Customer-Led Network Revolution

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Grand Unified Scheme (GUS)
Cost Analysis

DOCUMENT NUMBER

CLNR-L251

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ISSUE DATE

22/12/2014

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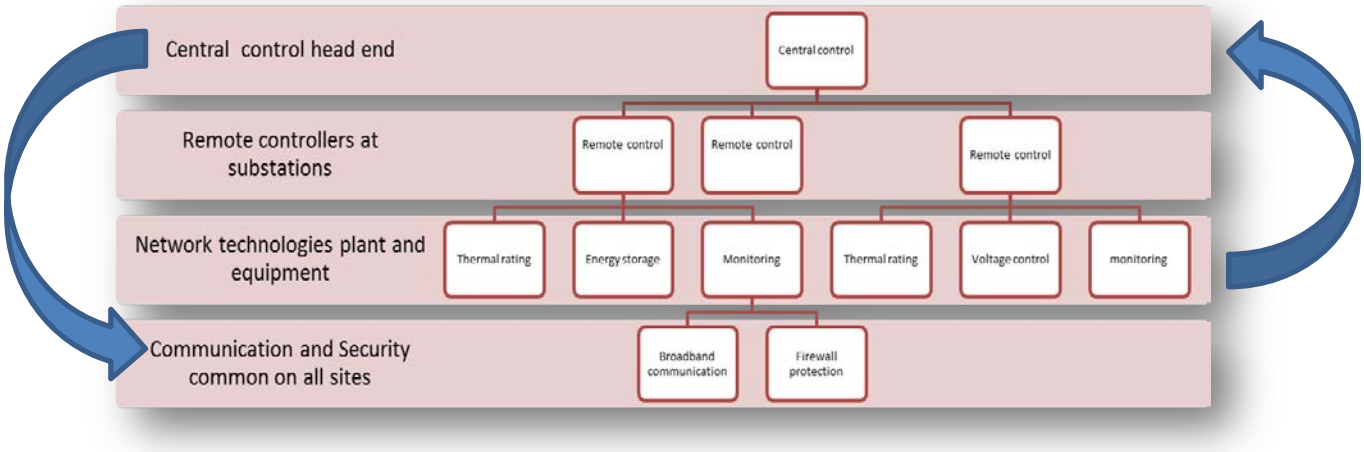
Document Purpose

The following report is a detailed breakdown of costs attributed to the design, modification and installation of the active network management system that has been configured on the CLNR project that has the name of the Grand Unified Scheme (GUS). The complexity of the control scheme cannot be reflected to the reader of this document, so in an attempt to simplify the following diagram explains the basic system architecture and the key costs captured.

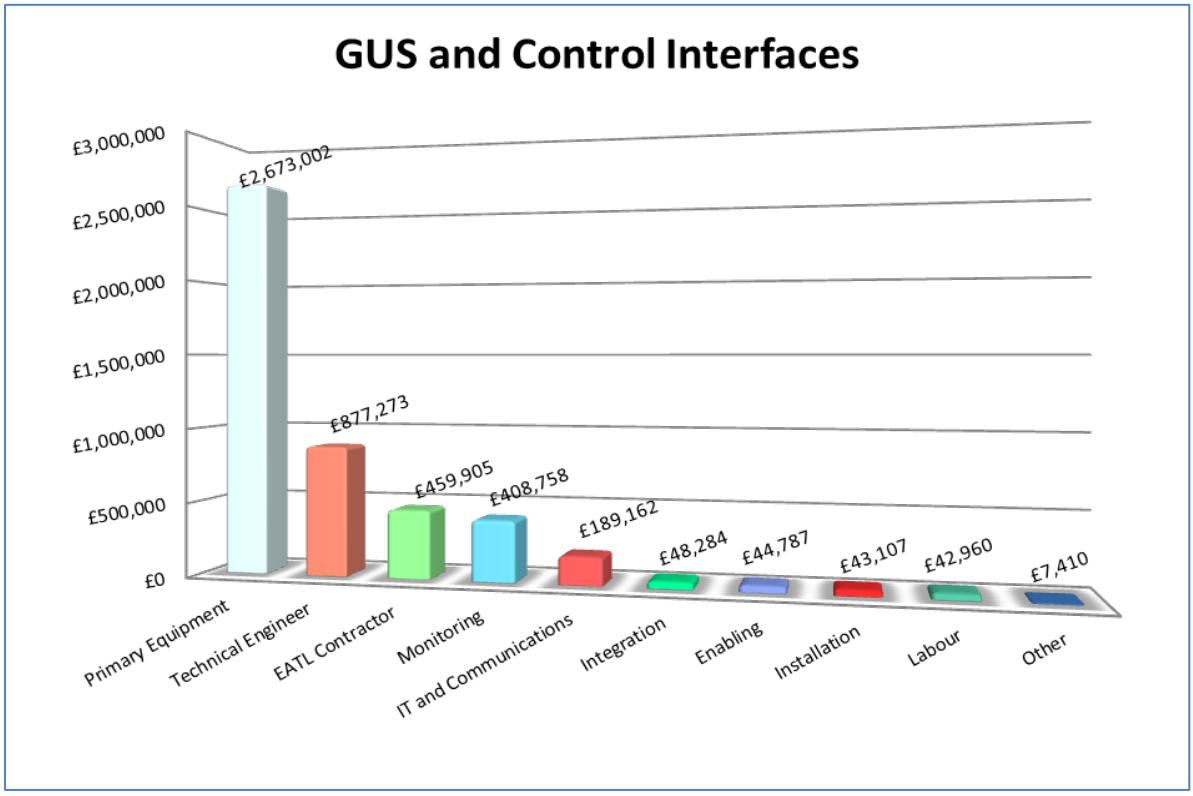
GUS – Basic architecture and communication



