

# ▶ LARGE COMPETITION IN CONNECTIONS PROJECTS

High Rise Housing Transmission Connection

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# LARGE COMPETITION IN CONNECTIONS PROJECTS

## High Rise Housing Transmission Connection

### Orchard Place

Orchard Place is the name given by EDF Energy Connections for the provision of a 132/11kV bulk supply substation supplying a number of residential high rise apartments on a peninsular into the river Lea in East London five minutes walk from Canary Wharf.

The site required substantial remediation owing to the previous use which was that of a lard factory.



Figure 1 View of Development and River Lea

### Electrical Topology

The first task undertaken by Kedvale Consultants was the production of a load list to determine the required installed capacity of the developer's proposals.

Having undertaken the load list it was decided that a 132/11kV substation with a firm capacity of 66MVA was required. Owing to limited space and to optimise the developers return on capital it was decided that a basement or subterranean substation was the required solution.

It was discovered in the early planning phase that there would be close proximity to the tunnels of the Crossrail Project. In consultation with the developer it was decided to erect a building at ground level to be used as, initially a marketing suite and upon completion of the development a gymnasium and small retail outlets, the substation being located in the basement.

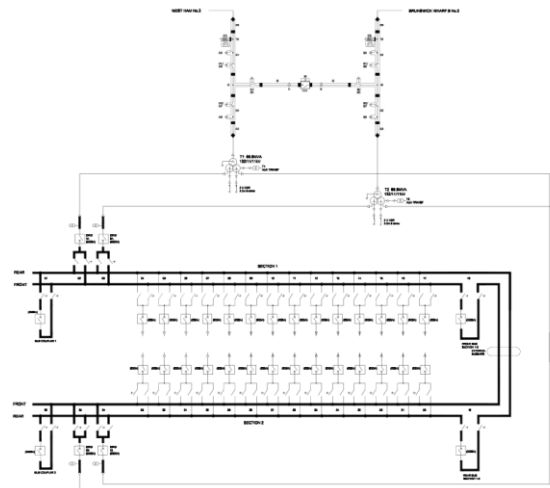


Figure 2 Scheme Single Line Diagram

### Civil Engineering

The substation comprises a subterranean cable basement to accommodate 132 and 11kV cabling, two transformer chambers, fire suppression rooms 132kV switchroom 11kV switchrooms protection

room, metering room, control room with raised computer floor, Office/Store, Kitchen/welfare and WC.

Due to the physical location of the active portion of the grid transformers it was necessary to devise an effective means to discharge the heat derived from the transformer losses. This comprised of an oil to water heat exchanger and a water cooling system to cooling towers located on the building roof.

Owing to the available ratings for 11kV switchgear the transformers comprised dual secondaries each rated at 33MVA.

The civil engineering construction and design would be undertaken by the developer with Kedvale Consultants providing close liaison with the developers civil engineering teams to ensure that all structural implications of accommodating the electrical assets was efficiently managed.

