DESIGN INTENT DOCUMENT – INVESTMENT PROPOSAL STAGE 3 (DID)

[The preparation of this document is arranged by the Lead Design Engineer (Verification)]

Investment N°	31721
Project Title	Jordanthorpe 275kV SFCL – Trial Project

DID ISSUE N°	5116450/03/001_3
DATE	26/04/13

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DID Freeze Agreement

Role	Name	Date
Lead Design Engineer (Verification) (CDU)	John Isaac	
Lead Design Engineer (Assurance)	Gary O'Neill	

1. DESIGN TEAM

Design Engineers (Verification)

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OHL Design	N/A			
HV Cable Design	N/A			

Other Design Engineers that are involved in the Project (but not TP141 Authorised)

Discipline	Name & Email Address	Telephone N°	Mobile N°	Date of Expiry of Authorisation
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OHL Design				
HV Cable Design				

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Investment Sponsor	Barry Reeves Barry.Reeves@nationalgrid.com		07760170929	N/A

2. RELATED DOCUMENTATION AND DRAWINGS (Status at time of DID approval)

Documentation Title	Issue N°	Rev Date
1. Design Justification Report	N/A (See Northern Powergrid Scope)	
2. Single Line Diagram	B	
3. CDS	N/A	
4. Key diagram	B	
5. Site Phasing Diagram (where required)	N/A	
6. Grid Code technical appendices (a) F1 (b) F2 (c) F3 (d) F4	TBA	
7. Stage by stage drawings (a) F1 (b) F2 (c) F3	N/A	
8. Condition Assessment reports	N/A	
9. Geotechnical Assessment reports	N/A	

Documentation Title	Issue N°	Rev Date
10. P&C drawings (a) (b) (c)	*	
11. Substation drawings (a) (b) (c)	*	
12. Civil, structural and building engineers drawing	*	
13. OHL drawings	N/A	
14. Cable drawings	N/A	
15. Pre-Construction SHES Information Pack	NG to prepare	
16. Work Coordination & Management Document (TP153)	N/A	
17. Project programme	Programme to be supplied by Northern PowerGrid	
18. Risk register	*	
19. Earthing survey	*	
20. Outage programme	*	

Note:
* Refer to Northern Powergrid for Technical Scope

All equipment must satisfy National Grid Technical Specifications (TS). Where this is not the case the Design Assurance Engineer must refer the equipment to Asset Policy for resolution

Documentation Confirmation

Confirmation that Network Operations and the NOC have agreed the 'Single Line Diagram' prior to DID freeze.	
Name of Network Operations representative providing confirmation	Changmei Li / John Addy
Name of NOC representative providing confirmation	Steve Cole

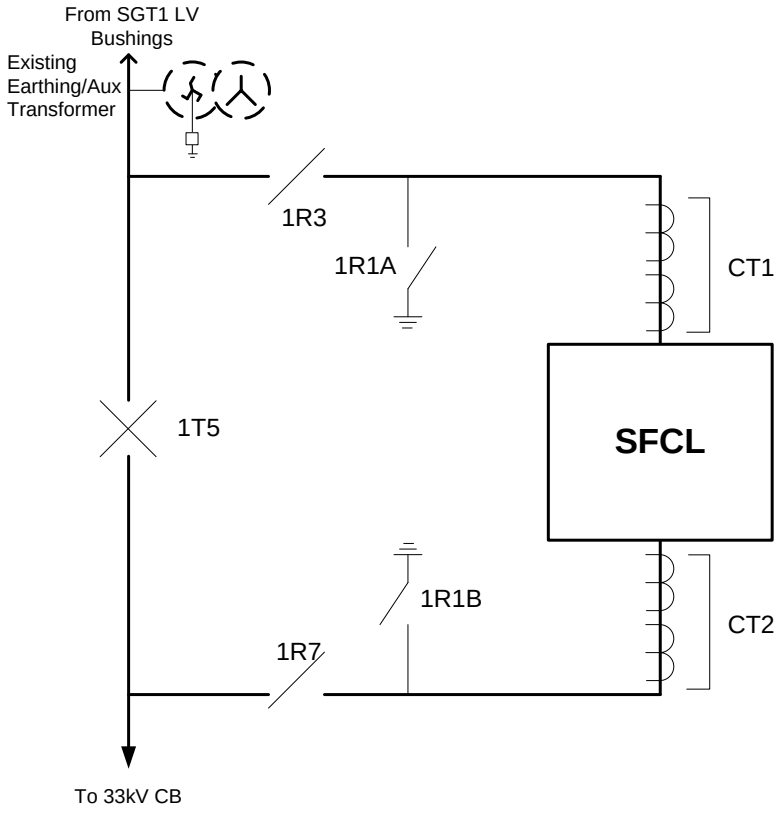
3. SCOPE OF WORK

Under Ofgem's Low Carbon Network Fund (LCNF) scheme, as part of R&D project, Northern Powergrid in collaboration with Applied Superconductor Limited (ASL) will install a Superconducting Fault Current Limiter (SFCL) at Jordanthorpe 275/33kV substation. The SFCL will be installed for a trial period of three years. After this period, it will be removed.

Jordanthorpe 275/33kV substation owned by National Grid's Electricity Transmission (NGET) is a single switch mesh outdoor air insulated substation. There are two 275/33kV 100MVA transformers either side of the single switch, which both provide the grid supply to Jordanthorpe 33kV metal clad indoor substation owned by Northern Powergrid. The substation is located at south of Sheffield.

The SFCL will be installed at the compound at LV side of transformer circuit of SGT1, which is owned and operated by NGET. The SFCL along with new associated equipment will be owned and maintained by Northern Powergrid. However they will be operated by NGET, hence must comply with NGET rules, specifications and procedures along with their enhanced level of design reviews and design assurance as per TP188. All construction works will have to be carried out under NG Operational Safety Rules and associated relevant Transmission Procedures.

New equipment required to form overall SFCL installation comprises a SFCL unit itself, a 33kV circuit breaker, two disconnectors with attached earth switches and associated protection equipment.



Sketch 1. Proposed arrangement.

The project is for design, engineering, supply, delivery to site, off loading, installation and erection, testing and commissioning, site clearance, replacement and/or adjustment of defective material and workmanship for the duration of the defect liability period for the works. This is being carried out by Northern Powergrid and their contractor.

It is assumed that NGET's VT/CT HAM units fitted to SGT1 and SGT2, which may hamper the proposed works, will be replaced by NGET prior to the site establishment. This is due to significant

number of FMJL and FMVG units failures and subsequently general NGET programme to replace these units to ensure safety for stuff, contractors and public.

