

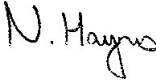
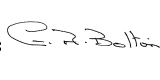
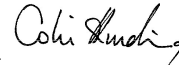
THE INFRASTRUCTURE PLANNING (APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009

Preesall Underground Gas Storage Facility, Lancashire

Technical Explanation of Draft DCO Schedule 1
(Authorised Development) and Works Plan

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THE INFRASTRUCTURE PLANNING (APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009

Preesall Underground Gas Storage Facility, Lancashire

DRAFT DEVELOPMENT CONSENT ORDER (DCO)

TECHNICAL EXPLANATION OF DCO SCHEDULE 1 (AUTHORISED DEVELOPMENT) AND WORKS PLANS

Schedule 1 of the draft DCO (the Work Schedule) and the Work Plans provide a technical description of the works and areas required for such works. This explanatory note aims to provide guidance as to how the scheme operates and provides further explanation as to how limits of deviation have been derived.

The ordering of the Works numbers has considered the principal work element, namely the subsurface gas storage cavern and subsurface pipelines to and from the caverns, as the focus of the scheme, hence these have been assigned Work Nos., 1A and 1B respectively, with surface support works for brine/wash water transmission, power supply, and gas transmission assigned subsequent works numbers in an outward direction from the central focus. Work Plan Sheet numbers commence at the Irish Sea brine outfall and increase in an easterly direction to the central gas storage facility; thereafter returning along the cable route to Stanah, before continuing in an easterly direction along the gas transmission pipeline route to the juncture with the National Grid NTS at Nateby, approximately 12 km to the east of the main Preesall site. All Works numbers are labelled on the Work Plans and cross-referenced in the Works Schedules. The following provides an overview of the works to be undertaken and explains reasoning behind the setting of Limits of Deviation (LoD) for individual work packages.

Work Nos., 1A and 1B

Work Nos., 1A and 1B define all deep subsurface works required as part of the scheme. Sub-surface works have been shaded on the Work Plans to provide clear distinction from surface works.

Work No 1A : Underground Gas Storage Facility

The Scheme comprises an underground gas storage facility to inject, store and release gas from the proposed caverns to the National Grid gas transmission mains near Nateby 12 km to the east of the main Preesall site. The 19 caverns will have a total storage capacity of 900 million standard cubic metres at standard temperatures and pressures (600 million cubic metres of “working gas”). Caverns will be formed in the area of two polygons (each defined by limits of deviation) by solution mining of the Preesall halite deposit and will be unlined. Extensive geological investigation has been undertaken to identify potential ground hazards to safe formation and operation of such caverns. The horizontal limit of deviation for development of each individual cavern will be constrained in accordance with recommendations for the safe design of salt caverns developed by Professor Rokahr, namely cavern construction is not allowed within 3 or 4 maximum cavern radii of adjacent hazards, subject to hazard type¹. An outer horizontal limit of deviation is provided for each of the two polygons beyond which no cavern development is authorised.

The vertical limit of deviation for cavern development is constrained within the halite body, and further constrained in accordance with the recommendations for the safe design of salt caverns developed by Professor Rokahr¹, namely in this instance, a minimum of 1 maximum cavern radii below the top of halite, and 0.2 maximum cavern radii above the base of Halite. The reality of these design rules and the actual position of the Preesall Halite Deposit, mean that all caverns will be developed within vertical limits of approximately 220m and 760m below ground surface. The horizontal LoD for cavern development is provided on the Work Plans. This LoD provides flexibility for future cavern positioning as, to an extent, the cavern detailed design process and hazard identification will be iterative as a function of detailed information obtained at the drilling and testing stage.

The underground storage caverns will be developed by dissolving the insitu salt deposit (Preesall Halite) by circulating sea-water transmitted from the Seawater Pump Station (Work No.15) at Fleetwood Fish Dock to the Well-heads (Work Nos., 2A-2G) down the well strings (Work No1B) and through the salt body, before pumping back to surface as a saturated brine. Insolubles will be removed at the Booster Pump Station (Work No 4), prior to discharge of the brine, off-shore into the Irish Sea. Once operational, natural gas will be transmitted into and out of the caverns via feed along the NTS Interconnector Pipeline (Work Nos., 20A-20H) from the NTS network at Nateby, with pressure equalisation occurring at the Gas Compressor Compound (Work No 3).