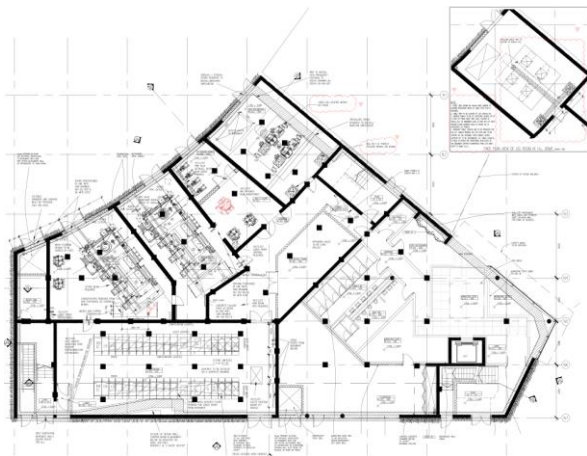


Figure 3 Substation Ground Floor Plan

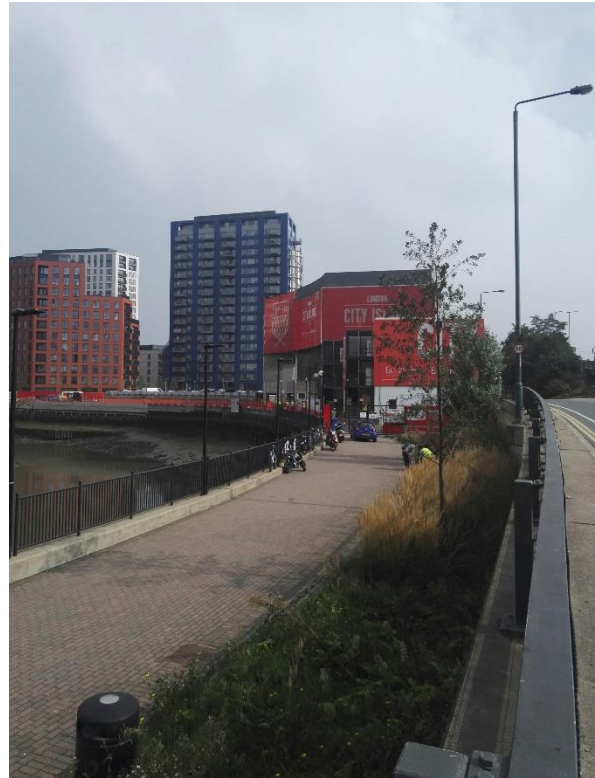


Figure 4 Substation Building Draped in Red Promotion Material

#### 132kV Hybrid Gas Insulated Switchgear.

Owing to the limited space on the site it was necessary to consider the use of hybrid GIS switchgear designs where disconnectors, earth switches and circuit breakers, together with protective transformers are effectively supplied as a single entity.

The GIS solution had been previously been developed by the client and Alstom for use on inner London 132kV ring mains and comprised the latter's F35 145kV GIS switchgear. The switchgear topology comprised a classic H arrangement with a single bus section circuit breaker and connections to feeders and transformers being effected by means of motorized disconnectors.

Kedvale worked closely with Alstom to secure final approval for the product liaising with the factory in

respect of gas zone identification and labeling and voltage transformer isolation requirements to meet Model Form Safety Rule requirement together with the disposition of protection current transformers.

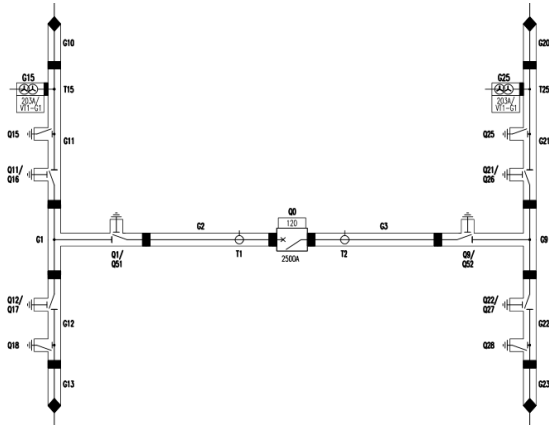


Figure 5 GIS Gas Zones

and fully participated in the procurement of the transformers

Kedvale participated in the full factory acceptance testing of the transformer ensuring compliance with the project specification and International Electrotechnical Commission standards.

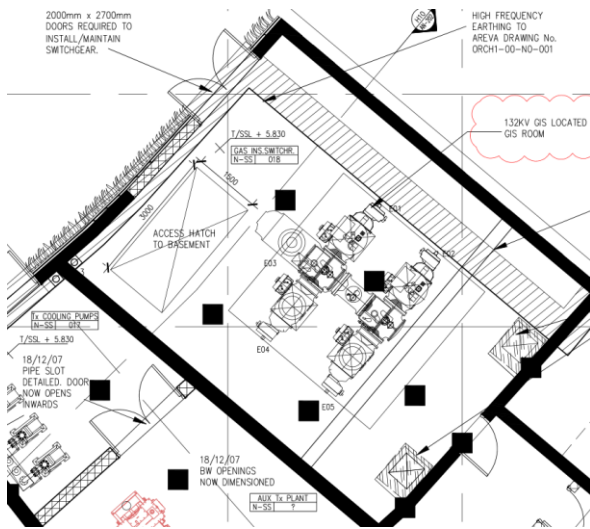
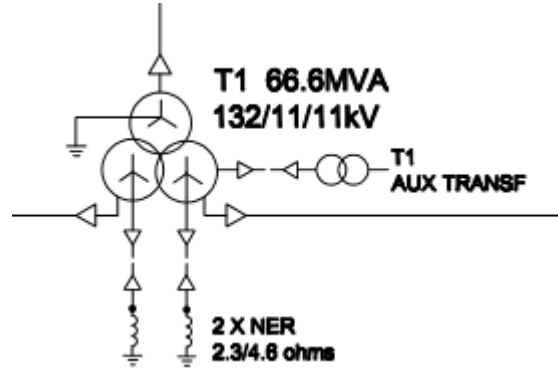


