Connections Case Studies

EXTRA HIGH VOLTAGE (EHV) CONNECTIONS

NORTHERN POWERGRID

Connections Case Studies

The connections projects described in this document are based on actual Northern Powergrid Extra High Voltage (EHV) connections delivered during 2015/16.

The following case studies can be used to help you:

(a) plan your application to connect different types of EHV connections projects to the Northern Powergrid network

(b) estimate the likely costs and timescales to deliver those connections

These examples show the most common generation connection scenarios with tables giving indicative costs.

More general connection examples and costs are already laid out in our connections methodology and charges statements, these can be found online:

- Yorkshire: www.northernpowergrid.com/asset/0/document/2926.pdf
- Northeast: www.northernpowergrid.com/asset/0/document/2925.pdf

This document should be read in conjunction with these statements.

EXAMPLE 1:

New generator required a 20MW connection

The customer was a developer who wanted to connect a 20MW wind farm to the Northern Powergrid electricity distribution network.

Upon receipt of the formal application, we performed a minimum information check on the application data the customer submitted. Our Commercial Engineer supplied some initial budget optioneering information to allow the customer to review the feasibility and viability of the project.

Following confirmation from the customer that the project was feasible, our Design team set about the detailed design work. This involved a comprehensive network assessment to check the network could accommodate a generator of this size and identifying the overall least cost technically acceptable solution.

The network study activities involved assessing whether the network would be large enough:

- to transport the energy (thermal rating)
- to stop the generator itself causing the voltage of the network to rise too much (voltage rise)
- to ensure the current flow in the event of a fault does not exceed existing network switchgear ratings and;
- to ensure when the generator starts and stops generating it does not cause voltage quality issues (voltage step change, starting current)

In this case, the existing Northern Powergrid network passing the customers site could accommodate the new generator capacity and a connection offer was made on that basis.

The connection was made to an existing 33kV overhead line via a new 33kV looped arrangement incorporating two new overhead line terminal poles and 33kV cables connecting to the customers' site.

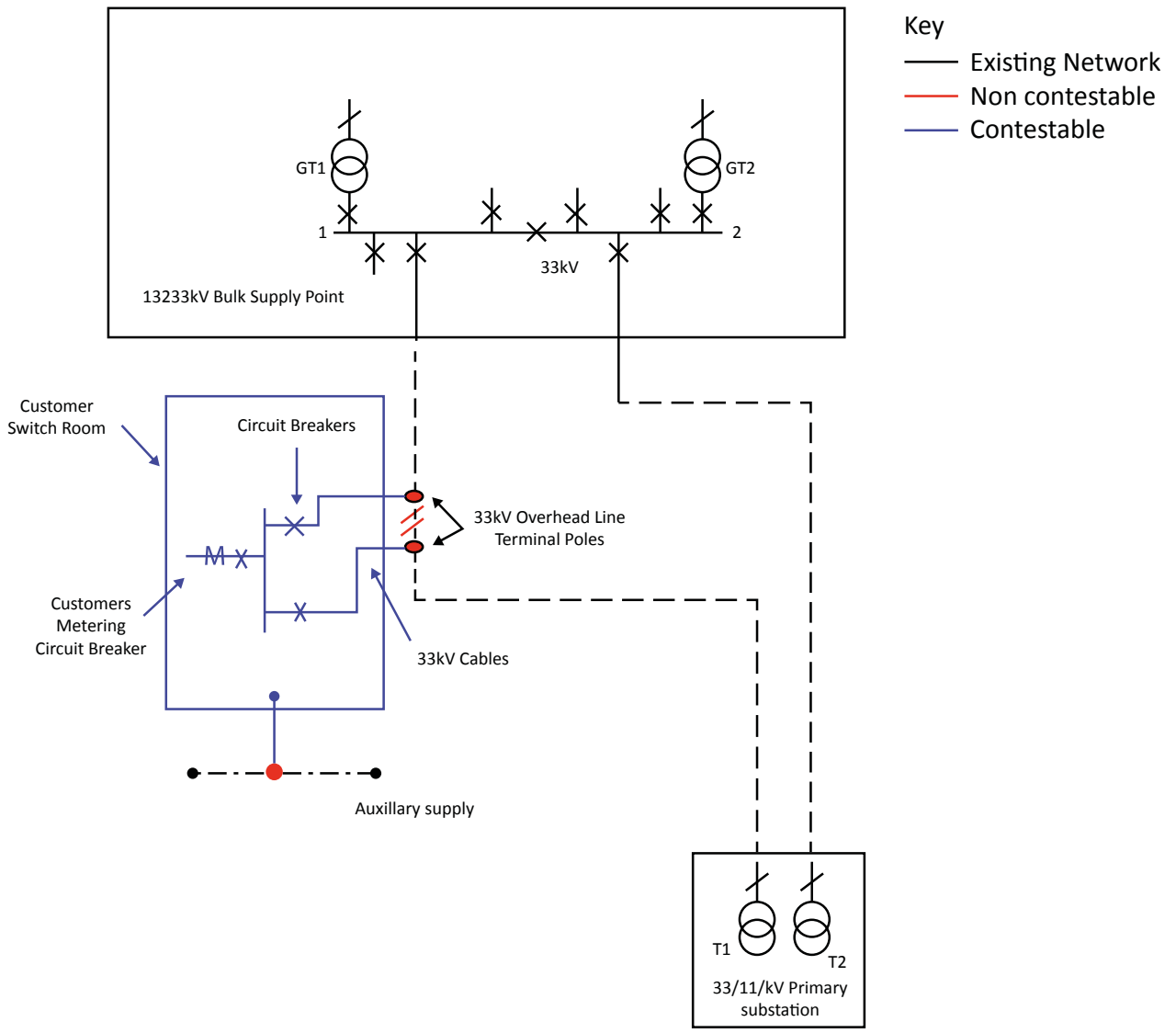
A new 33kV substation was established on site with a 3-panel switchboard incorporating the customers' metering circuit breaker and two other network circuit breakers. Control and protection was integrated into the existing distribution network systems via a new communications infrastructure. The customer's point of connection was the 33kV metering circuit breaker.

