time the necessary requests for authority approvals and environmental consents, mobilisation and rig move planning will be completed.

Drilling of each of the three Wells in White Rose scope is preceded by submission of the required authority and environmental notifications and consents. Drilling is executed in a continuous campaign including drilling and completion, Xmas tree and metrology spool installation and mechanical completion of the metering, monitoring and verification (MMV) sensor for each well in sequence.

Following construction and mechanical completion of the onshore and offshore facilities, the T&S system is filled with on-spec. full flow CO_2 from the OPP at the COD Oxy Mode Completion. Commissioning is performed sequentially from the Drax AGI through the onshore facilities and completing with the last offshore well.

A PPS follows the completion of commissioning, during which period performance testing will be carried out to verify that the pipeline and plant performs as designed, and to identify and quantify any differences. The amount of testing possible will be dictated by and dependent on the OPP. Any identified differences should be analysed for their effect on future operation when other CO_2 emitters are joined into the pipeline at Camblesforth.

Operational acceptance of the T&S system shall occur when commissioning and performance testing activities have been successfully completed. This is followed by full chain performance testing and a reliability run (see Section 4.8).

Note that the relationship between the T&S PPS and full chain testing will be further defined during ongoing technical discussions and commercial negotiations.

8.2 Key Assumptions

The following assumptions remained to be confirmed following NGC's supply chain tendering process, which was halted when CCS competition funding was withdrawn:

- The OPP laydown area for the Drax AGI will be handed over to NGC per programme requirements and access will be uninterrupted;
- That there are no delays caused by environmentalists at construction sites, or environmental impacts;
- That there are suitable ground conditions and no soil contamination on any NGC site;
- That there will be no critical path delay due to archaeology finds on the pipeline route and AGIs. Note that archaeological investigation is planned to commence ahead of construction to limit the risk of archaeological finds;
- That there will be sufficient access to construction sites;
- It is assumed that all equipment and materials will be purchased by the appointed contractor and are available in the market to meet programme requirements;
- It is assumed that the required workforce will be available at the required time to meet programme requirements;
- A twelve month period has been allowed between the end of design and the start of construction for required consents to be obtained; it is assumed that all consents will be in place at the time of Construction;
- No additional DECC approval of designs or inspections has been allowed for in programme durations;
- It is assumed that all main EPC contracts will be ready for award at NTP and no further tendering events will be required;

- Pre-commissioning will be completed prior to on-spec. CO_2 at full flow rate being available;
- Pre-commissioning handover documentation to be complete prior to commissioning;
- No allowance has been included in the T&S programme for downtime due to extreme weather events, for e.g. Force Majeure events during construction and commissioning phases.

8.3 Onshore Pipeline

- That all AGIs will be able to be worked on during the annual onshore pipeline season (April to September per the T&S DCO);
- All pipelines will be tested in stages to take into consideration the pipe wall thickness and elevation variations;
- T&S pipework at the OPP site is to be buried as required by the OPP DCO;
- Horizontal Directional Drilling (HDD) is being considered for installation of the pipeline at the OPP site; if selected open trenching will not be required;
- Onshore pipeline installation is planned to be carried out by three teams;
- Installation of the onshore pipeline from Camblesforth Multi-Junction (MJ) to Drax will not start until access to laydown area 1 is permitted by the OPP EPC Contractor;
- Super drying will be carried out within the mechanical completion stage;
- The fabrication location for the offshore pipeline is assumed to be North-East Scotland;
- The number of pipeline tests is still to be determined. The programme assumes one test per section between AGIs, with the exception of the 12” pipeline from Drax to Camblesforth MJ;
- Onshore pipe lengths will be 12m;
- Pipelines between AGIs will be tested in sequence prior to the final tie-ins;
- Onshore pipeline durations are based on a work rate of 800 metres per day (estimate provided by NGC’s main FEED Contractor);
- At special crossing locations, (e.g. HDD and Microtunnel), the working pattern will be 24 hours a day for 7 days a week;
- The Foulness and River Hull / Driffield Canal crossings are planned to commence early to allow for any unforeseen issues;
- It is currently anticipated that root pass will be a manual weld then completed by machine, to be defined during detailed design;
- Estimated weld failure rates have not yet been defined by NGC’s supply chain, however the overall window for pipeline installation is currently considered sufficient;
- Archaeological investigation is planned to commence ahead of construction to limit the risk of archaeological finds;
- Archaeological investigation within the OPP laydown areas will be completed by CPL prior to handover to NGC.

8.4 Pipeline Filling Operation

- Assumed that pipeline filling will start when onshore and offshore pipeline installation is complete and on-spec. full flow CO_2 is available at the COD Oxy Mode Completion subject to the following:
  - Confirmation that all systems are mechanically complete, with certificates in place i.e. the full system is ready;

- All safety/control/communication and other auxiliary systems have passed Site Acceptance Tests (SAT) and are in operation;
- All pipeline actuated valves and associated instrumentation are functioning correctly;
- All pipeline and plant instrumentation is calibrated and functioning correctly;
- All Hazard and Operability (HAZOP) and Hazard Identification (HAZID) actions have been successfully closed out;
- The entire pipeline and CO_2 system is clean, dry and preserved with low pressure dry air or nitrogen;
- Suitable real-time communication/control/safety mechanisms and procedures are in place, tested and operating between the OPP and T&S.

8.5 CO_2 Pumping Station

- Will have only local control rooms at this location;
- Work will continue throughout winter as clarified in the T&S DCO.

8.6 Beach Crossing

- The beach crossing will be carried out as close as possible to the offshore pipeline construction, and will only be open for as long as required to carry out the works;
- Beach crossing durations to landfall are based on a work rate of 730 metres per day;
- The short onshore section of the offshore pipeline will be undertaken by a separate pipeline sub-contractor to the offshore pipeline contractor. Completion of the onshore pipeline section and beach crossing should be the start date of the offshore pipeline installation.

8.7 Offshore Pipeline

- A DSV will install the tie-in spools, lay concrete mattresses and provide survey support;
- In all cases the near shore is dredged and backfilled and there is pre-sweeping nearer to the platform;
- The near shore pipe is laid by a Flat Bottomed Barge, 17km from shore the pipe is laid by a Fourth Generation S-Lay Vessel;
- Where the trench is backfilled an allowance is included for change-out of the trench tool for the backfill plough. A backfill rate of 4.8km per day with a half-day to cover deployment and a half-day to cover recovery of the backfill plough is assumed;
- Offshore pipeline installation is based on a work rate of 3,500 metres per day (estimate provided by NGC's main FEED Contractor);
- Rigid pipelines will be installed using the S-Lay method. Initial mechanical design and project characteristics will identify a preferred method;
- That all required vessels are available to carry out the works offshore and at the landfall site;
- Full commissioning can only take place once the Wells are commissioned with available CO_2;
- The 24" pipeline is 90km long of which the first 16km is pre-dredged and backfilled i.e. buried, and the next 72km is exposed i.e. concrete coated pipe laid on the seabed, (33km of this will have been 'pre-swept', i.e. ploughed approximately level);
- The crossings will be installed by a survey vessel. The pipelines are protected by rock dumping and mattresses;

- The installation estimate is based on the assumed marine fleet that will be required, mobilisation/demobilisation and activity durations. Allowances for Non-Productive Time (NPT) and weather downtime are not included in the T&S programme;
- There is a full mobilisation to pick up the plough and an intermediate mobilisation to pick up the backfill plough, and a full demobilisation to offload the plough;

- Wells will be drilled after jacket and topsides installation:
  - One day per spool including metrology;
  - 600m^2 per day mattress installation.
- The offshore pipe lengths will be 12m;
- Pipe-laying barge and supporting vessels will be available when needed;
- No Simultaneous Operations (SIMOPS) to be carried out during offshore construction.

8.8 Jacket and Topside/Plant

- The assumed location of the jacket fabrication yard is in Europe;
- The jacket bore hole survey is planned to be carried out as soon as possible after NTP;
- The jacket and topside modules will be fabricated and outfitted in a European yard and shipped directly to the offshore field for assembly and final commissioning prior to handover;
- Transport grillage to be designed by the Transport and Installation (T&I) Contractor;
- Factory Acceptance Tests (FAT) to be attended by NGC and CPL when possible.