Figure 6 132kV GIS Room

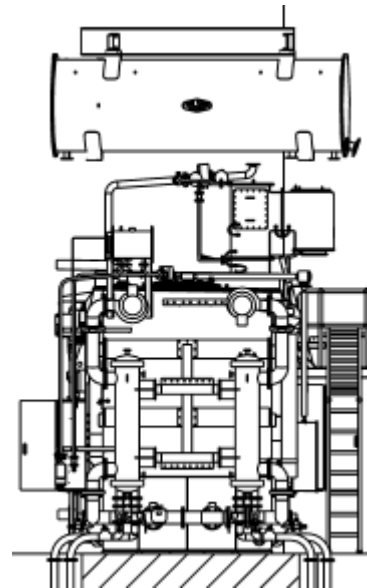


Figure 7 132/11/11kV Transformer General Arrangement

### 132/11kV Grid Transformer.

Kedvale Consultants fully designed and specified the requisite electrical performance of the grid transformers, tendered the same to the market place

### Protection and Control

132kV cable circuits were protected with digital unit differential IEDs using fiber optic pilots. Back up

protection is furnished by means of directional overcurrent and earth fault IEDs.

The 132kV GIS is protected by two high impedance zones each covering a circuit disconnector, transformer disconnector, section disconnector with an overlap in zones across the 132kV circuit breaker.

The 132/11/11kV grid transformer was furnished with an overall three winding biased differential scheme and high impedance attracted armature relays were provided to provide HV and LV windings restricted earth fault as a second main protective function.

Transformer back up protection was provided in the form of two stage three pole overcurrent relays. The LV 11kV system was reactance earthed via an oil filled earthing reactor. Two stage stand-by earth fault protection was provided by means of single pole over current relays.

Grid transformer Low voltage over current is also provided which was integrated into the 11kV switchboard protection scheme.

The 11kV switchgear comprised two double bus bar switchboards interconnected with resin impregnated Duresca bus bar. Each switchboard was equipped with a bus section circuit breaker allowing each of the grid transformer windings to autonomously supply its own bus bar. Two bus coupling circuit breakers were provided to allow connection between front and rear bus bars.

A comprehensive 11kV protection scheme was developed to identify faulted bus bars and instigate isolation. This comprised a bus bar protection scheme utilizing directional blocking and back tripping, auto closing of sections and or couplers to maintain supplies. A full circuit breaker fail scheme was also provided.

A substation outstation was provided to facilitate real-time monitoring and control from the Distribution System Monitoring and Control Centre.