¹ The internationally recognised recommendations for the safe design of salt caverns developed by Professor Rokahr are provided in detail within Annex A to this Technical Explanation. These rules have been incorporated as requirements 6 at Schedule 9 of the DCO Application.

Work No 1B: Drilling and Transmission Pipelines from Surface to the Gas Storage Caverns

Installation of vertical well, S-shaped well, slant well and extended reach slant well casing strings and internal operational pipeline strings, allowing construction of the gas storage caverns, and thereafter connecting the multiple well-head compounds (Work Nos., 2A-2G) constructed at surface, to the gas storage caverns constructed sub-surface within the Halite body. Extended slant wells will be constructed initially via micro-tunnelling techniques through sub-surface soil deposits and thereafter by directional drilling through Mercia Mudstone and Preesall Halite formations. Slant wells, Vertical and S-shaped wells will be constructed directly by directional drilling methods from surface. Two casing strings will connect each storage cavern to the surface well-head. All casing strings will comprise 2 to 3 concentric casings with concreted annuli and will be pressure tested prior to operation. The LoD for Work No 1B encompasses the subsurface area between the proposed cavern creation areas (Work No 1A) and the surface well-head compounds (Work Nos., 2A-2G), but allowing flexibility beyond these areas for future design investigation if so required.

Work Nos., 2A-2G: Well-Head Compounds

Work Nos., 2A-2G comprises 7 No Multiple wellhead locations within separate individual compound areas, which have been separately identified as Work Numbers 2A to 2G. These compounds will initially form the drilling platform areas for cavern construction, and thereafter at production stage will form the surface headwork to the caverns. Each compound will contain multiple wellheads and valve boxes, emergency hydraulic packs (for operation of valves in emergency situations), manifold valve boxes, instrument enclosures, close circuit television facilities, intruder detectors and compound lighting. Each wellhead compound area will be encircled by grassed mounds; stock proof fencing, security fencing and hard standings will be incorporated. Below ground gas manifold pipelines and brine feeds and returns are situated beneath the wellhead compound. Gated access will be provided to hardcore roads/tracks within the overall wellhead site area (Work No 8) linking the wellheads to the compressor compound and to the Booster Pump station. The LoD for the separate well-head compounds allows for flexibility for final detailed design configuration of the caverns and production strings (Work Nos., 1A & 1B), and allows sufficient room for construction and final landscaping requirements.

Work No 3: Gas Compressor Compound

Work No 3 comprises single storey buildings for the compressor station/electrical utilities building and provides the pressure equalisation facility for the scheme between the NTS Interconnector Pipeline and the storage caverns. It forms the largest part of the surface infrastructure required for the scheme and as such it has been designed and landscaped to minimise

its environmental impact. The facility will contain equipment such as pig launchers receivers, slug catchers, glycol contactors and regeneration system, compressors, compressor knock out separators, compressor aftercoolers, gas filters, and heaters and all storage tanks, sub stations, switch yards and valve pits necessary to operate the facility. Gas distribution pipelines to the well-head compounds will all be run underground.

A vent stack will be provided for use during commissioning, maintenance and during emergencies, situated within the centre of a fire water storage pond providing a sterile area around the stack. The fire water pond will be fed from surface water runoff from the facility and will drain to an existing watercourse in the vicinity. Interception facilities will be provided. Access roads (metalled) will be provided within the compressor compound whilst equipment will be sited within gravelled hard standing areas.

Cut and fill earthworks will be required to form a level formation for the construction of the main structure and excess spoil shall be utilised for construction of the landscaping bunds. The LoD has been fixed to account for all temporary construction stockpiling, lay-down and construction activities and includes for the proposed landscape extent.

Work No 4: Booster Pump Station, De-Brine Facility and Control Centre Compound

Work No 4 comprises a compound to contain the single storey Booster Pump Station building, hardstanding for nitrogen tanks, hydrocyclones, a de brine pond, other pumping equipment and a transformer compound. The Booster Pump Station building will contain high capacity pumps, a control room, electrical control equipment, switchgear and a standby generator. The building will be internally lit. The Booster Pump Station will pressurise washwater to allow washing of the storage caverns. This wash water is returned to the De-brine Facility as saturated brine and solids are removed. The brine is then pumped by separate pumps to enable discharge of the brine to the Irish Sea.