OUR COMMERCIAL ENGINEERS

Our Commercial Engineers will work with our customers to understand the upfront feasibility of planned connections projects. All EHV, 33kV/66kV and 132kV connections are bespoke and designed individually. If you are considering a major project, then we are happy to get involved to help you understand your connection options as early as possible.

www.northernpowergrid.com/help-and-information/getconnected/how-do-i-connect-generation-equipment-to-your-network/who-do-i-contact-about-large-scale-generation-connected-at-extra-high-voltage-ehv-33kv-66kv-or-132kv

Diagram of the proposed connection arrangement



£

Cost summary:

Breakdown of costs	Cost less VAT
Non-contestable works	£450k
Contestable works	£2m
Stability study and statement of works	£30k
11kV auxiliary supply	£150k
Regulated 4% margin	£87k
Total cost	**£2.7m**

ESTIMATED TIMESCALES FOR DELIVERY:

The project delivery timescales for this type of EHV work are estimated to be in the region of 18-24 months. Whilst we will always work with our customers' project team to coordinate the delivery of the work activities in the timeliest manner, the overall delivery time is dependent on the following;

- plant procurement lead times,
- network outages,
- any third party interactions with National Grid, ICPs and IDNOs
- planning approvals and;
- wayleaves required from other landowners or authorities

ACTUAL TIMESCALES FOR DELIVERY:

The full works programme has been broken down into the following categories:

1. Project development & tendering

8 Months

Following receipt of the acceptance a project initiation meeting was held to confirm the scope of works; develop and agree an outline programme; resource requirements and the commercial elements. On completion, the dedicated project team prepared a detailed specification that enabled a framework contractor to be engaged to complete all aspects of the work. This work took three months to complete. It then took a further five months to complete the tender and contract award process. During this period the necessary lease and easement negotiations were commenced with relevant stakeholders.

2. Detailed design and procurement

9 Months

(based on longest lead item and manufacturing periods)

Following contract award the successful framework contractor commenced detailed engineering, taking three months to prepare the specifications and place orders for all the main elements of plant and equipment. The major items, plant and equipment and their associated lead times were as follows;

Non-contestable works:

- Protection panels – Six months
- 2 x 33kV terminal poles – Two months
- Optical fibre – Two months

Contestable works:

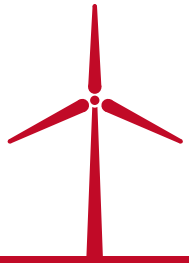
- 3 x 33kV circuit breakers – Six months
- Protection panels – Six months
- 33kV cables – Four months

Civil construction works commenced five months after award of the contract, having progressed to the civil design review earlier than normal. The early start was in part due to the completion of legal consents at the developers' site being undertaken in an efficient and timely manner.

3. Site works

11 Months

The site works overall took 11 months to complete. Some elements were able to commence in parallel with the specification and manufacture of the equipment.



The following sets out the respective non-contestable site works:

Civil works: The only civil works were those associated with excavation to complete the jointing works necessary to make the point of connection.

Plant installation: This work involved the installation of the on-site control and protection equipment and remote end protection works. Overall this work took six weeks to complete.