8.9 Jacket, Topside and Piling transport and Installation

- That all offshore structures will be transported on the same vessel to the offshore location;
- T&I will be carried out in the summer season;
- A 'floating hotel' or 'flotel' will be required during hook-up and commissioning of the offshore installation;
- There will be drilling after the offshore installation is in place and pre-commissioned.

8.10 Wells

- Three wells will be drilled, completed and commissioned prior to the injection of CO_2;
- The wells are constructed with 30" conductor, 13-3/8" intermediate casing, 9-5/8" injection casing and 7" injection liner and completed with 5-1/2" super duplex stainless steel completion tubing;
- The completion does not contain a downhole choking device;
- Currently MMV is envisaged to be from downhole pressure and temperature gauges in each well and surface annular pressure monitoring at the wellhead;
- Each well contains a surface controlled sub surface safety valve (SCSSSV);
- Wells will be drilled in the summer season;
- The programme assumes 20 months procurement time of the 25Cr completion tubing and Xmas trees;
- Well drilling durations are estimated at present, based upon a total of 25% expected NPT due to the sum of operational NPT and waiting on weather;
- Drilling is to commence after installation of the jacket and topsides;
- The provision of hydrate inhibitor and nitrogen injection is via the platform.

8.11 Integrated Control System

- The locations of the Control Rooms is not yet determined. This will be evaluated during detailed design and specified by the Storage Partner;
- It is anticipated that one contractor will design, build and commission the equipment;

- The Factory Accepted equipment will be supplied to the mechanical contractors to install, then the control system vendor will pre-commission at site and carry out the SAT;
- The full system is to be tested again once on-spec. CO_2 is present in the full chain up to the Storage facility.

8.12 Commissioning

- Offshore wells commissioning will start when reliable on-spec. full flow CO_2 is available at the COD Oxy Mode Completion;
- Dense phase CO_2 is available for NGC, although gaseous phase CO_2 may be requested for pipeline filling. This will be determined by further engineering studies;
- That NGC will receive control signals from CPL as agreed on the signal exchange list.

9 Glossary

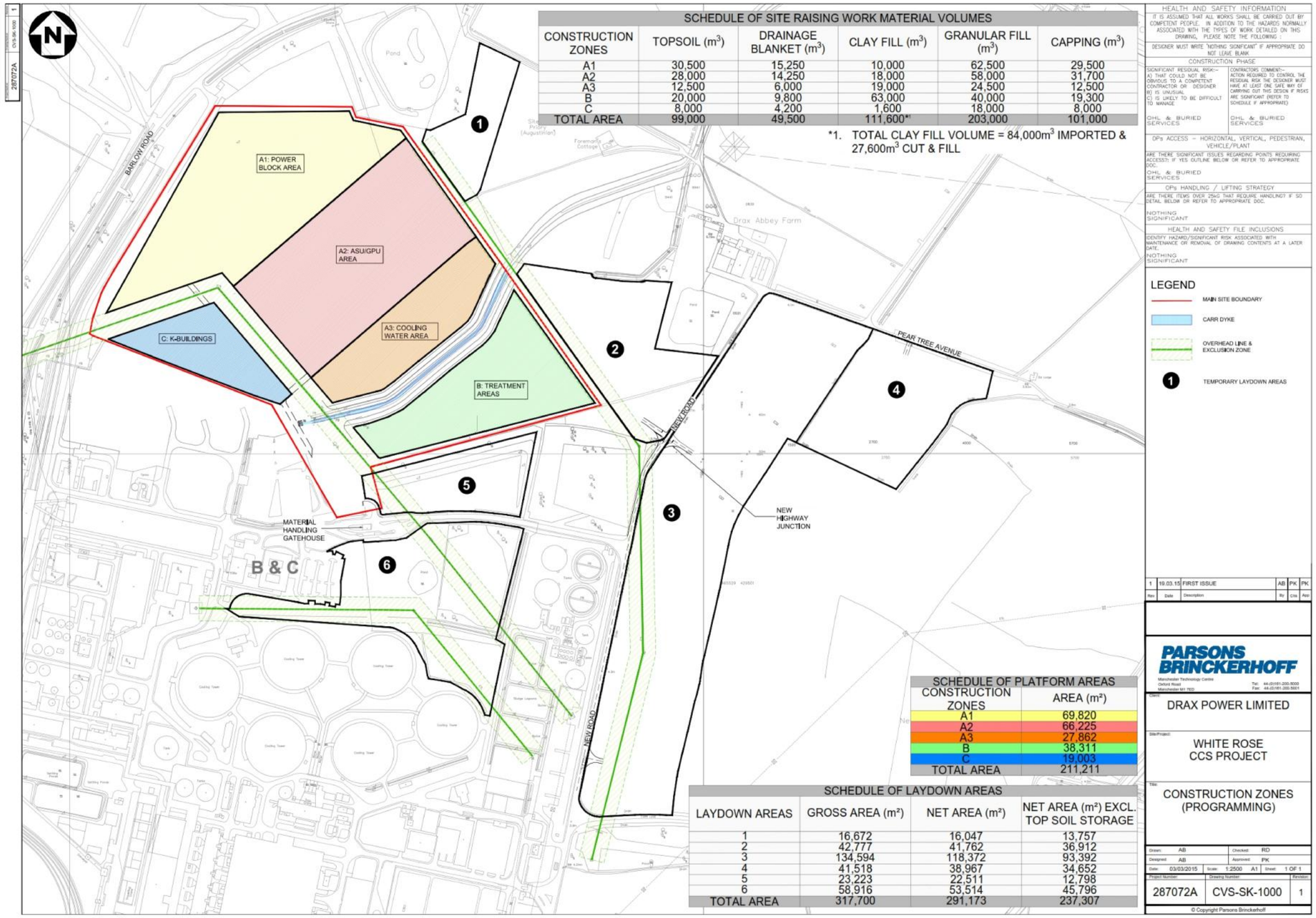
Abbreviation	Meaning or Explanation
AGI	Above Ground Installation
CCS	Carbon Capture and Storage
CDM	Construction (Design and Management) Regulations 2015
CfD	Contract for Difference
CO_2	Carbon Dioxide
COD	Commercial Operations Date
CPL	Capture Power Limited
CPP	Commercial Proving Period
DCO	Development Consent Order
DECC	Department for Energy and Climate Change
DoW	Division of Work
DPL	Drax Power Limited
DSV	Diving Support Vessel
EON	Energisation Operational Notification
EPC	Engineering, Procurement and Construction
EPCm	Engineering, Procurement and Construction Management
ESP	Electrostatic Precipitator
FAT	Factory Acceptance Test
FEED	Front End Engineering Design
FGD	Flue Gas Desulphurisation
FON	Final Operational Notification
GE	General Electric
GPU	Gas Processing Unit
HAZID	Hazard Identification
HAZOP	Hazard and Operability
HDD	Horizontal Directional Drilling
HSE	Health and Safety Executive
HV	High Voltage
ICSS	Integrated Control and Shutdown/Safety System
IDB	Internal Drainage Board
ION	Interim Operational Notification
IR	Industrial Relations
KKD	Key Knowledge Deliverable
LFO	Light Fuel Oil
MMV	Measurement, Monitoring and Verification
MTO	Material Take-Off
MJ	Multi-Junction
MWe	Megawatt electric
NETS	National Electricity Transmission System
NGC	National Grid Carbon Limited
NGET	National Grid Electricity Transmission Limited
NPT	Non-Productive Time

Abbreviation	Meaning or Explanation
NTP	Notice to Proceed
NYCC	North Yorkshire County Council
O&M	Operations and Maintenance
OPP	Oxy Power Plant
P&IDs	Process and Instrument Diagrams
PFD	Process Flow Diagram
PPS	Plant Proving Stage
SAT	Site Acceptance Test
SCR	Selective Catalytic Reduction
SCSSSV	Surface Controlled Sub Surface Safety Valve
SIMOPS	Simultaneous Operations
T&I	Transport and Installation
T&S	Transport and Storage
TP	Terminal Point
TSSA	Transport and Storage Services Agreement
WBS	Work Breakdown Structure
WSC	Water Steam Cycle
YW	Yorkshire Water