3.1 SUMMARISE WHAT IS TO BE ADDED:

- Installation of Superconducting Fault Current Limiter (SFCL) unit, which shall include:
  - Temperature probes and temperature simulating CTs to provide analogue inputs for the Winding/Oil temperature indicator (Ashridge 852+)
  - Digital status inputs from cooling fans and pumps provided on volt free contacts,
  - Auxiliary Enclosure located nearby the SFCL for all required auxiliary functions.
  - Chiller Enclosure located nearby the SFCL for cooling.

  The SFCL to be specified and provided by ASL,
- Installation of new 33kV Dead Tank Outdoor Circuit Breaker, acting as by-pass for the SFCL,
- Installation of two new 33kV Outdoor Disconnectors along with Earth Switches installed on SFCL side of each Disconnector.
- Installation of new 33kV Busbar Supports / Post Insulators,
- Installation of new 33kV Busbars and Clamps,
- Installation of new earthing,
- Installation of new Marshalling Kiosk for interface cabling between the SFCL associated switchgear and NGET,
- Installation of new associated Protection & Control Relay Panel in existing 33kV control room,
- Installation of new associated multicore and multipair cabling.

In addition to the above, there are modifications required to the existing Relay Panels, LVAC, DC Systems, above and below ground earthing, and associated multicore and multipair cabling.

4. SUBSTATION HIGH VOLTAGE EQUIPMENT

4.1 Drawings

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and list below those drawings that must be prepared and agreed prior to DID freeze (the following list is typical). Summarise the content and the changes to an existing drawing in the content column.

Circuit/Bay Title	Drawing Title	New/ Existing	Content
SGT1	Jordanthorpe 275/33kV Substation - Superconducting Fault Current Limiter (SFCL). Single Line Diagram. 5116450-00.009-0200	New	Single Line Diagram
SGT1	Jordanthorpe 275/33kV Substation - Superconducting Fault Current Limiter (SFCL). Key Line Diagram. 5116450-00.009-0201	New	Protection & Control Key Line Diagram
SGT1	Jordanthorpe 275/33kV Substation - Superconducting Fault Current Limiter (SFCL). Proposed Layout and Section. 5116450-00.009-0100	New	Proposed Layout and Section

4.2 Calculations

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and list below those calculations that must be prepared and agreed prior to DID freeze (the following list is typical).

Circuit/bay title	Calculation title	Standard/code upon which calculation is based	Equipment to which calculation applies
	Earthing	NGTS 3.1.2.	All Equipment
	Busbar forces / Terminal Loading Calculations	NGTS 2.1, NGTS 3.1.4, IEC 865	All Equipment

4.3 PLANT RATINGS AND THERMAL RATING SCHEDULE DATA

All plant ratings shall be assessed in line with the SDS requirements (this shall include other bay infrastructure equipment such as support structures and gantries).

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and define below the circuit ends which require rating schedule HV equipment data to be provided.

NASAP Code	Substation	Circuit title
T364	Jordanthorpe 275/33kV Substation	SGT1

4.4 DESIGN AND INSTALLATION

Existing Arrangement

Jordanthorpe 275/33kV substation owned by National Grid's Electricity Transmission (NGET) is a single switch mesh outdoor air insulated substation. There are two 275/33kV 100MVA transformers SGT1 and SGT2 either side of the single switch, which both provide the grid supply to Jordanthorpe 33kV metal clad indoor substation owned by Northern Powergrid .

For details of existing arrangement of the substation please refer to:

- 40/3353 Sheet 1 Issue D – Operation Diagram Jordanthorpe 275/33 kV Substation
- 21/24703 Rev AA – Layout of Electrical Equipment for 275/33 kV Substation
- 21/20204 Rev 5 – Layout of 33 kV Electrical Equipment associated with SGT1 & SGT2
- 21/20205 Rev 11 – Layout Plan of Electrical Equipment for 275/33 kV Substation

There are number of CVT and HAM units commissioned in the 1960's to be replaced as part of separate scheme following a number of failures of these items of plant. These include HAM units fitted to Super Grid Transformer SGT1 and SGT2 in the vicinity of the proposed SFCL related works. It is assumed that these HAM units will be replaced by National Grid prior to the site establishment.

Final Arrangement

This scheme is to design, supply and install:

- Disconnectors with Earth Switches and Circuit Breaker with associated structures and plinths,
- Associated Protection & Control and Interlocking,
- Busbar connections,
- New Marshalling Kiosk for interface cabling between the SFCL associated switchgear and NGET,
- 100kVA Three Phase 415V AC auxiliary supply to the SFCL,
- The plinth on which the SFCL will be installed (in case the existing one is not suitable for SFCL installation).

ASL (Applied Superconductors Limited) will be responsible for supplying, installing and cold commissioning the SFCL.

The Disconnectors shall comply with Northern Powergrid's National Product Specifications NPS/003/022 (Technical Specification for 33kV Disconnectors, Switch Disconnectors & Earth Switches) or NPS/003/007 (Technical Specification for 66 and 132kV Disconnectors, Switch Disconnectors and Earth Switches).
The Circuit Breaker shall comply with ENATS 41-36 issue 2.

Table 1. Minimum Ratings of the Switchgear.

Switchgear	By-pass Circuit Breaker	In Series Disconnector with 1 Earth Switches
Quantity	1	2
Class	Outdoor	Outdoor
Number of poles	3	3
Voltage [kV]	33	33
Rated normal current [A]	2000	2000
Rated short circuit current [kA]	31.5	31.5
Duration of short circuit [s]	3	3
Rated peak withstand current [kA]	54	54
Rated peak short-circuit making current [kAp]	54	-
Rated supply voltage of closing and opening devices [V]	110	110

In order to satisfy NGET's requirements and select equipment that is approved by Northern Powergrid, some of the 33kV Plant selected for the works is actually 66kV rated equipment. As such it is slightly higher cost than off the shelf 33kV equipment, but meets the requirements of both NGET and Northern Powergrid without requiring formal additional Type Testing of the items which would not be possible to complete within the required project timescales.

New equipment which will be supplied, installed and tested:

- **66kV Dead Tank Outdoor Circuit Breaker.**
  1 off 66kV Three Pole Circuit Breaker. CB to be supplied with Local Control Cubicle.

- **66kV Outdoor Disconnector with 1 Earth Switch.**
  2 off 66kV Three Pole, Motor Operated RCP Disconnector with one Motor Operated Earth Switch installed on SFCL side of the Disconnector.

- **33kV Post Insulator.**
  19 off 33kV Post Insulators.

- **33kV Superconducting Fault Current Limiter (SFCL).**
  The SFCL to be supplied, installed and cold commissioned by ASL.