The compound would be located adjacent to the Hackensall Sewage Treatment Works. Access to the compound would be provided from the track that extends from Monks Lane. A screen wall and grassed mounds are situated on the north and west sides of the compound area which will be obtained from earthwork cut for the de-brining pond. Metalled internal vehicular access routes and turning areas are included as are paved pedestrian areas. Underground and above ground pipework, electrical cables and other utilities will lie within the compound area. The compound area will be encircled by security fencing and will contain CCTV, motion sensing security systems and external lighting.

The LoD for these works have been determined to allow for construction of the works described above, to include construction of the landscape mounds.

Work No 5: Security and Support Facility at Higher Lickow Farm

Work No 5 comprises staff facilities and a maintenance workshop on the built area of the existing barn, an administration, health and safety and training facility sited within the existing farmhouse (to be refurbished) and a security gatehouse (single storey) to control inbound and outbound vehicular movements to the compressor compound and wider wellhead area. The proposal is to utilise the existing abandoned farmhouse and outbuildings where possible or rebuild on the same footprint to provide a 2 storey support facility and single storey security gatehouse, with attendant staff car-parking. The immediate area around the facility and the parking areas provided will be metalled. Security systems and lighting is included

The LoD for these works have been determined to allow for construction of the works described above.

Work No 6: New Access Road extending from the A588 up to and including the Security and Support Building at Higher Lickow farm.

Work No 6 comprises construction of a metalled private road between the public highway A588, Hall Gate Lane and the Security gatehouse to the gas storage compound. The road will be constructed to a standard to allow for the movement of large items of equipment such as transformers, interconnector pipes and compressors. The road will require a junction with Back Lane (adopted highway, unclassified road), the crossing of Grange Pool (Designated Main River) via a culvert or bridge and the crossing of or modifications to other minor watercourses by piped culverts or realigned ditches. The road will be drained by pipes or ditches to existing watercourses via interceptors where required. The road will be lit at low level (height) to cater for emergency operation and will be fenced to prevent livestock entry. Field access will be provided at appropriate locations. Grass Mounding and landscaping will be incorporated as screening where appropriate (Ivy Cottages) as will replacement or improvements to existing hedges.

A new junction with The A588, Hall Gate Lane is necessary. The junction layout and the sight-lines require the removal and replacement of the existing bus shelter on the A558.

The road alignment runs in a corridor with the NTS Interconnector pipeline (Work No 20A) and partially in corridor with twin electrical power cables (132kV) (Work No 17A), hence the LoD has been determined to allow for the construction and future access and maintenance to all elements; it allows for the works described above and for any reasonable detailed design alignment changes to incorporate the requirements of the Highway Authority.

Work No 7: New Access Road extending from the Security and Support Buildings at Higher Lickow farm (Work No 5) to the Gas Compressor Compound Area (Works No 3).

Work No 7 comprises construction of a metalled private road between the Security Gatehouse and the Gas Compressor Compound (Work No 3). The road will be constructed at grade and will be drained by pipes or ditches to existing watercourses via interceptors where required. The road will be lit at low level (height) to cater for emergency operation and will be fenced to prevent livestock entry. Field access will be provided at appropriate locations. Replacement or improvements to existing hedges will be included as appropriate. Crossing of or modifications to minor watercourses will be by the use of piped culverts or realigned ditches as appropriate.

The road alignment runs in a corridor with the NTS Interconnector pipeline (Work No 20A) and in corridor with twin Electrical Power cables (132kV) (Work No 17A), hence the LoD has been determined to allow for construction and future access and maintenance to all elements.

Work No 8: Permanent Access Tracks linking Wellhead compounds and Gas Compressor Compound,

Work No 8 comprises new stoned tracks or refurbished existing stoned tracks linking the Gas Compressor Compound to each of the Wellhead Compounds (Work Nos., 2A-2G), of a width appropriate to proposed vehicular usage. No positive drainage will be provided, save where necessary. Tracks link the wellhead compound areas to the gas compressor station and to existing roads or tracks. The tracks will be designed to accommodate construction, maintenance and emergency access vehicles. Work areas will be reinstated landscaping being provided at appropriate locations, hedgerows and fences where removed will be replaced.

The LoD for these works have been designed to accommodate the construction and maintenance of the above work, unless the proposed access track runs parallel to separate work packages (ie. Work Nos., 18 and 19 – Electrical cables between the Gas Compressor Compound and the Booster Pump Station), in which case the LoD has been widened to allow construction, maintenance and access of all work elements.