Appendices

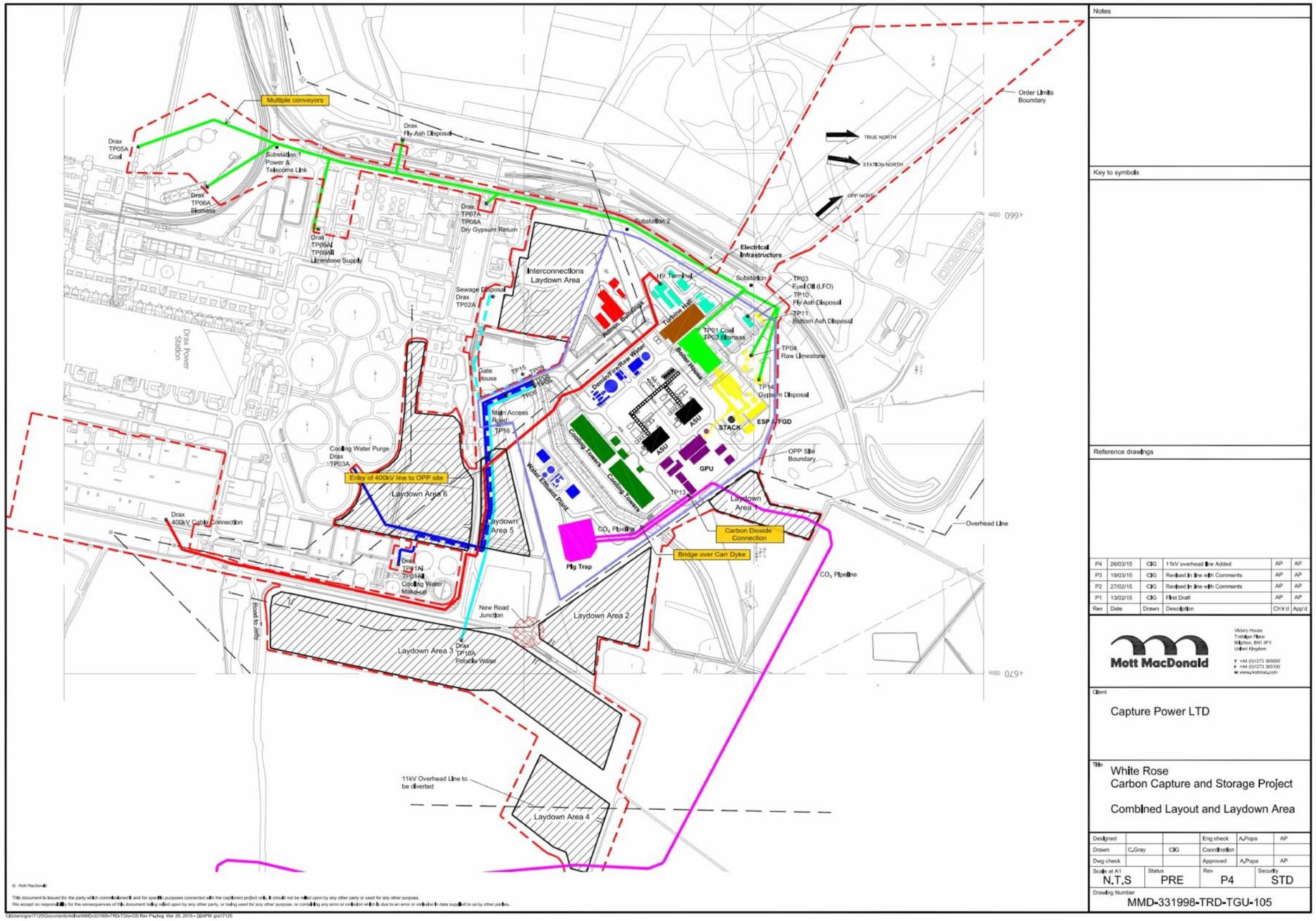
Appendix A OPP Site Drawings

Figure A.1: OPP Site Construction Zones



Source: Drax Power Limited

Figure A.2: Combined Layout and Laydown Area Drawing



Source: Mott MacDonald

Appendix B Full Chain Project Programme

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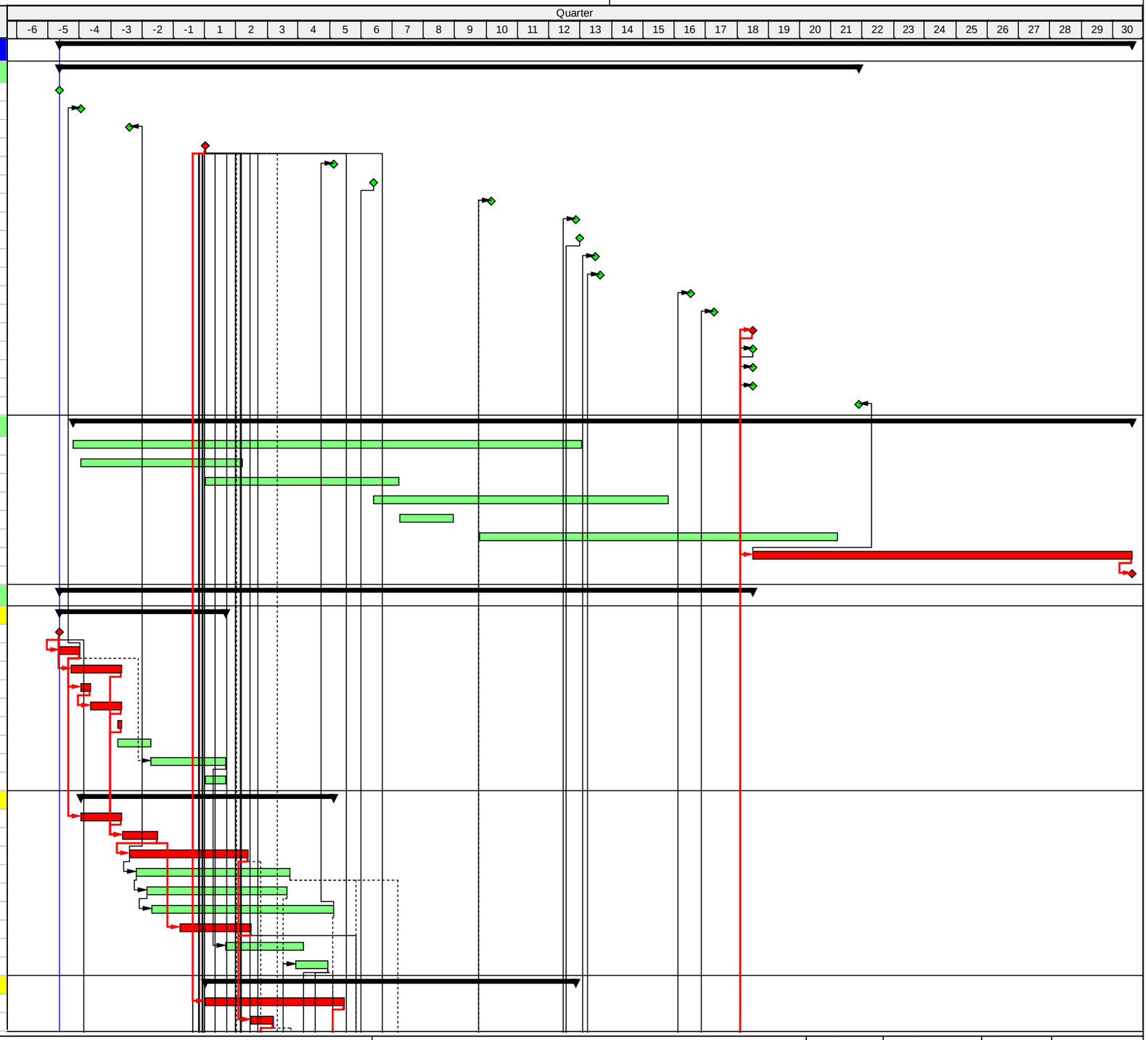
TASK filter: All Activities