For details of new arrangement of the substation please refer to:
- 5116450-00.009-0200 for proposed Single Line Diagram (SLD),
- 5116450-00.009-0201 for proposed Key Line Diagram (KLD),
- 5116450-00.009-0100 for proposed layout.
- 5116450-00.009-0101 for proposed elevation

Design clearances are in accordance with NGTS 2.1 and TGN 186 for the 33kV and 275kV equipment. Access for maintenance shall be adequate in all areas of new construction. Careful consideration of design clearances and access routes will be taken.

4.5 EARTHING

An Earthing Condition Assessment has been carried out for the site, refer to document ERM078, issue 1. The remedial actions identified in this report have been carried out.

An Earthing design verification study is to be conducted by a specialist in association with Northern Powergrid contractor where additional soil resistivity tests will need to be carried out pending the information already supplied by NG, using an approved method.

The results are to be interpreted and the Earth grid designed and extended in accordance with BS7354 and NGT 3.1.2. On completion of the relevant studies Northern Powergrid contractor will provide the sites Earth potential contours as expected upon completion, and tests will be carried out to reinforce the design data.
HF earthing of CVT"s and surge arresters has been taken into consideration.

It is required to design, install and commission the earthing for the new equipment installed, including the SFCL and connect all new equipment to the existing substation earth grid, as necessary in accordance with NGET specifications. Existing earth points are in place on the transformer plinths. If these are used, checks should be made to make sure they are connected to the existing earth grid.
All new equipment shall be permanently connected to the earth grid, using conductors of a suitable material and cross section for their purpose and joints/connections.
All materials and details of jointing and connection systems to be used with reference to the work scope, shall be agreed with NGET and Northern Powergrid and a detailed earthing schedule shall be provided. Additionally, a detailed 'as installed' drawing record of the earthing system shall be made.

Northern Powergrid and their contractor may require detailed drawings from the client on the services that exist on the site to complete the Earthing design.

4.6 GANTRIES, ANCHOR BLOCKS, DOWNLEADS AND DOWNDROPPERS

Not Applicable.

4.7 INTERLOCKING

An interlock system is required between the 33kV by-pass circuit breaker and in series disconnector / earth switches and NG's equipment. The existing substation electrical and mechanical interlocking system on the 33kV and 275kV sides will need to be modified to accommodate the new 33kV equipment.

Interlocking related works shall adhere to the following recommendations (please see SLD drawing 5116450-00.009-0200 for nomenclature):

- Disconnectors 1R7 and 1R3 shall be electrically interlocked such that operation is prevented with SGT1 energised (either on-load or off-load) i.e. dead operation only. The interlock shall be with H13 and DAR Supergrid 1 CB only. These disconnectors are not rated for breaking/making load or energising/de-energising the SFCL.
- Earth switches 1R1A and 1R1B shall be mechanically interlocked so they can only be closed with both disconnectors open.

Electrical interlocking is required between the 33kV CB (1T5) and 33kV CB SG1, as 1T5 is not rated for Check Sync.

The interlocking will ensure that CB 1T5 can be closed ONLY when both SFCL Disconnectors 1R3 & 1R7 are closed (or) ONLY when the SGT1 LV CB is Open. The first case caters to the needs of automatic closure of 1T5 for abnormal conditions of SFCL and the latter meets to the case of energising SGT1 with SFCL bypassed.

Further liaison with NGET is required to agree on the details of this system.

4.8 Site LVAC Supplies

It was noted during the SGT1 outage (April 2013) that the existing 415V switch on MVAC board next to SGT1 is fused at 150A to feed into oil pump room via. 4C x 50 Sq.mm cable. The isolator switch in the oil pump room needs replacing.

It is proposed to replace the 150A Fuse on the MVAC board with a 250A fuse (300A carrier) and disconnect the existing cable from this point to the oil pump room. A new cable will be installed (size to be confirmed during design) between the MVAC board and new Supplies Pillar to be installed for SFCL. The supply to SFCL compound will be extended from the above supplies pillar. Also, the existing 4C x 50 Sq.mm cable will be pulled back and diverted to the new supplies pillar to maintain the supplies to oil pump room.

4.9 Maintenance

The 33kV switchgear arrangement will be designed to provide adequate access to carry out maintenance utilising a MEWP or scaffold with the minimum requirement for circuit outages. Details of maintenance vehicle route access and any restrictions will be provided during detailed design.
If required, portable earthing spigots will be installed at adequate locations deemed necessary by the switchgear layout and NG site engineer.

All O&M manuals supplied will include the instructions and maintenance checks as suggested by the equipment supplier.

4.10 Type Registration

As agreed with NG no EGI codes will be issued for SFCL and associated equipment.

All other equipment shall meet relevant NG and/or ENA standards requirements.

Equipment	**EGI Code**
66kV Dead Tank Outdoor Circuit Breaker	P6GA01
66kV Outdoor Disconnector	P6IA04
66kV Earth Switch as part of above Disconnector	P6EA03
33kV Post Insulator	TBC
33kV Superconducting Fault Current Limiter	Not Applicable

4.11 Deviation from Standards

TBA

4.12 Redundant Equipment

Not Applicable at this stage.

4.13 Documentation Summary

During the Contract execution stage contract specific drawings will be entered into Northern Powergrid document control system to control the issue of “For Construction” drawings. Upon completion of the project an updated site drawings index will be provided along with 'As Built' documentation typically comprising:

- General arrangement Drawings
- Section and Elevation Drawings
- Earthing Layout Drawings
- Connectors and Connections Drawings
- Label Drawings
- Interlocking Drawings
- Equipment Schedules
- Calculations

- O&M Manuals

4.14 Interface with Other Projects

- The SFCL will be installed at the compound at LV side of transformer circuit of SGT1, which is owned and operated by NGET. The SFCL along with new associated equipment will be owned and maintained by Northern Powergrid, but operated by NGET.

- There are number of CVT and HAM units commissioned in the 1960's to be replaced as part of separate NGET scheme following a number of failures of these items of plant. These include HAM units fitted to Super Grid Transformer SGT1 and SGT2 in the vicinity of the proposed SFCL related works. It is assumed that these HAM units will be replaced by NGET prior to the site establishment.

4.15 Commissioning

Commissioning and site testing will be carried out according to TP106. Please refer to relevant Northern Powergrid documentation for commissioning philosophy details.
Commissioning Method Statements will be prepared well in advance of the works and will normally cover the tasks as defined by the Commissioning Panel Chairman and/or Commissioning Officer.

4.16 Design to be Resolved

- Earthing design,
- Superconducting Fault Current Limiter and associated equipment design by ASL.
- Type Registration Derogation on SFCL (Being progressed by NG and ASL)

4.17 Design Compliance Audit

The following design packages will be submitted for design compliance audit.