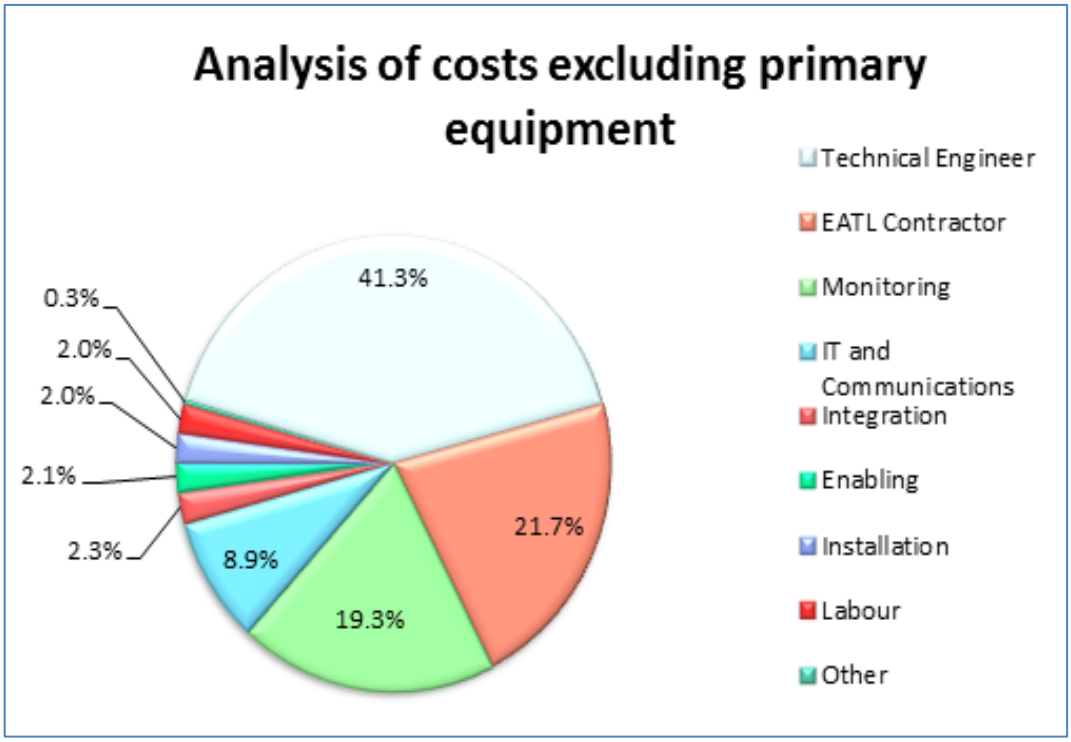
The diagram illustrates GUS, comprising of the central controller inclusive of its data store, coordinating with 14 remote controllers located on the network at our substations, that each then coordinate with many multiple network technologies. There is a secured communication layer that has enabled data transfer and a vast amount of network monitoring at more than 150 locations that enables the control systems ability to perform safely and accurately.

The cost categories have been chosen to best illustrate the areas of wok undertaken to safely install, secure and commission and operate the equipment in a central control room and on a group of UK DNO owned substations.

The total Northern Powergrid project cost for GUS was just under £4,795k. A breakdown of the costs is presented in the charts below.



Cost Categories	Original Budget	Total spend to date	Budget v Spend Variance %
Primary Equipment		2,673,002	
Monitoring		408,758	
IT and Communications		189,162	
Integration		48,284	
Enabling		44,787	
Installation		43,107	
Labour		42,960	
Other		7,410	
Total GUS/Control Interfaces Costs	**3,209,000**	**3,457,470**	**8%**
EATL contractor	537,000	459,905	-14%
Technical Engineer	375,000	877,273	134%
Contingency	850,000	-	-100%
Total	**4,971,000**	**4,794,648**	**-4%**



Primary Equipment

The primary equipment category is wide ranging and captures the actual costs associated with the contract tendered to achieve the specification for the entire control system, its warranty support as delivered and deployed.

There were a number of variations to the original contract to modify the control system to comply with Northern Powergrid policies on control, security, safety and protection, and to facilitate its integration with the new and existing distribution system assets including the existing SCADA network control management system.

This includes the application platform, both central and distributed, the design, creation and development and debugging of complex control algorithms and its assisted installation and operational support.