FULL CHAIN PROJECT PROGRAMME

Activity ID	Activity Name
Full Chain Project Programme	
KEY MILESTONES	
KML1000	Pre NTP Works Earliest Commencement
KML1010	Access to Site Granted on Vacant Possession
KML1020	Start of Site Raising & Soil Consolidation Works
KML1030	Notice To Proceed (NTP)
KML1040	OPP Site Raising Complete
KML1050	NGET Connection
KML1060	Back Energisation Started
KML1070	Boiler First Firing LFO
KML1080	Drax AGI (Pig Trap) Area Available to NGC
KML1090	First Steam to Turbine
KML1100	First Synchronisation
KML1110	Completion in Air Mode
KML1120	Onshore Transportation Facilities Complete
KML1130	CfD Commences
KML1140	Oxy Mode Completion
KML1150	Commercial Operation Date - Oxy Mode Completion
KML1160	Carbon Dioxide Available to NGC at TP13
KML1170	Full Chain Testing Complete
OWNER'S ACTIVITIES	
CPL1830	Compliance and Consents
CPL1840	Owner's Establishment
CPL1860	Full Chain Engineering
CPL1865	Visitor Centre Design/procurement & Fit Out
CPL1880	Operational Readiness
CPL1890	Grid Connection Management
CPL1810	Commercial Proving Period (3 years)
CPL1820	End of Commercial Proving Period
OPP	
Enabling Works and NTP	
OPP1000	Project Start (Pre-NTP Works)
OPP1020	Secure Vacant Possession
OPP2020	Planning Conditions Clearance
OPP2000	Hedgerow/Tree Clearance
OPP2040	NYCC Footpath Relocation
OPP2010	Badger Sett Clearance
OPP2050	Woodyard Relocation
OPP2030	Highway Works
OPP2060	11kV Diversion Works
Ground Preparation	
OPP1005	Site Raising Design & Tender
OPP1007	Mobilisation for Early Works and Ground Preparation
OPP1040	Site Raising Power Block Area
OPP1060	Site Raising ASP/GPU Area
OPP1080	Site Raising Cooling Water Area
OPP1100	Site Raising Non-process Buildings & Treatment Areas
OPP1120	Soil Investigations & Piling Design
OPP1010	Laydown Areas - Preliminary Works
OPP1150	Piling - Remaining Areas
Boiler	
OPP1380	Boiler - Procurement to Enable Boiler Erection
OPP1130	Boiler - Piling



WHITE ROSE CARBON CAPTURE & STORAGE PROJECT

Remaining Work
Critical Remaining Work
Critical Milestone
Milestone
Summary
Remaining Level of Effort

Full Chain Project Programme
1 of 7

Date	Revision	Checked	Approved
25-Feb-16	02	MH	RR

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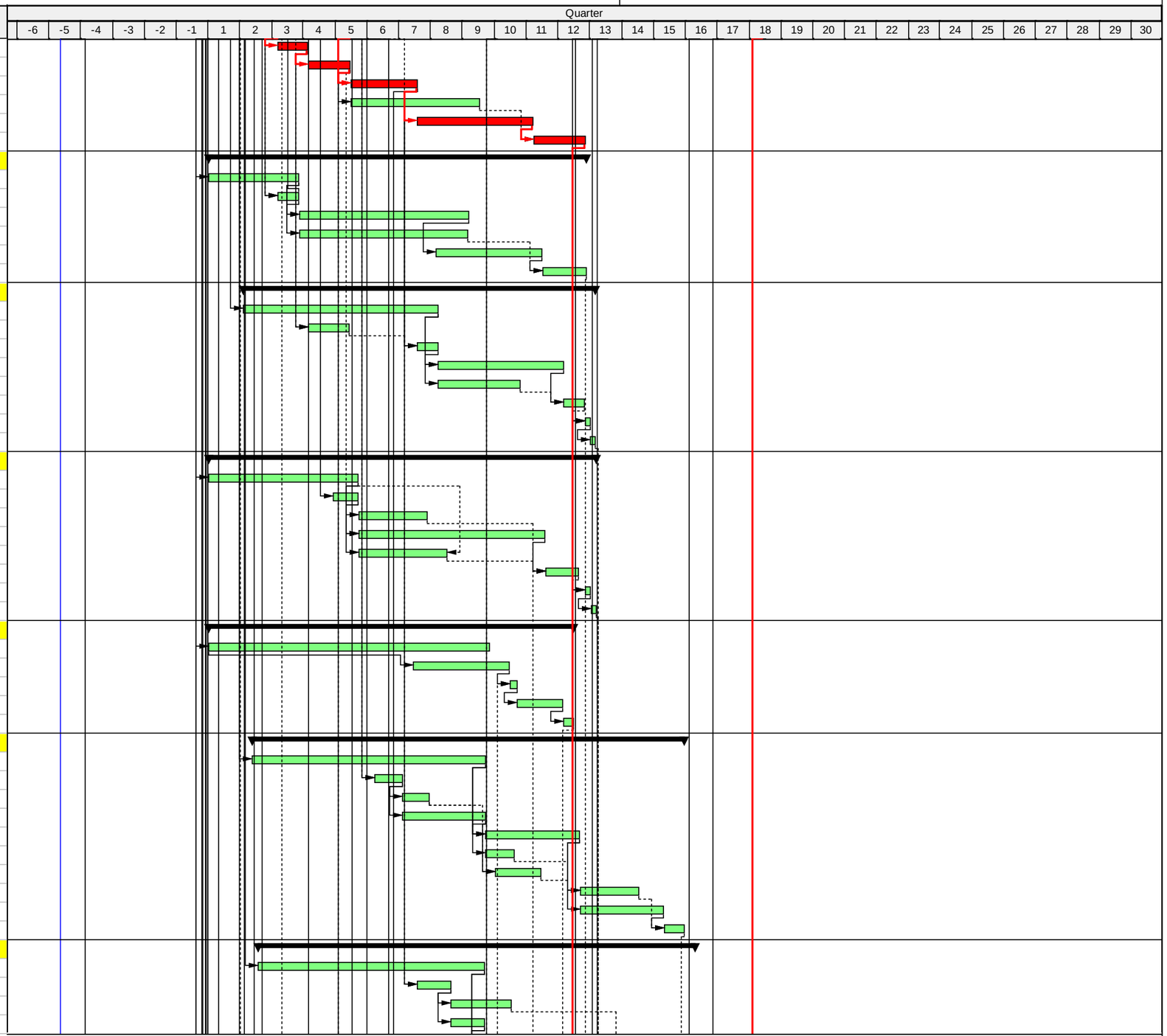
Standard
TASK filter: All Activities