Work No 9: Gas Manifold, Distribution Pipelines, Power, Control and Telecommunication Cables

Work No 9 comprises underground pressure pipelines, power, control and telecommunication cables within the works areas linking wellheads to the Gas Compressor Compound. General Work areas will be reinstated landscaping being provided at appropriate locations, hedgerows and fences where removed will be replaced. Markers posts as required will be installed.

For much of the route of these works, they run parallel to the washwater and brine discharge pipelines (Work Nos., 10 and 11) hence where this is the case the LoD corridor for these works has been determined to allow construction, access and maintenance to all elements. The LoD corridor for the underground gas distribution pipelines into the wellhead compounds have been designed to allow for flexibility in relation to the detailed design fix of the well-head locations, and allow for construction, maintenance and access to the pipelines/cables.

Work No 10: Wash Water Pipelines Linking Booster Pump Station to Wellheads

Work No 10 comprises wash water underground pressure pipelines linking the Booster Pump Station (Work No 4) to each wellhead compound (Work Nos., 2A-2G). These pipelines will carry seawater to the well-heads. General Work areas will be reinstated, landscaping being provided at appropriate locations, Hedgerows and fences where removed will be replaced. Marker posts as required will be installed.

For much of the route of these works, they run parallel to the gas manifold and brine discharge pipelines (Work Nos., 9 and 11) hence where this is the case the LoD corridor for these works has been determined to allow construction, access and maintenance to all elements. The LoD corridor for the underground wash water pipelines into the wellhead compounds have been designed to allow for flexibility in relation to the detailed design fix of the well-head locations, and allow for future maintenance and access to the pipelines.

Work No 11: Brine Outlet Pipelines Linking Wellheads to Booster Pump Station

Work No 11 comprises return wash water underground pressure pipelines linking each wellhead compound to the Booster Pump Station. These pipelines will carry saturated brine from the solution mining process during cavern construction, to the De-brine Facility and Booster Station. General Work areas will be reinstated landscaping being provided at appropriate locations, hedgerows and fences where removed will be replaced. Marker posts as required will be installed.

For much of the route of these works, they run parallel to the gas manifold and wash water pipelines (Work Nos., 9 and 10) hence where this is the case the LoD corridor for these works has been determined to allow construction, access and maintenance to all elements. The LoD corridor for the underground brine pipelines from the wellhead compounds have been designed to allow for flexibility in relation to the detailed design fix of the well-head locations, and allow for future maintenance and access to the pipelines.

Work No 12: Wash Water Pipeline, Seawater Pump Station Works to Booster Pump Station.

Work No 12 comprises a high pressure pipeline to transmit wash water from the Sea Water Pump Station (Work No 15) situated to the west of the Wyre Estuary, to the Booster Pump Station (Work No 4), situated to the east of the Wyre Estuary. The pipeline will be installed by trench methods when land-side, but installed by directional drilled methods beneath the Wyre Estuary. The route corridor for the pipeline allows sufficient room for further directional drill bores for the returning brine discharge pipe (Work No 13), and electrical cables (Work No 14). The pipeline corridor will be constructed to allow a minimum headroom of 8m below the river bed. Marker posts as required will be installed.

For much of the route of these works they run parallel to Work Nos., 13 & 14, hence the LoD has been determined to allow sufficient flexibility during construction for installation of each work number.

Work No 13: Brine Discharge Pipeline, Booster Pump Station Works to Seawater Pump Station.

Work No 13 comprises a high pressure pipeline to transmit brine discharge from the Booster Pump Station (Work No 4) situated to the east of the Wyre Estuary, to the Sea Water Pump Station (Work No 15), situated to the west of the Wyre Estuary. The pipeline will be installed by trench methods when land-side, but installed by directional drilled methods beneath the Wyre Estuary. The route corridor for the pipeline allows sufficient room for further directional drill bores for the wash water pipe (Work No 12), and electrical cables (Work No 14). The pipeline corridor will be constructed to allow a minimum headroom of 8m below the river bed. Marker posts as required will be installed.

For much of the route of these works they run parallel to Work Nos., 12 & 14, hence the LoD has been determined to allow sufficient flexibility during construction for installation of each work number.

Work No 14: Power and Control cables laid in sleeves beneath the bed of the River Wyre, Seawater Pump Station Compound to Booster Pump Station.