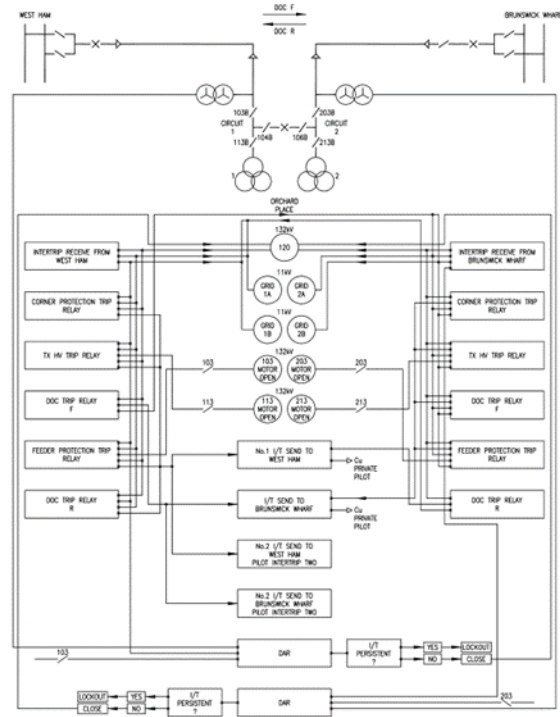


Figure 8 Protection Functional Diagram

### 11kV GIS Double Busbar Switchgear

Owing to the current output of the transformer two secondary windings were required to provide current within the rating of the switchboard, as a consequence double bus bar switchgear was necessary. The total number of panels was 36 and this was arranged in two separate switchboard interconnected with type approved prefabricated resin impregnated busbars.

In order to reduce floor space to the minimum allowing the developer as much utilization of the land as possible compact SF6 gas insulated switchgear was utilized, feeder panels being 600mm in width. A continuous cable access slot was designed under each switchboard together with installation channels to secure the switchboard to the building fabric. All feeder cables were bottom entry together with protection pilot cables.

The switchboard comprised four incomers, one per bus section, two bus couplers and two bus section circuit breakers and twenty eight feeders. All incomers bus sections couplers and bus bars are rated at 2000A.

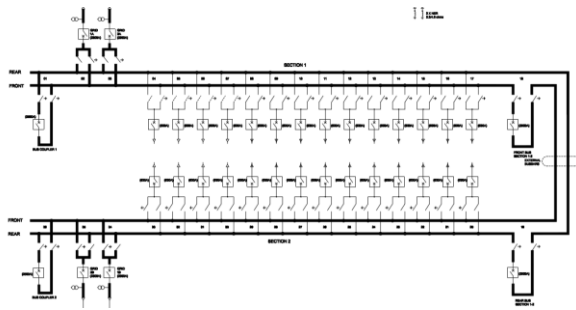


Figure 9 Schematic Representation of 11kV Switchboard

#### Low Voltage AC and DC Systems.

The substation auxiliary supply is provided from two 150kVA auxiliary transformers each of which is cable connected directly from one of the grid transformer secondary windings.

The auxiliary transformer is connected to a switchboard with automatic change over facilities to allow connection to the Distribution Network Operators Public Electricity Supply in the event of a grid transformer outage.

The LVAC switchboard is provided with manual by-pass facilities to allow the maintenance of the change over switchgear. This manual by-pass is fully mechanically interlocked to prevent inadvertent paralleling of the supplies.

A 110V DC Valve Regulated Lead Acid battery and charger is provided to operate the sub station and its ancillary services for a period of six hours.

#### Power Cabling

The Bulk Supply Substation is connected to a 132kV ring feed from West Ham Grid Supply Point by

132kV cables. Cables from the new substation are through jointed to existing 132 ring cables at an appropriate location for future access. The new cables terminate at the appropriate gas insulated line disconnecter cable box on the 132kV switchgear. The output of the GIS switchgear is connected to a cable/oil bushing in the grid transformer HV cable box. Using inner cone plugs and sockets. All 132kV cabling is designed and restrained on a cable containment system rated to withstand the prevailing short circuit currents. All cable installations are designed to ensure no derating of the existing circuit ratings.

The secondary of the grid transformers are connected to the relevant 11kV bus section by three cables per phase. Each of the secondary winding star points is connected to a dedicated neutral earthing reactor.

There are twenty eight feeder circuits some of which supply adjacent areas but the majority feed consumers within the development. Substantial spatial coordination is required to prevent unnecessary crosses and to maintain inter circuit spacing sufficient to prevent circuit derating. Cables are typically 6.35/11kV to BS 7878-4-10.

#### Neutral Earthing

The 11kV system connected to each of the two secondary windings was earthed by means of an earthing reactor in order to ensure that the 11kV cable sheaths under earth fault conditions operated within their adiabatic withstand criterion.