FULL CHAIN PROJECT PROGRAMME

Activity ID	Activity Name
OPP1160	Boiler - Civils - to Allow ESP Civils
OPP1170	Boiler - Civils - to Enable Boiler Erection
OPP1180	Boiler - Erection
OPP1870	Boiler - Procurement to Enable Installation Works up to Cold Commissioning
OPP1190	Boiler - Installation
OPP1200	Boiler - Cold Commissioning
Turbine Hall	
OPP1880	Turbine Hall - Procurement to Enable Turbine Hall Civils and Erection
OPP1140	Turbine Hall - Piling
OPP1210	Turbine Hall - Civils and Erection
OPP2070	Turbine Hall - Procurement to Enable Installation works up to Cold Commissioning
OPP1220	Turbine Hall - Installation
OPP1230	Turbine Hall - Cold Commissioning and Turning Gear Testing
Electrostatic Precipitator System	
OPP2080	ESP - Procurement to Enable ESP Installation
OPP1240	ESP - Foundations
OPP1250	ESP - Civlis
OPP1260	ESP - Installation
OPP2090	ESP - Procurement to Enable Cold Commissioning
OPP1270	ESP - Cold Commissioning
OPP1280	ESP - Hot Commissioning (LFO)
OPP1310	ESP - Hot Commissioning (Coal)
Wet Flue Gas Desulpherisation	
OPP2100	WFGD - Procurement to Enable WFGD Absorber and Equipment Installation
OPP1290	WFGD - Civils to Enable WFGD Absorber Installation
OPP1300	WFGD - Civils to Enable Cold Commissioning
OPP1320	WFGD - Absorber and Equipment Installation
OPP2110	WFGD - Procurement to Enable Cold Commissioning
OPP1330	WFGD - Cold Commissioning
OPP1570	WFGD - Hot Commissioning (LFO)
OPP1580	WFGD - Hot Commissioning (Coal)
Water Steam Cycle	
OPP1950	Water Steam Cycle - Procurement
OPP1960	Water Steam Cycle - Installation
OPP1970	Water Steam Cycle - Hydrotest
OPP1980	Water Steam Cycle - Cold Commissioning
OPP1990	Water Steam Cycle - Feedwater HP/LP Preheaters Flushing
Air Separation Plant	
OPP2120	ASP - Procurement to Enable Installation
OPP1350	ASP - Piling to Enable ASP Civils
OPP1360	ASP - Piling to Enable Installation
OPP1370	ASP - Civils Foundations
OPP1400	ASP - Installation to Enable Start of Cold Commissioning
OPP2130	ASP - Procurement to Enable Installation Works to Hot Commissioning
OPP1390	ASP - Civils Buildings
OPP1410	ASP - Installation to Enable Hot Commissioning
OPP1420	ASP - Cold Commissioning
OPP1590	ASP - Hot Commissioning
Gas Processing Unit	
OPP2140	GPU - Procurement to Enable Equipment Installation
OPP1430	GPU - Civils to Enable GPU Steel Structure Installation
OPP1440	GPU - Civils to Enable Cold Commissioning
OPP1450	GPU - Steel Structure Installation to Allow Equipment Installation



WHITE ROSE CARBON CAPTURE & STORAGE PROJECT

Remaining Work
Critical Remaining Work
Critical Milestone
Milestone
Summary
Remaining Level of Effort

Full Chain Project Programme
2 of 7

Date	Revision	Checked	Approved
25-Feb-16	02	MH	RR

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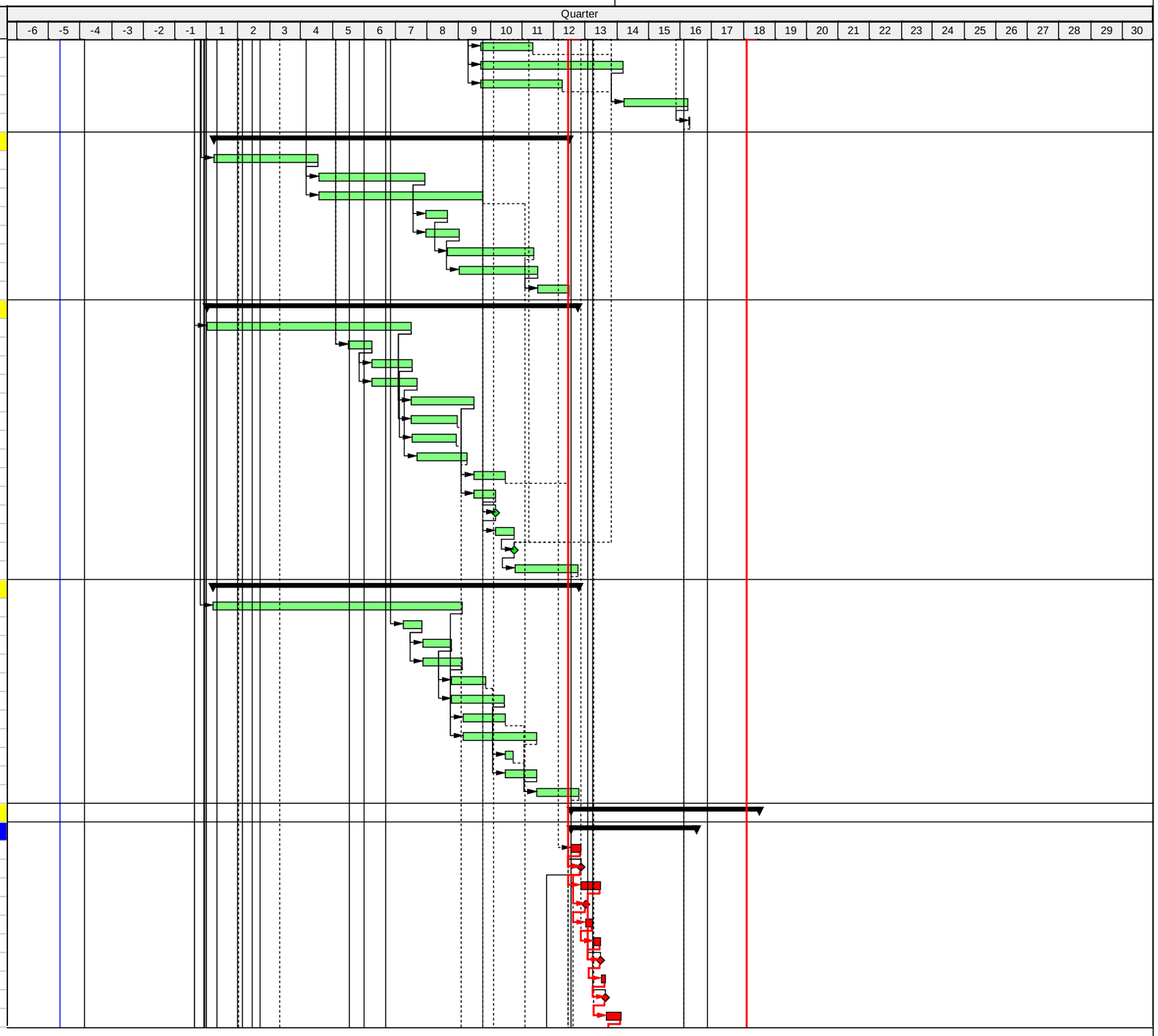
Standard
TASK filter: All Activities

FULL CHAIN PROJECT PROGRAMME

Activity ID	Activity Name
OPP1460	GPU - Steel Structure Installation to Enable Cold Commissioning
OPP1470	GPU - Equipment Installation
OPP2150	GPU - Procurement to Enable Cold Commissioning
OPP1480	GPU - Cold Commissioning
OPP1600	GPU - Hot Commissioning
Cooling Water	
OPP2160	Cooling Water - Procurement to Enable Foundations & Superstructure/Piping Install
OPP1890	Cooling Water - Foundations & Superstructure (Pump & Towers) / Piping Installation
OPP2170	Cooling Water - Procurement to Enable Cold Commissioning
OPP1900	Cooling Water - Cooling Water Towers Finishing
OPP1910	Cooling Water - Cooling Water Pump Finishing
OPP1920	Cooling Water - Cooling Towers Installation
OPP1930	Cooling Water - Cooling Water Pumps & Treatment Equipment Installation
OPP1940	Cooling Water - Cold Commissioning
Electrical and Control	
OPP2180	E&C - Procurement to Enable Electrical & Cabling Installation
OPP1490	E&C - Electrical Buildings Civil Works to Enable Transformer Area Civils
OPP1500	E&C - Electrical Buildings Civil Works to Enable Electrical & Cabling Installation
OPP1520	E&C - Transformer Civils
OPP1530	E&C - Electrical and Cabling Installation to Enable E&C Cold Commissioning
OPP2190	E&C - Procurement Electrical & Cabling Installation Remainder
OPP1510	E&C - Electrical Buildings Civil Works Remainder
OPP1550	E&C - Transformer Installation
OPP1540	E&C - Electrical and Cabling Installation to Enable Boiler 1st Firing LFO
OPP1560	E&C - Cold Commissioning to Enable Back Energising Start
OPP1563	E&C - Back Energising Commences
OPP1565	E&C - Cold Commissioning to Enable DCS Available
OPP1575	E&C - DCS Available
OPP1585	E&C - Cold Commissioning To Boiler 1st Firing LFO
Coal and Fuel	
OPP2200	Coal & Fuel Procurement
OPP1610	Ash & Slag Areas - Foundations & Superstructures to Enable Fuel Areas start
OPP1620	Ash & Slag Areas - Foundations & Superstructures to Enable Ash & Slag Storage
OPP1640	Fuel Areas - Foundations & Superstructures to Enable Fuel Equipment Installation
OPP1630	Ash & Slag Areas - Foundations & Superstructures to Enable Final Storage Erection
OPP1660	Ash & Slag Storage Erection to Enable Conveyer Installation
OPP1650	Fuel Areas - Foundations & Superstructures to Enable Cold Commissioning
OPP1690	Fuel Oil Equipment Installation (Storage/Transfer/Pump Station)
OPP1670	Ash & Slag Storage Erection to Enable Cold Commissioning
OPP1680	Slag Conveyer Installation
OPP1700	Coal & Fuel Cold Commissioning
Hot Commissioning	
Air Mode	
OPP1702	Acid Cleaning
OPP1710	Boiler - 1st Firing LFO
OPP1720	Hot Commissioning
OPP1730	Boiler - 1st Coal Firing
OPP1740	Steam Blowing and Restoration
OPP1750	Condenser Vacuum & Bypass Operation
OPP1760	1st Steam to Turbine
OPP1770	Generator Electrical & Short Circuit Tests
OPP1780	1st Synchronisation
OPP1790	Boiler & WSC Tuning