Work No 14 comprises power (twin 11kv) and Control cables laid in sleeves between the Seawater Pump Station Compound (Work No 15) to the Booster Pump Station, (de brining facility) (Work No 4), and to connect into the power and control cabling feed to the Gas Compressor Compound (Work Nos., 18 and 19). The power and control cables will be installed by trenched method landside but by directional drill methods beneath the Wyre Estuary within the combined pipeline corridor to encompass Work Nos., 12 & 13. Marker posts

as required will be installed. The LoD has been determined to allow sufficient flexibility during construction for installation of each work number.

Work No 15: Seawater Pump Station Compound

Work No 15 comprises the Seawater Pump Station Compound. The purpose of the pumping station is to pump sea-water from Fleetwood Fish Dock beneath the Wyre Estuary to the well-heads via the Booster Pump Station. The sea-water will be utilised for cavern formation. The compound contains, a Seawater Pump station building housing multiple pumps connected to the fish dock by an existing culvert and the proposed wet well (abstraction system). Infrastructure from the original Fish Dock will be reused where possible. Filters would be employed within the inlet to the pump station to minimise impact on marine organisms. A connection to the brine discharge pipeline is provided to facilitate washout of the Seawater Pump Station sump/wet well as required. The building will contain electric pump drive units, switchgear and control panels together with a control panel desk and sanitary facilities. The pumping station building will be internally lit. A mobile gantry crane and roller shutter doors facilitates maintenance.

A bunded transformer compound will be sited adjacent to the building. Internal vehicular access routes and parking areas will be metalled whilst pedestrian areas will be in concrete flagging or other forms of paving. Other external areas will be landscaped, or grassed with wildflower, trees or shrubs with a birch and conifer screen being positioned to the northern and eastern boundaries. Flow meters and monitoring systems for the brine discharge pipeline are contained in pits beneath the compound area. The compound area will be fenced with gated security fencing, CCTV and intruder detection systems will be incorporated as will compound lighting. Positive piped drainage systems are included discharging surface water to the dock and foul water to adjacent sewers in Herring Arm Road.

Access is from Amounderness Way (Trunk Road) via Dock Avenue (unclassified adopted highway part) and Herring Arm Road currently a private road but anticipated to be adopted in the future.

Work Nos., 16A-16L: The Brine Discharge Pipeline, Seawater Pump Station to its termination at the Single Two Port Diffuser Offshore of Rossall Promenade.

Work Nos., 16A-16L comprises the brine discharge pipeline between the discharge monitoring point at Fleetwood Fish Dock to the brine outfall and Single Two Port Diffuser point, 2.3km offshore of the Rossall Promenade. The pipeline route is approximately 7.4km in length and has been designed to minimise environmental and residential impact. The route corridor varies to between 23-33m width through the land corridor, increasing to 58m width through the fore-shore and off-shore section. The pipeline route has been subdivided within the work schedules, this subdivision relates to the nature and location of the pipeline either onshore, within the limits of the promenade, between mean high and mean low water marks and below mean low water mark. For the majority of the route, construction will be via trenched methods or through existing subsurface ducting, to include topsoil strip and storage mounding, subsoil excavation (to form trench) and mounding, provision of a temporary plant haul road, pipe storage area, temporary fencing and installation of marker posts as required. However, the following sub-work numbers described below are identified areas with more onerous construction conditions, requiring alternative construction methodologies. The LoD determination allows for the working methods discussed above and below, and incorporates sufficient width for detailed design and construction flexibility. Post-construction, along the pipeline route an easement of 10m width centred on the pipeline will be required. All other areas within the LoD affected by construction shall be returned to existing or improved use.

Work No 16D: The Brine Discharge Pipeline, Jamieson Road Temporary Works Compound Approximate Chainage 1820m to Temporary Works Compound/Pipe Insertion and Reception Compound Approximate Chainage 1580m. A pressure pipeline and sleeve laid by trenchless methods beneath Fleetwood Road and adjacent land. All haul roads and other facilities within the working area. A temporary works compound/pipe insertion and reception compound and fencing.

Work No 16E: The Brine Discharge Pipeline, Temporary Works Compound/Pipe Insertion and Reception Compound Approximate Chainage 1580m to Pipe Insertion and Reception Compound Approximate Chainage 1410m. A pressure pipeline and sleeve laid by trenchless methods beneath Amounderness Way and adjacent land. A temporary works compound/pipe insertion and reception compound and fencing.