Logistics, haulage, delivery duty and project management of the assisted installation and commissioning are included.

This category also includes, the coordinated support interface that links the prototype control platform with demand response outputs, it does not include the cost of scheduling operational usage or calling for a demand response action from the control system.

It is very important to note that this is a prototype development system, over 4 particular test electricity networks, and had little redundancy built in to it, much less than what would be required to consider this architecture to be stable enough to operate a full distribution network.

EATL Contractor

The EATL contractor costs relate solely to fees incurred during the preparation for procurement, contract drafting and execution and configuring the test cells (for example defining the system specification, defining location and quantity of controllers and clarifying technical uncertainty) for each network trial with the integrated control system.

Enabling works

This category captures the prime enabling activities carried out to allow modification to the control room layout, or each of the sites and to the network technologies. This includes site surveys, site designs, security improvements, IT security upgrades, upgrades to perimeter protection of substations, and even working with local authorities to allow better communication coverage via GPRS antennae.

An important note to capture is that on many of the substation sites involving the integration of new technology, whether it is simple monitoring equipment or the most advanced energy storage system. That each required their own enabling works and data communication. The addition of and extra power socket or an additional duct were considered at the design phase which greatly reduced the amount of "GUS" bespoke enabling requirements.

Key examples of these works were; the routing of a fibre communications cable from the server room to the terminal stations at the control room at a cost of £1.2k, or simply the addition of extra power outlet at a distribution substation at a cost of £200. The volume of activities lifted this total to £44.7k.

Technical Engineer

These costs were for engineering works associated with the systems design, acceptance testing, redesign, commissioning and debugging of this first of a kind product. Costs were heavily affected by the amount of technical thinking and development time that was initially required in the design phases and debugging phase of the central system. These costs are likely to be similar for the development of similar sized test networks, and would require much more support should the system be up scaled to cover the full distribution network.

Deployment of the remote controllers engineering costs were affected by multiple visits to each deployed site. We feel that these would reduce considerably for subsequent implementation as this learning has been achieved.

Labour

This is the measure of the amount of activity performed by Northern Powergrid employees that covers the activities of Northern Powergrid's program delivery department; it is inclusive of work done by field engineers, fitters, jointers, linesmen, craft attendants, safety auditors, supervisors, quality inspectors etc.

The following costs are associated with the entire GUS system, and are partially consolidated within the costs for monitoring, enhanced automatic voltage control, thermal rating and electrical energy storage, and all other aspects of the CLNR integrated control project.

Monitoring

The key requirements of the control system and the architecture of a smarter grid, comes from the visibility of the existing network assets and the monitoring of it in as near to real time as is possible. Monitoring comes in many forms from the simplest current transducer up to full waveform capture of line and phase values at key strategic network locations, which feed the invaluable data that enables the control platform to accurately assess the network and issue control commands from it. With over 150 monitoring stations feeding over 3 million data points a day the project spent £409k on this vital category.

IT and Communications

Information technology and the communication configuration required to enable, fast, reliable, secure, communications to distributed substation sites was a key enabler to the smart grid controller. A variety of solutions were required, from mobile technology like GSM and GPRS, ADSL and fibre communication to secure licenced radio that were all engineered to cover a number of different protocols including standards like IEC61850 and DNP3.0. Each required security enabled by advanced routing, firewall protection and isolated front end processors. The cost of the design, development and configuration of our relatively small scale test across one central control system and 14 controlled hubs was £189k.

Installation and civil works

Installation and civil costs are a combination of activities associated with the physical installation of the equipment at the control room and at the remote substations, not covered by the primary equipment contract and not performed by Northern Powergrid. This work forms part of the integration between the new control system, the remote control systems, the network technology and the existing infrastructure at each site. Typical examples would be the configuration of the server room at the head end, routing cables between equipment and controllers and the configuration of auxiliary supplies.

Integration

The integration of the components for the CLNR active network management scheme and its coordinated customer interface of demand side response are included. Significantly, the dynamic thermal response systems coordination with voltage control and real/reactive power control combine to form a major activity in integrating network technologies, both with the developed control system and the existing Northern Powergrid control system.

The total Northern Powergrid project cost for Integration was £48.2k

Operational Expenditure (OPEX)

Specifically identifiable expenditure has been incurred in the routine day to day operation of the control system, post its commission. This work is a combination of user learning and an extended amount of system testing and trialling of combinations of new, modified or novel network technologies. However, in the future there would be less costs relating to the ongoing operation and maintenance of the asset as its automated features are enabled and confidence in the prototype systems ability is at a much higher level.

Further operational expenditure is likely as the current system is not able to integrate itself fully with the current control platform to modify its network configuration in the event of a network model change, the associated labour costs / technical engineer cost to support the model update is estimated at £20k per annum.

A maintenance and warranty support package is in place, which we anticipate to cover most faults on the system over the next three year period, options to increase or decrease the level of support currently contracted would affect the renewal price of this service agreement, our ability to self-maintain the system will also change this cost significantly.

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