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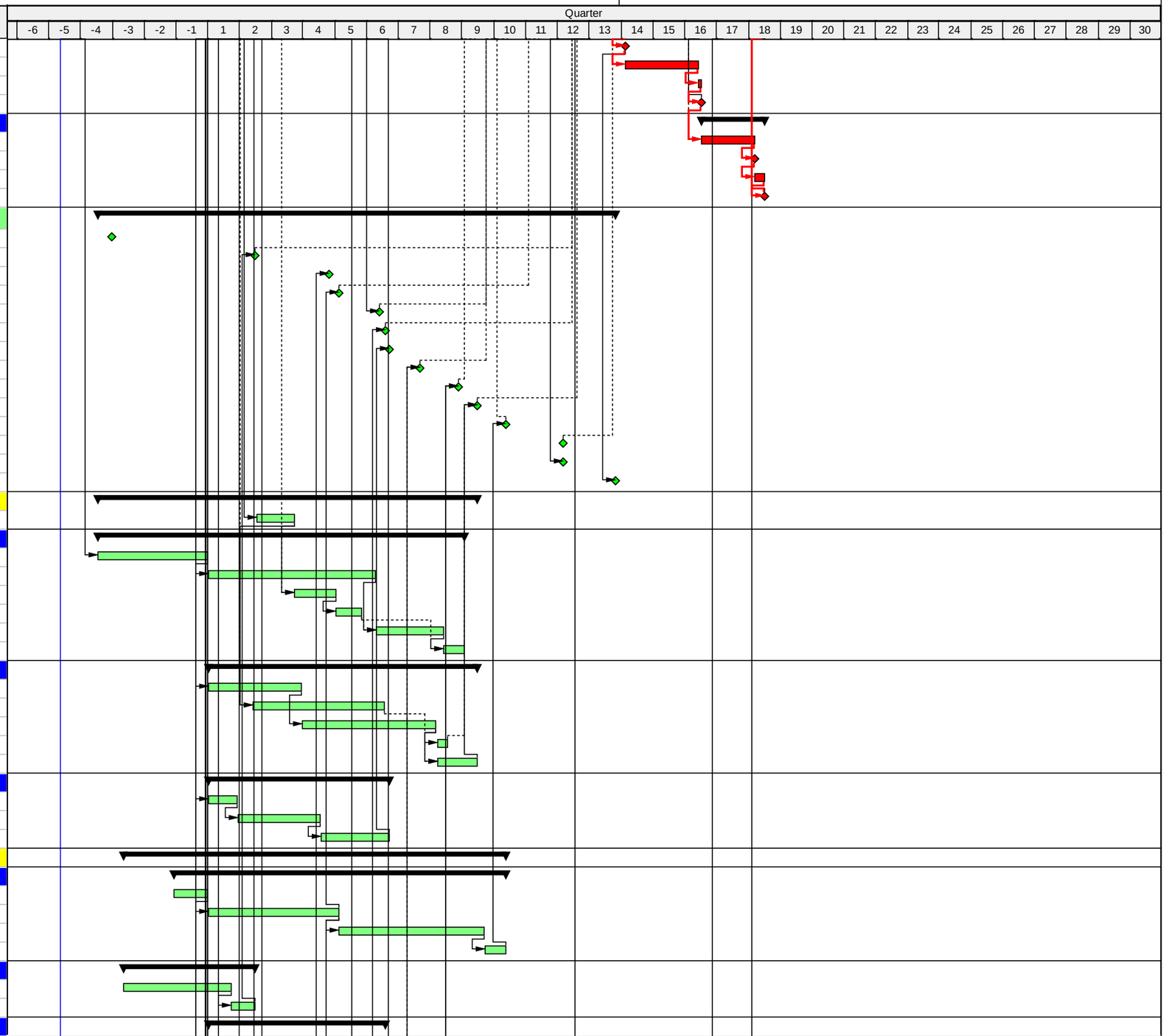
Activity ID	Activity Name
OPP1800	Energy Export Air Mode
OPP1810	Load Tests & Functional Tests
OPP1820	Trial Run in Air Mode
OPP1830	Completion in Air Mode
Oxy Mode	
OPP1840	Oxy Mode Hot Commissioning
OPP1845	Oxy Mode Hot Commissioning Complete
OPP1850	Oxy Mode Trial Run & Performance Tests
OPP1860	Commercial Operation Date - Oxy Mode Completion
INTERCONNECTIONS	
INT1310	TP08c - Temporary Rain Water Discharge
INT1340	TP06 - Drinking Water
INT1410	TP12 - Trenchwork for 400kV Cable
INT1330	TP05 - Cooling Water
INT1430	NGET Connection Complete for Back Energisation
INT1360	TP09 - Sanitary Sewage Network
INT1370	TP10a - Fly Ash Disposal by Conveyor
INT1390	TP12b - High Voltage Connection at NGET Switchyard
INT1400	TP12c/d - 11kV Connection at GE Distribution Board
INT1130	TP01 - Coal Supply
INT1350	TP08a - Cooling Water Purge
INT1420	NGET Connection Complete for Energy Export (Air Mode)
INT1440	TP 16f - Access to NGC's Drax AGI (Pig Trap) Compound
INT1450	Release of Laydown Areas 1 & 4 for Pipeline Installation
Bunkers & Conveyors	
INT1030	Interconnections Laydown Area
Transfer Towers	
INT1039	Transfer Towers - Design
INT1040	Transfer Towers - Procurement & Delivery
INT1050	Transfer Towers - Construction, Fabrication and Delivery
INT1070	Transfer Towers - Commissioning to Enable Installation of Systems
INT1060	Transfer Towers - Installation of Systems
INT1080	Transfer Towers - Commissioning Remainder
Coal	
INT1090	Coal Conveyors - Procurement & Delivery
INT1100	Coal Conveyors - Construction and Fabrication of Bunkers (Rail and Road Unloadin
INT1110	Coal Conveyors - Installation of Conveyors to Enable Commissioning
INT1113	Coal Conveyors - Installation of Conveyors Remainder
INT1115	Coal Conveyors - Commissioning
Ash	
A1000	Ash/PFA - Design & Approval
A1010	Ash/PFA - Procurement and Delivery
A1020	Ash/PFA - Installation and Commissioning
Pipework	
Cooling Water	
INT1200	Cooling Water - Design
INT1210	Cooling Water - Procurement & Delivery
INT1220	Cooling Water - Installation
INT1230	Cooling Water - Commissioning & Testing
Potable Water	
INT1240	Potable Water - Design and procurement
INT1250	Potable Water - Installation and Commissioning
Sewage	