NO.	PACKAGE	DCAAR	P&C	PLANT	CIVIL	CABLE
1	Single Line Diagram	PL001	X	X		
2	33kV Substation Layout and Elevations	PL002		X	X	
3	33kV Busbar Loading Calculations			X		
4	33kV Busbar Connector Layout			X		
5	Relay Room / Marshalling Kiosk Layout		X	X	X	
6	SFCL and associated equipment Layout and Elevations	PL003		X	X	
7	SFCL marshalling kiosk / auxiliary room Layout and Elevations		X	X	X	
8	Below ground Earthing incl. Earthing Report	PL004		X	X	
9	Above ground Earthing			X		
10	Plant Nomenclature & Labels	PL005	X	X		
11	Mechanical and Electrical Interlocking		X	X		
12	As Builts	N/A		X		

The content of each package will be finalised during detailed design. Dates for submissions will be outlined on the project program.

4.18 Design Change Record

Date	Change details

Record all design changes between DID freeze and first on-site meeting of commissioning panel.

5. PROTECTION & CONTROL

5.1 Drawings

Listed below are the major schemes which will be submitted for design assurance.
In addition to the below drawings a new Single Line Diagram for Jordanthorpe 275/33kV substation has been produced and is in line with the latest DH11 requirements for Single Line Diagrams.

Circuit / bay title	Drawing / schedule application software title	New/ existing	Content
SGT1 / Common	Key Line Diagram	New	
SGT1 / Common	AC Connections Protection Diagram	New	
SGT1 / SFCL	SFCL Protection	New	Overload Alarm, Differential Protn, Mechanical Protn.
SGT1 / SFCL	CB 1T5 Trip & Control	New	
SGT1 / SFCL	Disconnector 1R3 Control	New	
SGT1 / SFCL	Disconnector 1R7 Control	New	
SGT1 / SFCL	Earth Switch 1R1A Control	New	
SGT1 / SFCL	Earth Switch 1R1B Control	New	
SGT1 / Common	110VDC & 48VDC Circuits	New	
SGT1 / Common	LVAC	existing	
SGT1 / Common	Substation Control (SCS)	New	
SGT1 / Common	National Grid Power Quality Monitoring (PQM)	New	
SGT1 / Common	Northern Powergid Power Quality Monitoring (PQM)	New	
SGT1 / Common	Interlocking	New	

5.2 Calculations

The Design Engineer (Assurance) shall define below the calculations to be compliance checked by Design Assurance (the following list is typical).

Circuit / bay title	Equipment identity & calculation title	Settings guidance document reference	Software identity (for computer generated calculations)

SGT1 / SFCL	SFCL Protection	N/A	N/A
SGT1 / SFCL	CB Trip Coil Calculations	N/A	N/A
SGT1 / Common	DC Loading Calculations	N/A	N/A
SGT1 / Common	AC Loading Calculations	N/A	N/A
SGT1	SGT Protection (existing)	N/A	N/A

5.3 Thermal Rating Schedule Data

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and define below the circuit ends which require rating schedule protection data.

NASAP Code	Substation	Circuit title
B371/T364	Jordanthorpe 275/33kV	SGT1

5.4 Protection & DAR Schedules

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and define below the circuits which require protection and DAR schedules.

NASAP Code	Circuit title
B371/T364	Jordanthorpe Substation / SGT1 Circuit

5.5 Setting Changes on Other Relays

The Settings Engineer (Verification) and the Settings Engineer (Assurance) shall agree and define below setting changes required on relays other than those to be commissioned (eg. installation of a transformer at one substation may require distance protection setting changes at remote circuit ends).

Substation	Circuit	Relay
Jordanthorpe 275/33kV	SGT1	SGT protection – list of relays shown in section 5.7
Jordanthorpe 275/33kV	SGT1	ATCC

5.6 Fault Level Considerations

The Settings Engineer (Verification) and the Settings Engineer (Assurance) shall agree and define below situations which may result in unusually high or low fault levels – which must be taken into account when undertaking relay settings calculation.

Situation
The SFCL will limit the fault level seen at 33kV.

Narrative

5.7 Relay Specification

The following shall be specified and shall include new and existing (ie. remaining) relays.

Protection Relays (ie. containing a tripping function)

Circuit/Bay Title								
Relay						**CT**		
Function	**Type**	**New/ Exist**	**Rating (A)**	**Range (A)**	**Type & Rating of a Relay Being Replaced**	**New / Exist**	**Tapping Range (1)**	**Type (2)**
2 Stage O/C	PBO	Exist						
Directional O/C	NPO2	Exist						
Hsoc	CAG69	Exist						
Hv Restricted E/F	FV2	Exist						
Interlocked O/C	PBOK	Exist						
Low Frequency Trip	BEI.81.0/U	Exist						
Lv Restricted E/F	FV2	Exist						
Neutral E/F	FGL	Exist						
O/C Guard	CAG69	Exist						
Sbef Stage 1	PG3	Exist						
Sbef Stage 2	PG3	Exist						
Stage 2 Timer	AKA2	Exist						
Transfr I/T Timer	AKH3	Exist						
Transfr Overall	DT2	Exist						
Voltage Supvn	VB	Exist						
Winding Temp	ARIC	Exist						
*	*							

Narrative:
* Please refer to NORTHERN POWERGRID relevant documentation for details of new/modified relays.

Other Relays

Circuit/Bay Title								
Relay						**CT**		
Function	**Type**	**New/ Exist**	**Rating (A)**	**Range (A)**	**Type & Rating of a Relay Being Replaced**	**New / Exist**	**Tapping Range (1)**	**Type (2)**

5.8 Design and Installation

There is a common protection room for the 275kV substation; this contains the protection equipment associated with the NGET assets. There is a common protection room for the 33kV substation (separate building to the indoor 33kV substation building); this contains the protection equipment associated with the NORTHERN POWERGRID assets. The proposed protection arrangements are shown in the KLD.

All new protection equipment will need to comply with NGET specifications where applicable and be accepted by Northern Powergrid.

SGT1 Protection
The existing protection for SGT1 (as detailed in section 5.7), and associated SCS interfaces will be retained in its current arrangement. The existing 275kV protection equipment is located within floor

mounted panels with top entry and wall boxes. The existing 33kV protection equipment is located within floor mounted panels with below ground entry.

It is not expected that there will be any changes to the existing protection philosophy implemented on this circuit due to the addition of the SFCL. The SFCL provides nominal reactive impedance during normal (passive) operation (see SFCL tech data), this may have impact on SGT1 protection settings which will need to be assessed.

A protection settings check will be carried out, with results presented to Northern Power Grid and National Grid to confirm the suitability and sensitivity of the existing settings.

SFCL Protection General Arrangements

The SFCL is supplied by Applied Superconductor Ltd (ASL), this includes specific mechanical protection for the SFCL. This protection will need to be interfaced to the existing protection systems on SGT1 circuit to effect correct tripping under fault conditions. Details of the tripping requirements are shown on the KLD.