Work No 16G: The Brine Discharge Pipeline, Temporary Works Compound/Pipe Insertion and Reception Compound

Approximate Chainage 890m to Temporary Works Compound/Pipe Insertion and Reception Compound at Approximate Chainage 770m. A pressure pipeline and sleeve laid by trenchless methods beneath the Blackpool Tramway and adjacent land. A temporary works compound/pipe insertion and reception compound and fencing.

Work No 16H: The Brine Discharge Pipeline, Temporary Works Compound/Pipe Insertion and Reception Compound Approximate Chainage 770m to Temporary Works Compound/Pipe Insertion and Reception Compound at Approximate Chainage 610m. A pressure pipeline and sleeve laid by trenchless methods beneath the junction of Broadway, South Strand, the Strand and adjacent land. A temporary works compound/pipe insertion and reception compound and fencing.

Work No 16J The Brine Discharge Pipeline Within and Adjacent to Rossall Promenade. This section includes for the crossing of the existing sea-wall defences. To facilitate this, the sea wall will be locally extended onto the existing rock armour with construction of an observation platform, through which the pipeline will descend to sub-foreshore level. Works comprise a pressure pipeline laid in trench beneath the promenade and affixed to the existing modified sea wall to descend to and beneath the foreshore with pipe protection where appropriate. All permanent or temporary, full or partial, removal of the existing promenade surfacing, access ramps and retaining walls from the landward and seaward sides of the promenade. Modifications/breaking through the sea wall to allow the passage of the pipeline beneath the promenade to the foreshore. Modifications to the promenade rear flood wall including the provision of flood gates. The construction of an observation platform/shelter, including new steps, retaining walls and revetments to access the foreshore. The making good to all areas of the sea wall and promenade affected by the works.

Work No 16K The Brine Pipeline Rossall Promenade (Sea Wall) to Approximately Mean Low Water Mark. A pressure pipeline laid in trench from and beneath the foreshore. All temporary protective and warning measures to facilitate the construction of the works and to segregate the public from the works whether on the foreshore or offshore.

Work No 16L The Brine Pipeline, Approximately Mean Low Water Mark to its termination at the Single Two Port Diffuser. A pressure pipeline laid in a backfilled trench beneath the sea bed from a seagoing vessel. A Single Two Port Diffuser fitted to distribute flows into the Irish Sea. All warning measures required to delineate the works area. Any temporary measures necessary to construct the works.

Work Nos., 17A-17C 132KV Electrical Circuits extending from the proposed Electrical Substation /Switchyard at the Gas Compressor Compound to the Main National Grid Utilities Substation/Switchyard at Stanah

For a strategic project such as this, it is a requirement that there is a robust high integrity electricity supply. The installation would be supplied from the connection point at the Stanah Switchyard via dual circuits, so that, if one supply is not available, the load can be supplied by the other circuit. Additional switchgear would be required at Stanah and this would be included within the existing Sub Station building. No changes are required to the layout and external appearance of the existing building. There would be no effect on other consumers in respect of reliability of supply or voltage control.

Cables would be laid underground from UU switchgear in the Stanah Switchyard, beneath the Wyre Estuary and north through to the Sub Station at the Gas Compressor Compound. Marker posts would be installed as required. Crossing of the Wyre Estuary would be achieved by directionally drilling two pipes for two circuits. The pipes would be a minimum of 8 metres below the bed of the River to ensure that the existing silt, sediments and flood defences are not disturbed.

Cable ducts and ultimately the electricity cabling would be drawn from the Preesall side across to the Stanah Switchyard. This will entail cable ducting being laid out across the field on the Preesall side so that a continuous pull can be achieved. The cables would be delivered on cable spools which would feed the cable out as the pull progresses.

The work is divided into sections to reflect different construction situations as detailed below. The LoD for the works has been determined to allow detailed design alignment flexibility, construction and future maintenance. Post-construction, along the cable route an easement of 10m width centred on the pipeline will be required. All other areas within the LoD affected by construction shall be returned to existing or improved use.

Work No 17A: 132kv cables laid in trench in fields between the Gas Compressor Compound and the temporary exit compound for the directional drill. Works include road

crossings and reinstatement of Agglesby Road, Corcas Lane (unadopted), Unnamed Public Highway (Linking High Gate Lane with Burrows Lane) and Burrows Lane (Adopted). Splice Pits as required situated in the vicinity of the river exit point, adjacent to Burrows Lane, Highgate Lane and Agglebys Road.