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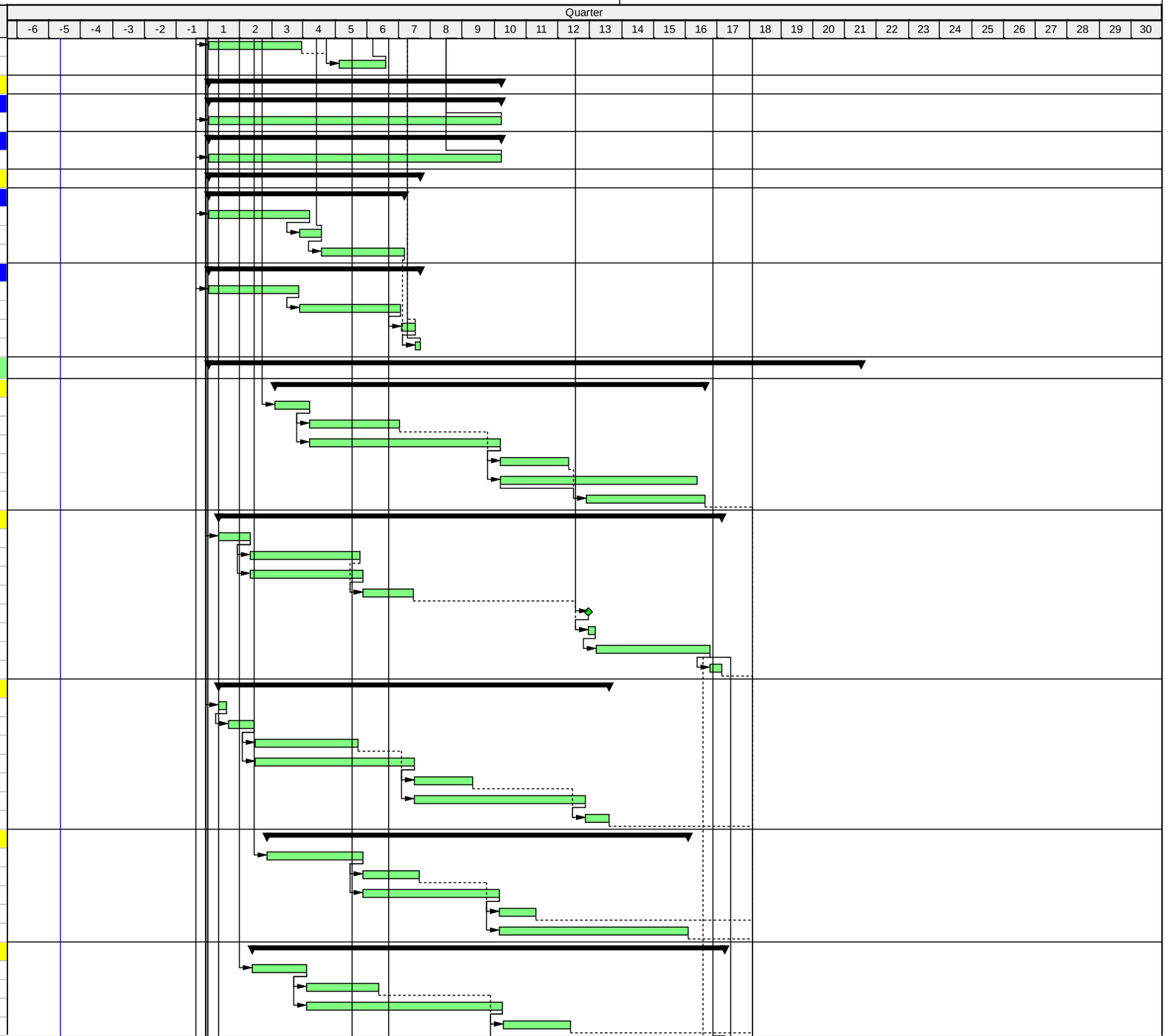
Activity ID	Activity Name
INT1260	Sewage - Design & procurement
INT1270	Sewage - Installation & Commissioning
Site Electrical	
Cabling	
INT1290	Site Electrical Cabling - Design Procurement & Installation
Sub Stations/Pumphouse/PFA Handling	
INT1300	Sub Stations/Pumphouse/PFA Handling - Design, Procurement & Installation
400kV	
400kV Cable	
FCKV100	400kV Cable - Procurement
FCKV101	400kV Cable - Mobilise to Site
FCKV102	400kV Cable - Installation & Commissioning
400kV Bay	
FCKV104	400kV Bay - Design & Procurement
FCKV105	400Kv Bay - Construction
FCKV107	400kV Bay - Commissioning
FCKV106	400Kv Bay - Main & Reserve Bar Energisation
TRANSPORT & STORAGE	
Onshore Pipeline	
TSS1600	Onshore Pipeline - Design to Enable Construction
TSS1610	Onshore Pipeline - Design Remainder
TSS1620	Onshore Pipeline - Procurement to Enable Construction
TSS1630	Onshore Pipeline - Procurement Remainder
TSS1640	Onshore Pipeline - Construction
TSS1670	Onshore Pipeline - Mechanical Completion
Drax Pig Trap	
TSS1870	Drax Pig Trap - Design to enable Start of Procurement
TSS1880	Drax Pig Trap - Design remainder to Enable Remainder of Procurement
TSS1890	Drax Pig Trap - Procurement
TSS1900	Drax Pig Trap - Procurement Remainder
TSS1910	Drax Pig Trap - Site Becomes Available
TSS1920	Drax Pig Trap - Mobilisation
TSS1930	Drax Pig Trap - Construction
TSS1940	Drax Pig Trap - Pre-Commissioning
Camblesforth Multijunction	
TSS1510	Camblesforth Multijunction - Mobilisation & Design Set-up
TSS1520	Camblesforth Multijunction - Design to Enable Procurement
TSS1530	Camblesforth Multijunction - Design Remainder
TSS1540	Camblesforth Multijunction - Procurement to Enable Construction Start
TSS1550	Camblesforth Multijunction - Procurement Remainder
TSS1560	Camblesforth Multijunction - Construction
TSS1580	Camblesforth Multijunction - Mechanical Completion
AGIs	
TSS1450	AGIs - Design To Enable Procurement Start
TSS1460	AGIs - Design Remainder
TSS1470	AGIs - Procurement To Enable Construction Start
TSS1480	AGIs - Procurement Remainder
TSS1490	AGIs - Construction
Onshore - Barmston Pumping Station	
TSS1380	Barmston Pumping Station - Design to Enable Procurement
TSS1390	Barmston Pumping Station - Design Remainder
TSS1400	Barmston Pumping Station - Procurement to Enable Start of Construction
TSS1410	Barmston Pumping Station - Procurement to Enable Completion of Construction