The protection arrangements for the SFCL will follow the philosophy of NGET TS 3.24.10, noting that some of this protection will be provided by the existing SGT1 transformer protection. Consequently, as a minimum, a new overall unit based protection scheme, specific to the SFCL, is to be provided under the contract. This is to provide discrimination / identification of the SFCL under fault conditions and will be installed in a new relay panel to be provided by the contractor and located in the 33kV control room.

A separate overcurrent 2-Stage overload alarm relay is to be provided. Upon operation of Stage – 1 this will notify NGET via the SCS systems, closing of the bypass circuit will be required via NG ENCC manual intervention within 15 minutes of overload alarm relay, thus off-loading the SFCL.

In addition, there will be a provision for the automatic closure of 33kV Bypass CB (1T5), under the following conditions:

a) If the above overload stage – 1 condition stays for more than 15 minutes (or) if the overload stage – 2 operates. (Settings to be agreed in settings report)
b) If the winding (or) Oil temperature of the SFCL exceeds a defined setting (Provided by ASL).
c) Internal faults of the SFCL that arise due to the failure of supply to DC Magnets on the SFCL (or) due to their saturation (or) due to the failure of SFCL monitoring system.

   It is understood that the conditions in a), b) and c) are likely to result in unwarranted operation of the ATCC (or) lead to potential system instability. Hence, upon detection of these faults automatic closure of the bypass CB will be initiated.

d) The 33kV bypass Circuit Breaker (1T5) provides an alarm when the SF6 level goes low (“SF6 Falling”). Upon detection of such a falling pressure condition, the automatic closure of SFCL is initiated. This is because a further pressure drop can lockout the closing operation of the CB...which would defeat the very purpose of having the bypass facility on SFCL.

Marshalling of alarms/indications/analogues from the SFCL to the NGET SCS shall be provided.

All marshalling of tripping, control and SCS data from the SFCL shall be via a dedicated marshalling kiosk, located adjacent to the SFCL.

Any associated fuses/links will be front mounted on the box – RS20 type or equivalent. The box should be connected by the contractor to the substation earth grid in accordance with NGET Earthing requirements. The contractor should liaise with ASL regarding the design of the marshalling kiosk.

Unit Protection

A single overall unit protection is required. The protection shall be responsive to both phase faults and earth faults on the SFCL and associated connections.

If a biased differential principle is used, the protection shall comply with the requirements of IEC 255-13.

The protection shall not give an unwanted operation under all normal operating conditions and all external fault conditions up to the maximum through-fault current limited only by the impedance of the SFCL itself.

Operation of a main protection function shall:

- Trip the associated circuit breakers providing a fault infeed.
- Initiate the existing CB fail protection where appropriate.
- Initiate trip relay reset where required.
- Block DAR (lockout)
- Initiate H13 disconnector auto-isolation

Back Up Protection

Back up protection shall be provided in accordance with NGTS 3.24.38 and shall consist of two IDMT earth-fault protections, one on each side of the SFCL reactor.

Since the SFCL is installed within another circuit (SGT1), account shall be taken of the back-up protection already provided for that circuit.

Mechanical Protection

The SFCL is provided with the following mechanical protections:

a) An Ashridge 852 plus unit which is fed by one of the SFCL bushing CTs. The device also takes a PT100 input for oil temperature in the AC Tank. The Ashridge Unit gives contacts when the Winding (or) Oil temperature exceeds a defined level. These outputs will initiate closure of bypass CB (1T5).

b) An Oil level Low trip, which is wired into the existing SGT1 HV/LV Trip System. This will trip SGT1 HV/LV via existing trip relays. Intertrips to the remote ends, initiation of Trip relay reset & CB Fail, auto isolation of H13 and DAR lockout on 33kV CB (SG1) will all be achieved through the existing arrangements.

c) A rapid rise of Pressure in the SFCL AC tank will result in tripping of the SGT1 HV/LV system and achieve the same as (b) above.

The SFCL manufacturer has identified that there are specific conditions that require the SFCL plant to be tripped and isolated and other conditions that only require bypass CB closing. These are identified in the previous paragraphs.

The auxiliary supply for the main protection relay shall be from the battery system that supplies the first tripping system.

All DC supplies to the relays shall be monitored and provide an alarm for loss (i.e. watchdog; MCB).

A relay test block (MMLG) will be provided and mounted within the new protection cubicle.

Trip Circuit supervision is provided as part of the existing SGT protection trip circuits.

Indication

Switchgear Indication

Informative: The available control points are local, substation and remote. Local is at the plant being controlled. Substation is at some central point in the substation. Remote is at the National Control Centre (NCC) or National Operations Centre (NOC).

The new switchgear associated with the SFCL circuit shall provide indications of position to all control points.

The earth switches shall provide ‘open and closed’ indication to local and substation control points.

Each function shall provide alarms and indications as appropriate to the National Grid substation control system (SCS).

Each protection function shall be provided with a time reference.

Current Transformers

General
CTs will be supplied and installed in the bushings of the SFCL by ASL.

The CTs will be specified by the contractor to NGET standards and agreed by Northern Powergrid.

CTs shall usually be conventional electromagnetic devices as specified in NGTS 3.2.4 and NGET TS 3.2.5.

ASL will provide a suitable CT marshalling box.

Please refer to the KLD for the CT arrangements. All CTs shall have a rated continuous thermal current of the SFCL including its overload capacity, and shall be capable of thermally withstanding the 3 second fault rating of the switchgear.

Protection
The main overall protection functions shall be connected to class X type A Current Transformers.

Backup protection functions shall be connected to protection class Current Transformers such as class 5P20 (See NGET TS 3.2.4).

275kV Mesh Corner Protection and 33kV Busbar Protection
The existing Mesh corner / busbar protection arrangements shall be retained. No modifications are envisaged to the existing protection arrangements.

CB Fail (CBF) Protection and Interlocked Over Current Protection
No change is envisaged on the 275 kV side. CBF not fitted at 33kV, existing interlocked overcurrent to be retained.

Power Quality/Disturbance Recorder

National Grid PQ Monitoring (PQM)
A PQ sensor to enable high bandwidth monitoring of harmonics, will be installed and connected to the 33kV redundant metering CTs and VTs on the LV side of SGT1 (confirmed 15/1/12 - Gary O'Neil / Peter Haigh NG). The connection point will be within the 33kV relay room.