Pre-commissioning: The elements of pre-commissioning associated with these works took two weeks to complete.

Cable & overhead (O/H) line: To provide the new point of connection (PoC) the existing poles on our 33kV circuit were replaced with two new terminal poles 1km along the circuit. It also required fibre wrap on the 33kV overhead line circuit between our Bulk Supply substation and the new terminal poles to provide the protection and intertripping circuits. The works were undertaken during the project outages.

The following sets out the respective contestable elements of the site works:

Civils: The construction of a new 33kV metering substation was initiated to accommodate the 33kV circuit breakers, associated control and protection panels and the associated auxiliaries, including the heating and lighting works. The work took four months to complete.

Plant installation: Delivery of the plant and main installation works included the following; overall these works took three months to complete:

- 3 x 33kV circuit breakers
- Control and protection panels

Pre-commissioning: The pre-commissioning activities associated with these works took two months to complete.

Cable & O/H lines: Installation of 33kV cables and associated fibre cable from the new terminal poles at the point of connection to the new customer's substation. These works commenced in parallel with the plant installation on site and took two weeks to complete.

Outage works: Due to substations affected by the outages and their respective high system risk category (3 & 4); the outage could only be taken during BST which slightly extended the project delivery timescale.

End-to-end commissioning: End-to-end commissioning took place after completion of the outage works and was completed within one month.

The project was completed on time and within budget.

EXAMPLE 2:

Educational institute requiring a new firm 35MVA demand connection

The customer was an educational institution who applied to connect a new supply capable of delivering a firm 35MVA import.

Upon receipt of the formal application, our Commercial Engineer performed a minimum information check on the application data submitted. We supplied some initial budget optioneering information to allow the customer to review the feasibility and viability of the project before any detailed design work was carried out.

Following confirmation from the customer that the project was feasible our Design team set about the detailed design work. This involved a comprehensive network assessment to check the network could accommodate a demand connection of this size and identifying the overall least cost technically acceptable solution.

The network study activities involved assessing whether the network would be large enough:

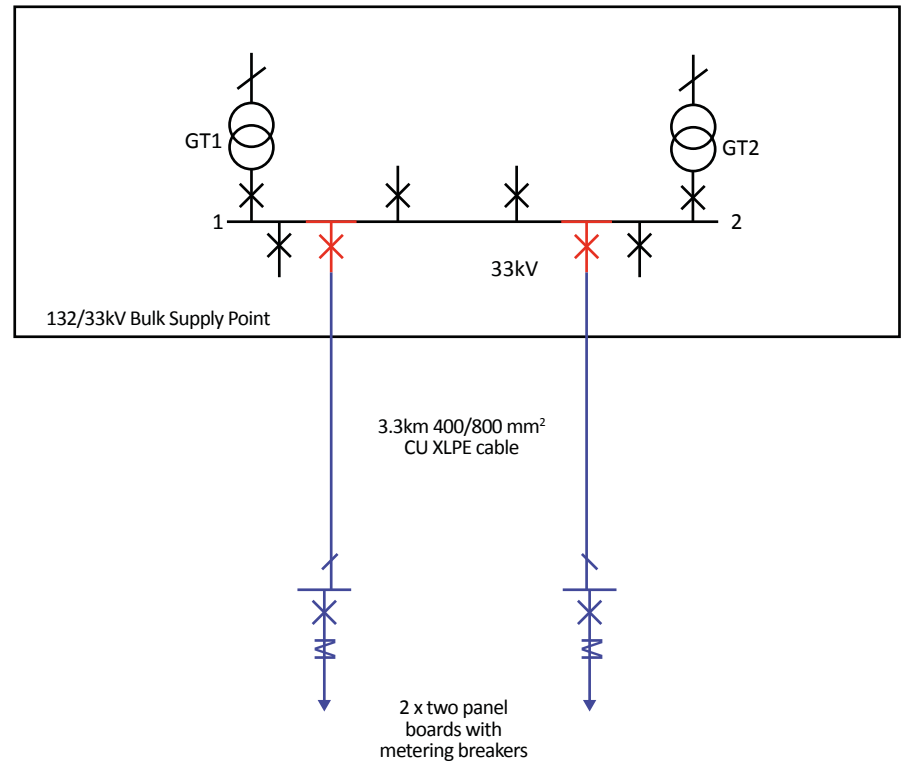
- to transport the energy (thermal rating)
- to ensure the current flow in the event of a fault does not exceed the existing switchgear rating and;
- to ensure the new connection complies with P2/6 requirements.