Work No 17B: South River Temporary Exit Compound to South River Temporary Entry Compound. Works comprise twin sleeves and 132kv Electricity Cables laid beneath the bed of the River Wyre by trenchless methods. Temporary compounds at the pipe under river entry and exit points containing drive and reception pits and temporary work facilities including temporary cabins plant and machinery. A temporary access track linking to Burrows lane. Fencing and lighting to temporary facilities.

Work No 17C: South River Temporary Entry Compound to Stanah National Grid Substation and Switchyard. Works comprise twin sleeves and 132kv Electricity Cables laid beneath the existing caravan park (Flints) and Hillilaid Pool by trenchless methods. Temporary compounds at the pipe exit points and within the Stanah Substation Switchyard. Temporary work facilities including temporary cabins plant and machinery. A temporary access from River Road to the South River Temporary Entry Compound. Connection to National Grid Electricity infrastructure.

Work No 18 11kv Electrical Circuits extending from the proposed Electrical Substation /Switchyard at the Gas Compressor Compound to the Booster Pump Station

Twin 11kv Electric cables laid in trench crossing Footpaths 45, 61 and 42 and a watercourse designated as Main River to reach the Booster Station. The entirety of this work runs parallel to the access tracks (Work No8) and the electrical control cables (Work No 19), hence LoD's have been determined to allow construction and maintenance of all elements. Marker posts would be installed as required.

Work No 19 Electrical control cables extending from the from the proposed Electrical Substation /Switchyard at the Gas Compressor Compound to the Booster Pump Station

Electrical control cables laid in trench and sleeve, crossing Footpaths 45, 61 and 42 and a watercourse designated as Main River to reach the Booster Station. The entirety of this work runs parallel to the access tracks (Work No8) and the electrical circuits (Work No 18), hence LoD's have been determined

to allow construction and maintenance of all elements. Marker posts would be installed as required.

Work Nos., 20A-20H the NTS Gas Interconnector Pipeline Gas Compressor Compound to Its termination at Nateby at the Transco 42 inch feeder main No 15.

Work Nos., 20A-20H comprise the 42 inch interconnector pipeline which links the GCC to the NTS near Nateby, approximately 12 km away. A connection is proposed to National Grid Gas pipelines (No.21 and No 15 Feeder) to ensure maximum flow rate and availability, connecting the underground gas storage facility to the national gas transmission network. These pipes form the gas inflow and outflow from the facility. At the connection point there would be a shut-down valve under National Grid Gas control. The pipeline would be a buried high tensile steel pipe designed and constructed in accordance with British Standard 8010 – Code of Practice for Pipelines (BS 8010) and the Pipelines Act 1962. Marker posts would be installed as required.

The LoD typically allows for a working width of 37m facilitating construction and maintenance within a corridor. Access points for the construction phase and for future maintenance requirements will be from existing public roads as detailed on the Work Plans and within Schedule 5. Locally the LoD has been widened adjacent to access points to allow for vehicular turning, within proposed temporary compound areas, and adjacent to road or watercourse crossings where additional construction lay down areas and plant movement requirements may be anticipated. Post-construction, along the pipeline route an easement of 20m width centred on the pipeline will be required. All other areas within the LoD affected by construction shall be returned to existing or improved use.

The pipeline is broken down into various sections to ease description.

Work No 20A: Interconnector Gas Pipeline, Proposed Gas Compressor Compound to A588 Hall Gate Lane, running in parallel to the New Access Road (Work No 6). A gas, pressure pipeline laid in trench crossing Monks Lane (Unadopted Highway) and Back Lane (Adopted Highway). The crossing of Hall Gate Lane (Adopted Highway Classified Road) will be by trenchless methods unless otherwise agreed with the Highway Authority. The pipeline will cross numerous minor watercourses and Mill Pool (designated as Main River). Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20B: Interconnector Gas Pipeline A588 Hall Gate Lane to Lancaster Road C308. A gas, pressure pipeline laid in trench crossing Footpath 31, Bridle Way No 29, White Lane (Unadopted), Shaws Lane Footpath 34 (Unadopted), Longwood Lane (New Lane) (Unadopted) and Lancaster Road C308 (Adopted Classified Road). The crossings of all footpaths bridleways and unadopted roads would be by open cut methods. The crossing of Lancaster road will also be by open cut methods unless otherwise agreed with the Highway Authority. The pipeline will cross numerous ordinary watercourses and drains and an unnamed watercourse designated as Main River. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20C: Interconnector Gas Pipeline Lancaster Road C308 to Bradshaw Lane C414. A gas, pressure pipeline laid in trench or by trenchless methods crossing Bradshaw Road C414 (Adopted Classified Road), by agreement with the Highway Authority A crossing of Ridgy Pool a watercourse designated as Main River and. Crossings of the ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20D: Interconnector Gas Pipeline Bradshaw Lane C414 to Bone Hill Lane A gas pressure pipeline laid in trench crossing Footpath 39 and Bone Hill Lane (Adopted unclassified). Crossings of ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20E: Interconnector Gas Pipeline Bone Hill Lane to Black Lane C436. A gas pressure pipeline laid in trench crossing Black Lane in trench or by trenchless methods as agreed with the Highway Authority. A crossing of an unnamed watercourse designated as Main River and. crossings of other ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed

with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20F: Interconnector Gas Pipeline Black Lane C436 to Metering Station No 1 A gas pressure pipeline laid in trench. Crossings of other ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20G: Interconnector Gas Pipeline Metering Station No 1 National Grid Feeder Main No 21 to Station Lane A gas pressure pipeline laid in trench crossing Station Lane (Adopted unclassified). Crossings of ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 20H: Interconnector Gas Pipeline Station Lane to National Grid Feeder Main No 15 A gas pressure pipeline laid in trench crossing Station Lane (Adopted unclassified), Footpath No 4 and Footpath No 2. Crossings of ordinary watercourses/drains. Temporary fencing stock proof or otherwise as required to prevent access to the works. Plant crossings of existing highways will be controlled in a manner agreed with the Highway Authority. Temporary Haul Roads will be installed removed and reinstated.

Work No 21 Interconnector Gas Pipeline Metering Station No 1.

Work No 21 comprises an interconnector metering station consisting of a compounded single brick building. The interconnector pipeline would rise out of the ground within the Compound and re-enter the ground to connect to the NTS feeder. The above ground pipeline would have flow measurement devices, isolation and emergency shutdown valves. The building would house automatic metering and gas analysis instrumentation and is not normally manned. The Compound would be surrounded by a security fence and landscaping in the form of trees and hedges screens the facility.

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MOTT MCDONALD

ANNEX A

Design Recommendations for the Safe Development of Salt Caverns

Hazard exclusion zones to cavern development will be implemented in accordance with recommendations for the safe design of salt caverns for gas storage developed by Professor Rokahr (Institute for Underground Construction, University of Hannover). These have been internationally accepted and successfully applied within the industry. These recommendations were provided as a baseline conservative approach to allow indicative design and should be considered as a minimum requirement unless site specific insitu testing and modelling justifies to the satisfaction of the cavern design team and regulatory authorities that relaxation of criteria is appropriate. Table 1 summarises the design recommendations, as schematically shown in Figure 1.

Table 1: UGS Cavern Design Recommendations (As incorporated into requirements 49-55 Schedule 12, of the draft DCO)

Rokahr Design Recommendations	
1	A minimum distance of 3 maximum cavern radii from the Burn Naze fault plane. Professor Rokahr's view is that this minimum distance could be relaxed for intra-grabinal faults if gas tightness could be proven. No such direct testing has been undertaken hence the indicative cavern layout applies a 3r rule.
2	A minimum distance of 4 maximum cavern radii from existing ICI caverns or mineworkings. Again Professor's view is that this minimum distance could be relaxed where negligible risk of collapse could be proven. No such relaxation has been applied by Halite. A minimum distance of 2 maximum cavern radii from existing exploratory holes which penetrate the Preesall Halite body.
3	Assuming that wet-rockhead conditions may potentially result in subterranean voiding, then a minimum distance of 4 maximum cavern radii from mapped wet rockhead areas.
4	A minimum salt pillar width between proposed caverns of 3 maximum cavern radii ¹
5	Proposed caverns to maintain a minimum salt roof thickness below salt rockhead of 1 maximum cavern radius. Proposed caverns to maintain a minimum salt thickness of 0.2 maximum cavern radius from the base of the Preesall Halite body.
6	Operational cavern pressures will not exceed a maximum internal pressure of 83% of the vertical overburden pressure, and will not decrease below 30% of the vertical overburden pressure.

Source: Professor Rokahr

Note: ¹ Maximum radii is averaged for the adjoining caverns where different cavern radii apply

Figure 1: Industry Standard Rules for Safe Placement of Caverns

Rokahr Rules