The following NG specifications should be considered:
TS 3.02.05 – Voltage Transformers
TS 3.24.69 – Quality of Supply Monitoring
TS 3.24.70 – Dynamic System Monitoring

Northern Powergrid PQM
Northern Powergrid will also be installing a PQM meter shall be connected to the existing and unused metering CTs and VTs within the 33kV relay room.
Shall comply with the following specification:

- A multi-mode high speed, high accuracy measurement device is required to be installed.
- The unit shall be provided with an Events ON/OFF switch which when selected to OFF will disable event recording in the device, this to be used during panel maintenance and commissioning. This may be implemented by switching ON/OFF Event DC field supply.
- The primary function of this device will be to monitor power quality. This will be obtained by the measurement of three phase voltage and currents on the SGT1 feeder including: V, I, F, P, Pf, H (63), THD, K-factor, voltage and current unbalance, impedance and sequence components.
- The recorder shall be powered from the substation DC auxiliary supply and mounted on or in, the associated relay panel.

High Accuracy / Settlement Metering

The existing settlement metering system, adjacent to the 33kV Cable Sealing End, will be retained.

AVC (Automatic Voltage Control) / ATCC (Automatic Tap Changer Control)
A review of the existing AVC/ATCC system shall be carried out and modified accordingly.

It is thought at this stage, that there will be no modification required as the SFCL response time is in the order of ms rather than seconds, as typical of the AVC/ATCC system. Thus under fault conditions (when the SFCL is actively operating), the AVC/ATCC will be to slow to respond and the fault will have been cleared accordingly.

Under steady state normal conditions, the SFCL presents nominal impedance to the system. Inclusion of this impedance within the SGT1 leg is not envisaged to cause significant problem with AVC/ATCC scheme, as the ATCC scheme operates by maintaining selected LV target voltages.

However, the impedance of the two parallel SGT circuits differ due to the addition of the SFCL (SGT1+SFCL~26% and SGT2~21% on 100MVA) and potentially will cause a load imbalance between the two parallel legs. This can be managed through tap staggering between the two transformers.
This operating arrangement needs to be simulated, in conjunction with the ATCC manufacturer, to confirm that the existing ATCC algorithm will operate as required to maintain the LV voltage, minimise the circulating current and keep the tap stagger within the required NGET limits.
Design Verification Engineer is required to seek early confirmation of this.

It is accepted that following further investigation, (simulation with the manufacturer), additional works maybe necessary. (NB: A database change/update for this is likely to be combined with the SCS update).

For reference the existing SGT1 and SGT2 impedances are quoted as 21% on 100MVA base and the steady state impedance of the SFCL is 5.97% on 100MVA.

Substation Control System

The existing substation control system for the 275kV is a “Cruickshanks” system with centralised architecture with each bay having its own I/O unit. The new protection equipment shall be interfaced with the above control systems.

NG will be responsible for carrying out the database changes necessary in their SCS. The contractor shall provide all necessary connections to the SCS system and any necessary I/O cards. This shall be done to NG’s standards.
Augmentation of NGET SCS shall include, but not be limited to:

- Change in the SGT1 circuit parameters (impedance change due to SFCL)
- Interfacing of the new HV equipment as per the proposed Single Line Diagram with the NGET SCS systems.
- The contractor to provide information to NGET who will update the NGET SCS databases and displays to reflect the new equipment.

Jordanthorpe 275/33 kV Synchronising & Voltage Selection Scheme
It is not thought that modification to the existing synchronising and voltage selection schemes will be required.

Relay Settings
Relay settings will be required to be provedn via FAT to be arranged by contractor.

The scope under relay settings shall be:

a) The new SFCL mechanical protection shall be setup and tested by the manufacturer (ASL).

b) New SFCL Winding/Oil Temperature Indicator (WTI/OTI) will be provided by ASL. Settings for this will be agreed with ASL prior to issue to NG for review.

c) The new SFCL unit protection shall be calculated, setup and tested by the contractor for these works. Where necessary, the relay manufacturer can be proposed to configure the relay.

d) The existing SGT1 protection settings shall be checked by the contractor to ensure compliance with the relevant NGTS and policy documents and grading is maintained with the 33kV OC and EF protections, due to the additional item of plant within the SGT1 circuit.

e) The contractor will verify all new and revised protection settings using the appropriate NGET TP141 authorised setting engineers. All settings will be agreed with NGET and Northern Powergrid. NGET will carry out design assurance.

All new and revised relay settings will be produced by the contractor. Specifics to the SFCL will be provided by the SFCL manufacturer.
Following approval, the contractor will upload and issue the new and revised settings using the NGET Livelink database.

Testing and commissioning
The contractor will provide all documentation as necessary to comply with NGET commissioning practises, e.g. TP106 and shall be carried out by suitably competent and authorised engineers, e.g. TP141. This commissioning documentation will clearly show the activity to be carried out, test documentation to be used, duration of test and include witnessing hold points for Northern Powergrid and NGET. The name and CV of the proposed Commissioning Engineer shall be provided.

The SFCL will be tested and cold (stage 1) commissioned by the manufacturer. They will also be present during hot (stage 2) commissioning. However, the contactor shall provide a suitably competent and authorised engineer to represent ASL for the commissioning of the SFCL.

5.8.1 Relay panel and cubicles

Protection and Control Accommodation Requirements
A new protection cubicle shall be supplied and installed by the contractor for the new SFCL equipment at Jordanthorpe 33kV Substation. The new cubicle shall be equipped with the required protection and control IEDs together with associated switches, fuses, links, test points and pushbuttons.

5.8.2 Marshalling cubicles, kiosks and supplies pillars

ASL will provide an Interface cubicle within their compound. This will be the point of interface for any external interface/cabling with SFCL. Ashridge Unit for WTI/OTI and other instruments required for SFCL Monitoring/Mechanical Protection, CTs and other alarms will be wired to the Interface Cubicle. The supplies required for the SFCL instruments will be wired via this interface cubicle.

A new Bay Marshalling Kiosk / Supplies Pillar shall be provided to interface the new 33kV Switchgear with the NGET System.

5.8.3 110V and 48V battery supplies

There is one existing spare way on the existing 110VDC board which will be utilised for this project.

Motor, Control and interlocking supplies for the new 33kV Switchgear and instrument supplies for the SFCL will be provided via the new Supplies Pillar.

5.8.4 LV AC supplies and diesel generators

See Section 4.8 for details.

5.8.5 Multi-core cabling

Multicore and auxiliary cables shall be in accordance with TS 2.19.
The installation, testing of multicore and auxiliary power cables shall be in accordance with TS 2.19.
Multicore, multipair and auxiliary power cables, shall be installed as necessary to complete the works, and shall meet the full requirements of the substation equipment control and protection schemes etc.

5.8.6 Telephony requirements

NG PQM to connect to LAN network via RAMM access point.

5.8.7 Telecommunications/Energis cubicles

Not Applicable.