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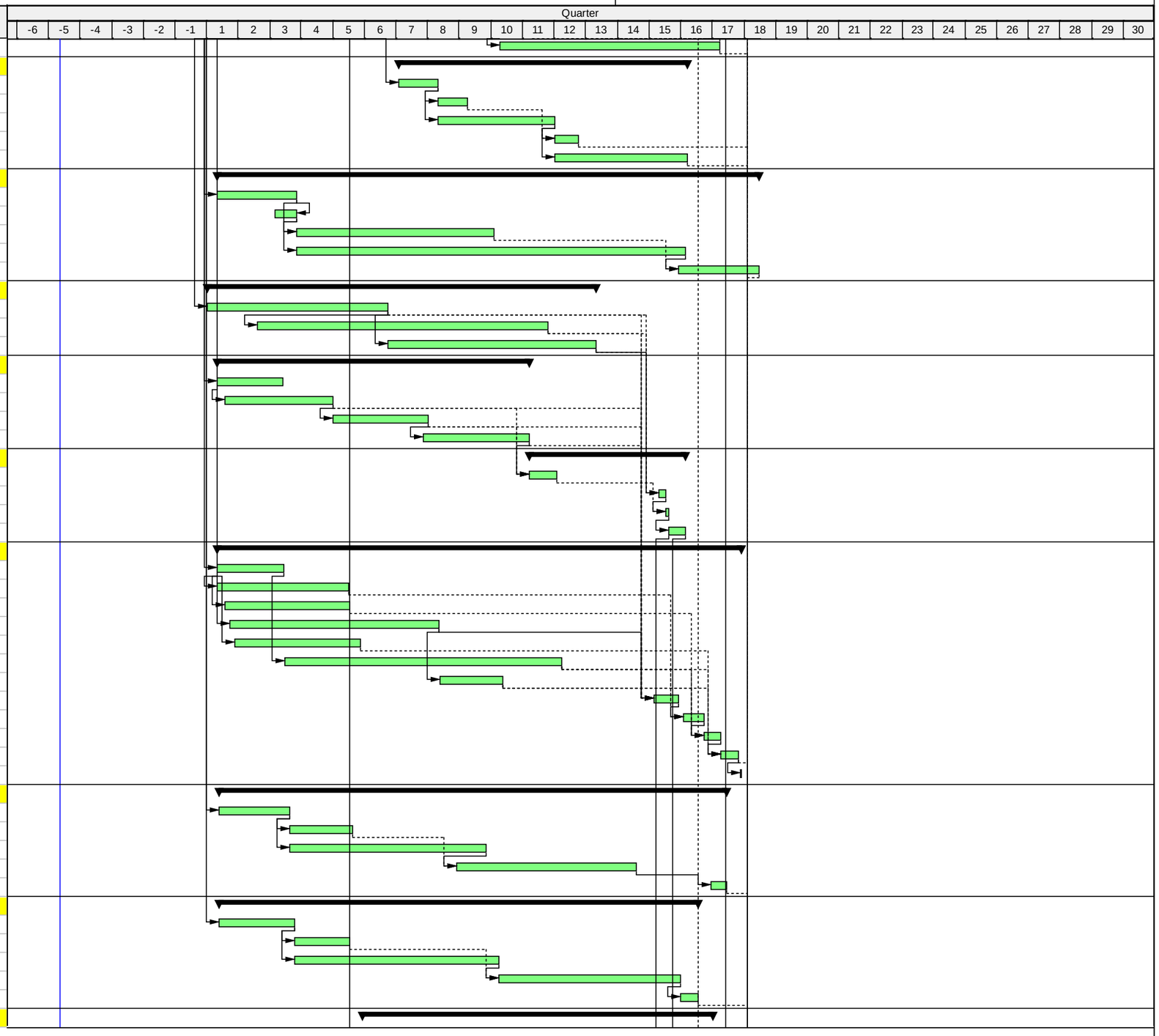
Activity ID	Activity Name
TSS1420	Barmston Pumping Station - Construction
Beach Crossing	
TSS1960	Beach Crossing - Design to Enable Procurement Commencement
TSS1970	Beach Crossing - Design Completion
TSS1980	Beach Crossing - Procurement
TSS1990	Beach Crossing - Procurement Completion
TSS2000	Beach Crossing - Construction
Offshore Pipeline	
TSS1690	Offshore Pipeline - Design
TSS1710	Offshore Pipeline - Procurement to Enable Construction
TSS1720	Offshore Pipelien - Procurement Remainder
TSS1730	Offshore Pipeline - Construction
TSS1740	Offshore Pipeline - Preservation
Offshore Topsides	
TSS1070	Offshore Topsides - Design
TSS1090	Offshore Topsides - Procurement
TSS1110	Offshore Topsides - Construction
Jacket	
TSS1000	Jacket & Pile Borehole Survey - Procurement, Obtain Consents, Survey
TSS1010	Jacket - Design
TSS1030	Jacket - Procurement
TSS1050	Jacket - Construction
Jacket & Topsides Installation	
TSS2020	Jacket & Topsides Installation - Shipping & Installation Jacket to Seabed
TSS2030	Jacket & Topsides Installation - Shipping Topsides
TSS2040	Jacket & Topsides Installation - Install Topsides to Jacket
TSS2050	Jacket & Topsides Installation - Hook-up and Pre-commissioning
Wells	
TSS1130	Wells Specification
TSS1170	Well 1 Design & Approval
TSS1180	Well 2 Design & Approval
TSS1140	Rig Tender & Contract Award Process
TSS1190	Well 3 Design & Approval
TSS1200	Wells Procurement
TSS1150	Interface Engineering Design & Manufacturing (Mechanical & Electrical)
TSS1220	Plan, Mobilise, Tow, Jack-up and Interface Drilling Rig
TSS1230	Drill and Complete Well 1 (incl. Xmas Tree Installation and Tie-ins)
TSS1240	Drill and Complete Well 2 (incl. Xmas Tree Installation and Tie-ins)
TSS1250	Drill and Complete Well 3 (incl. Xmas Tree Installation and Tie-ins)
TSS1260	Demobilise Rig
T&S Control Centre	
TSS1270	NGC Control Centre - Design to Enable Procurement
TSS1280	NGC Control Centre - Design to Enable Construction
TSS1290	NGC Control Centre - Procurement
TSS1300	NGC Control Centre - Construction
TSS1310	NGC Control Centre - Pre-Commissioning
T&S Offshore Control Centre	
TSS1320	Offshore Control Centre - Design to Enable Procurement
TSS1330	Offshore Control Centre - Design to Enable Construction
TSS1340	Offshore Control Centre - Procurement
TSS1350	Offshore Control Centre - Construction
TSS1360	Offshore Control Centre - Pre-Commissioning
ICSS Systems	



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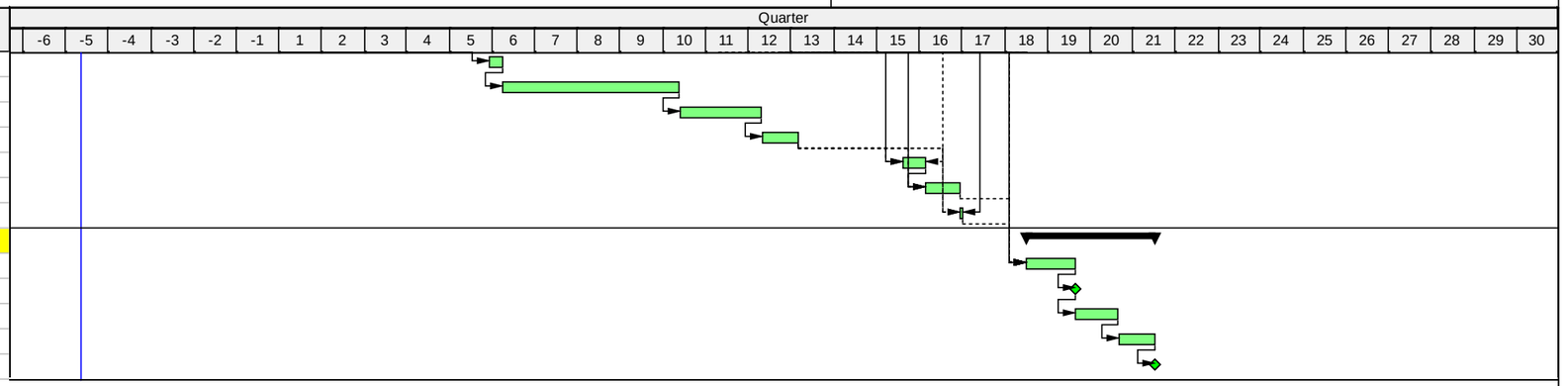
Activity ID	Activity Name
TSS1790	ICSS - Mobilisation
TSS1800	ICSS - Detailed Design
TSS1810	ICSS - Build, FAT & Ship to Site
TSS1820	ICSS - Installation at Sites
TSS1830	ICSS - Pre-commissioning Offshore ICSS
TSS1840	ICSS - Pre-commissioning Onshore ICSS (Excl. Drax)
TSS1850	ICSS - Pre-commissioning Drax ICSS
Test & Commissioning	
TSS2060	Fill and Pressurise Export Pipeline with Carbon Dioxide
TSS2070	Export Pipeline Filled with Carbon Dioxide
TSS2080	Test & Commissioning
TSS2090	Plant Proving Stage
TSS2100	Completion of T&S Commissioning



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