In this case, the nearest available capacity to accommodate the customer's load requirement was two direct connections to the Northern Powergrid 132/33kV bulk supply point.

The connection was made via two new circuit breakers at our 132/33kV bulk supply point and two 33kV cables to the customer's site. A new 33kV metering substation was established on site with 2 x 2-panel boards, each incorporating a metering circuit breaker. Control and protection was integrated into the existing system via a new communications infrastructure.

"Following the customers confirmation that the project was viable and that they wished to proceed our Design team undertook a comprehensive network study and assessment."

Diagram of the proposed connection arrangements



£

Cost summary:

Breakdown of costs	Cost less VAT
Non-contestable works	£700k
Contestable works	£3.7m
Regulated 4% margin	£150k
Total cost	**£4.5m**

ESTIMATED TIMESCALES FOR DELIVERY:

The delivery time for this project was estimated to be in the region of 24 months. Whilst we will work with our customers' project team to coordinate the delivery of the work activities in the timeliest manner, the overall delivery time is dependent on the following;

- plant procurement lead times
- network outages
- any third party interactions with National Grid, ICPs and IDNOs
- planning approvals and;
- wayleaves required from other landowners or authorities

ACTUAL TIMESCALES FOR DELIVERY:

The full works programme has been broken down into the following categories:

1. Project development & tendering

9 Months

Following a valid acceptance complete with payment, a project initiation meeting was held to confirm the scope of works, develop and agree an outline programme and to resource requirements and commercial elements. On completion, the dedicated project team prepared a detailed specification to enable our framework contractors to tender for the work. For this particular project it took three months to complete this work. A further six months was required for tendering, post offer negotiations and contract award.

- 33kV cable work was delivered via our EHV cable framework contract. A scope of works was prepared and issued for firm pricing in parallel with this project development.
- During this period lease and easement negotiations were also commenced along with all relevant stakeholder engagement.

2. Detailed design and procurement

9 Months

(based on longest lead item and manufacturing periods)

Following award of contract, the successful framework contractor commenced detailed engineering – three months was allowed for this work. At the end of this period approval was given to order the associated plant. The major plant requirements along with their associated lead times were;

Non-contestable Works:

- 33kV circuit breakers – Six months
- Protection panels and manufacturing – Six months
- 33kV Cables – Four months

Contestable Works:

- 33kV circuit breakers – Six months
- Protection panels and manufacturing – Six months
- 33kV cables – Four months

We were in a position to commence the associated civil construction works at our substation six months after the award of the framework contract. At the customer's site, work commenced within five months.

3. Site works

12 Months

The site works actually took 12 months to complete although some elements were carried out in conjunction with the deliverables above.

The following sets out the respective non-contestable site works:

Civil works: Civil works were required at the Supply Point substation to establish a new 33kV switch/control building to accommodate the 33kV indoor circuit breakers and associated protection panels; this was needed to facilitate the Supply Point extension. Civil works commenced in parallel with plant procurement. The overall duration of these works was three months.

Plant installation: Upon delivery of the plant, the main installation works included:

- 2 x 2-panel 33kV switchboards.
- Control and protection panels.

Pre-commissioning: The pre-commissioning activity associated with these works took approximately two months.

Cable & O/H line: Cable works involved installation, jointing and termination of the 33kV cable circuits to facilitate the new connection. Cable installation work commenced alongside the pre-commissioning works on the new switchgear equipment and took eight weeks to complete.

The following sets out the respective contestable site works:

Civils: This project required the construction of a new 33kV metering substation at the customer site to accommodate 33kV switchgear, associated control and protection panel. The overall duration of these works was collectively four months.

Plant Installation: Upon completion of all the associated civil works and delivery of the plant, the main installation works included the following and took three months to complete:

- 2 x 2-panel 33kV switchboard
- Control and protection panels

Pre-commissioning: The pre-commissioning activity associated with the 33kV switchgear and protection works took approximately two months.

Cable & O/H line: This project required the installation of 2 x 33kV cable circuits and associated fibre optic cable for approximately 3km each, from the customer's substation to the PoC at our Supply Point substation. Cable installation was carried out in parallel with the plant procurement and switchgear installation/pre-commissioning at the customer's substation. Assuming an installation rate of 200m per week, five months were allowed to complete this task.

Outage works: Locally, the affected substations were a system risk 3; meaning outages could only be taken during British Summer Time (BST). Given the complexity of these works, they took eight weeks to complete.

Commissioning: End-to-end commissioning took place after completion of the outage works and took just under one month.

The project was completed on time and within budget.

NORTHERN POWERGRID **CONNECTIONS CASE STUDIES**

CONNECTIONS ENQUIRIES

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