5.9 Grid Code Requirements

- List all Grid Code requirements to be undertaken (see Grid Code technical appendices)
- Identify where protection grading with a third party must be undertaken

5.10 Third Party Interfaces

Superconducting Fault Current Limiter (SFCL) to be provided by Applied Superconductor Limited (ASL).

5.11 Secondary Terminal Points

- SFCL Marshalling Kiosk
- Interface Marshalling Kiosk
- Protection Relay Panel in existing 33kV relay room
- SCS Master Control Panel
- Existing LVAC Distribution Board
- Existing 110VDC Distribution Board

5.12 Type Registration

All new protection relays associated with the SFCL will be NG type registered where possible.

A technical derogation will be submitted identifying use the Alstom SBS O/A protection for a Series reactor to be used as the SFCL reactor O/A protection.

5.13 Database Change Control

One SCS database change will be undertaken prior to energisation of the SFCL.

5.14 Maintenance

No special maintenance requirements are deemed necessary for any equipment installed, and the normal basic instructions will be provided in the relevant O&M Manual.

Relevant combiflex test leads and serial communication leads for the NICAP relays will be supplied for all new equipment.

The SFCL related instructions shall be provided in the relevant O&M Manual by ASL.

5.15 Deviation from Standards

Not Applicable.

5.16 Redundant Equipment

Not Applicable.

5.17 Documentation Summary

During the Contract Execution Stage contract specific drawings will be entered into the Northern Powergrid document control system. Before site works commence. Contract Drawings List will be be provided identifying all drawings being produced and issued to the Project Site Manager to verify that

all drawings are available at site. Upon completion of the project a comprehensive drawing list will be provided along with „As Built" documentation typically comprising.

- Key Line Diagram (SLD / Block Tripping diagrams)
- Circuit diagrams
- Cable schedules
- Cable block diagrams
- Panel wiring diagrams
- Configuration files
- Setting files
- O&M Manuals.

5.18 Interfaces with Other Projects

- The SFCL will be installed at the compound at LV side of transformer circuit of SGT1, which is owned and operated by NGET. The SFCL along with new associated equipment will be owned and maintained by Northern Powergrid, but operated by NGET.

- There are number of CVT and HAM units commissioned in the 1960's to be replaced as part of separate NGET scheme following a number of failures of these items of plant. These include HAM units fitted to Super Grid Transformer SGT1 in the vicinity of the proposed SFCL related works. It is assumed that these HAM units will be replaced by NGET prior to the site establishment.

5.19 Commissioning

Commissioning and site testing will be carried out according to TP106. Please refer to relevant Northern Powergrid documentation for commissioning philosophy details.
Commissioning Method Statements will be prepared well in advance of the works and will normally cover the tasks as defined by the Commissioning Panel Chairman and/or Commissioning Officer.

5.20 Emergency Return to Service

TBA

5.21 Design to be Resolved

	Description	**Resolution Date**
5.21.1.	SFCL impedance impact upon AVC system.	
5.21.2.		
5.21.3.		
5.21.4		

- List areas of design yet to be resolved.
- Identify named individuals tasked with resolution – including target dates.

5.22 Design Compliance Audit – see DH24

NO.	PACKAGE	DCAAR	P&C	PLANT	CIVIL
1	Key Line Diagram	PC001	X		
2	Standard Bay Solution Schemes / General Arrangement Drawings	PC002	X		
3	Interface Schematics		X		
4	Panel General Arrangements		X	X	
5	Wiring Diagrams / Cable Schedules		X		

6	Marshalling Kiosk Details		X	X	
7	Multi-core Cable Routing		X	X	
8	Trip Circuit Burden Calculations		X		
9	Substation Control (SCS)	PC003	X		
10	LVAC Single Line Diagram	PC004	X	X	
11	As Builts		X		

All foundations will be subject to Civils Design Compliance Audit.
Safety Clearance drawing will be required to be design assured by Plant Assurance Engineer.

5.23 Design Change Record

Date	Change details

Record all design changes between DID freeze and first on-site meeting of commissioning panel.

6. CIVIL, STRUCTURAL & BUILDING ENGINEERING

6.1 Drawings

The Design Engineer (Verification) and Design Engineer (Assurance) shall agree and list below those drawings that must be prepared and agreed prior to DID freeze. Summarise the content and the changes to an existing drawing in the content column.

Circuit/Bay Title	Drawing Title	New/ Existing	Content
SGT1	Jordanthorpe 275/33kV Substation - Superconducting Fault Current Limiter (SFCL). Proposed Layout and Section.	New	Proposed Layout and Section
SGT1	Foundation Drawings	Existing	To be modified at DDD stage
SGT1	Bund Drawings	Existing	To be modified at DDD stage
SGT1	Plinth Drawings	Existing	To be modified at DDD stage

6.2 Calculations

The Design Engineer (Assurance) shall define below the calculations to be compliance checked by Construction Assurance.

Equipment identify & calculation title	Policy/code defining calculations	Software identity for computer generated calculations

Codes to be proceeded during DDD stage, to include foundations / bund / plinths.

6.3 Design and Installation

One of the two existing NGET Supergrid Transformer plinths is proposed to be used to mount the SFCL on. One plinth should be suitable for mounting the entire SFCL of reactor mass 30 tonnes including oil, with a bund capable of containing 4000 litres of oil. Dimensions of the SFCL reactor are approximately 2.2m diameter x 3.7m tall to the top of the bushings.

Chiller Enclosure:
3.2(L) x 2.7(W) x 2.0(H) weighing approx. 500kg (TBC) plus two chillers each weighing 361kg plus 260 Litres of water glycol (total ~1500kg)

Auxiliary Enclosure:
4.2(L) x 2.2(W) x 2.2(H) weighing approx. 4000kg.
DC cables and helium lines will run from the side of the SFCL to the auxiliary enclosure and these have a maximum length of 40 feet. The auxiliary enclosure therefore needs to be within 40 feet of the SFCL.

The chiller enclosure can be anywhere close by but there will be pipe and cable runs to the auxiliary enclosure which will need to be lagged and covered.
The contractor will be responsible for ensuring that the plinths are suitable for the SFCL and auxiliary equipment to be mounted on, or for providing new plinths. Equipment layout drawings will be required. ASL will install the SFCL and associated auxiliary equipment on the plinths.

The SFCL reactor and surrounding equipment (upto new trench), will be encapsulated within an Omnibund which will be sized for the SFCL reactor. The Omnibund comes with its own pump and oil detector, this will stop operation if the presence of Oil is detected.

The contractor shall remove/modify an existing lamp post adjacent to the SGT1 auxiliary transformer in agreement with National Grid site engineer.
The contractor shall also remove some existing concrete steps, on one of the transformer plinths to make it level.

The contractor shall include for the design, supply and installation of plinths and structures as necessary for all equipment, which shall be in accordance with NGET specifications.

Temporary Works
The contractor shall include for the design, installation, maintenance and removal of all temporary works required. This includes the contractor's working area, car parking and access for all contractors and sub-contractors, together with all temporary fencing which shall be 'Heras' or similar approved.

6.3.1 Drainage

The SFCL Omnibund will drain into the existing site drainage and interceptor via dedicated oil detection devices within the Omnibund and Spare transformer bund.

6.3.2 Oil Containment

One of the two existing NGET Supergrid Transformer plinths is proposed to be used to mount the SFCL on. One plinth should be suitable for mounting the entire SFCL of reactor mass 30 tonnes including oil, with a bund capable of containing 4000 litres of oil.

The Omnibund will pump into existing sump within the spare transformer bund, this in turn has its own pump and oil detector.
The spare transformer bund drains into the existing site drainage system and subsequently into the site interceptor which is sized for 6x Oil tank and 3 x transformers.

6.3.3 Fire Prevention and Control

Not Applicable.

6.3.4 Structures

TBA

6.3.5 Foundations

TBA

6.3.6 Geotechnical

- Define potential problem areas (eg. water)
- Describe method of contamination resolution
- Describe ground conditions and bearing capacity
- Define proposed foundation type (eg. piled/spaced)
- Contamination

6.3.7 Line Termination Structures

N/A

6.3.8 Buildings

N/A

6.3.9 Building and Site Services

- Asbestos hazard

6.3.10 Roads and Paths

N/A

6.3.11 Cable (main/multicore) Trenching and Ducting

New multicore cabling will be installed. Please refer to relevant NGC documentation for details of trenching / ducting requirements.

6.3.12 Fences and Gates

National Grid to confirm this requirement

A new palisade fence is required to prevent public access to the road area adjacent to the SFCL compound. This is due to the potential risks posed from the magnetic field generated by the DC magnets within the reactor.
The fence will be 'U'-shaped with 2 gates to permit controlled vehicular access through this area and on towards the Oil Plant buildings.

Within the NG compound, a RMHZ demarcation zone will be established, following the radius of the magnetic field. It is proposed that the zone will either be via cones and chains or via simple harass fencing. This will be agreed with NG SAP.

6.3.13 Site Access

Site Access is as existing.

6.3.14 Landscaping

N/A

6.3.15 Impressed Voltage

- For projects involving large structural steelwork Identify potential for Impressed Voltages and if possible any actions required to mitigate the danger during construction and operation.

Gantry structure to be installed in accordance with RAMS and NG SAP supervision.

6.3.16 Cable Tunnels

N/A

6.3.17 Cable Tunnel Accessories

N/A

6.3.18 HVAC Systems

- Define High Level Specification for each area of coverage
- List specialist design activities and related design specifications

6.3.19 Other

6.4 Maintenance

The 33kV switchgear arrangement will be designed to provide adequate access to carry out maintenance utilising a MEWP or scaffold with the minimum requirement for circuit outages. Details of maintenance vehicle route access and any restrictions will be provided during detailed design.
If required, portable earthing spigots will be installed at adequate locations deemed necessary by the switchgear layout and NG site engineer.

All O&M manuals supplied will include the instructions and maintenance checks as suggested by the equipment supplier.

6.5 Type Registration

As agreed with NG no EGI codes will be issued for SFCL and associated equipment.

6.6 Deviation from Standards

Not Applicable.

6.7 Redundant Equipment / Debris Removal

TBA.

6.8 Documentation Summary

During the Contract execution stage contract specific drawings will be entered into Northern Powergrid document control system to control the issue of “For Construction” drawings. Upon completion of the project an updated site drawings index will be provided along with 'As Built' documentation typically comprising:

- General arrangement Drawings
- Section and Elevation Drawings
- Earthing Layout Drawings
- Connectors and Connections Drawings
- Label Drawings
- Interlocking Drawings
- Equipment Schedules
- Calculations
- O&M Manuals

6.9 Interfaces with Other Projects

TBA

6.10 Bilateral Connections Agreed

See connection agreement.

6.11 Commissioning

Commissioning and site testing will be carried out according to TP106. Please refer to relevant NORTHERN POWERGRID documentation for commissioning philosophy details.
Commissioning Method Statements will be prepared well in advance of the works and will normally cover the tasks as defined by the Commissioning Panel Chairman and/or Commissioning Officer.

6.12 Design to be Resolved

TBA

6.13 Design Compliance Audit - as per DH24

- Design Engineer (Assurance) to stipulate the anticipated extent of design compliance audit, ie. defined areas and % of drawings

6.14 Design Change Record

Date	Change details

Record all design changes between DID freeze and first on-site meeting of commissioning panel.

7. OVERHEAD LINES

Not Applicable.

8. HV CABLES

Not Applicable

9. SDS

See SDS.

10. CDS

(Add CDS) – n/a

11. PROCEDURAL REQUIREMENTS

11.1 The guidance notes in CDS (see template in TP146) describe the interface between CDS and DID.

11.2 A DID shall be prepared by the CDUs for each substation or OHL or cable route respectively for which they have responsibility. The text for each section shall be provided by a design engineer authorised for that discipline.

11.3 The purpose of the DID is to enable the CDU and Design Assurance to agree the scope of the detailed design work, particularly from the perspective that the design accords with National Grid policy and process and that it is joined up and holistic – prior to full production of detailed design work commencing. This is both to ensure the project is achieved to time, cost, quality and satisfies the SHE objectives, and to ensure that design engineering resource is put to best use, by getting the design right first time. To achieve this, the DID will comprise the following.

(a) Drawings/schedules which experience has shown are necessary to be defined at the DID stage.
(b) Calculation to be inspected/agreed with Design Assurance.
(c) Existing and final arrangements, including stages and temporary works.
(d) Solutions to areas or risk, hazard and complexity.
(e) Third party interfaces, primary and secondary equipment terminal points and responsibility boundaries.
(f) Design yet to be resolved.
(g) Type Registration requirements.
(h) Explanation for the reasons/acceptability of non-compliances or use of non Employer standards.
(i) Commissioning strategy.
(j) Redundant equipment and method of disposal.
(k) Summary of documentation to be transferred to the Employer on completion
(l) Maintenance requirements.
(m) Site specific Safety and Environmental considerations applicable to each discipline (i.e. Civil, Plant, OHL etc) that has a design impact.
(n) Copy of CDS.

11.3 Prior to DID freeze a Hazard Identification Design Review must be undertaken (aimed at achieving zero by design). Justification for the design from a SHES perspective must be recorded in the Design Justification Report.

11.4 Once the DID is frozen it should only be updated in the following circumstances.

(a) To correct an error.

(b) When both the CDU and Design Assurance agree to a design change.
(c) To record any design that was outstanding at the time of DID freeze.