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400 kV GIS Development for Ireland

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400 kV GIS Development for Ireland - background

- Demand for energy increases
  - Utilities tasked to supply the energy efficiently
  - Low cost, highest reliability.
- Achieving lower cost
  - manufacturers decrease size of equipment
  - Smaller footprint, not giving up any of features of the equipment. This has to be done in co-operation with the various suppliers and the utilities.
- This describes approach taken in the development and installation of new 400 kV GIS equipment in the existing Moneypoint 400 kV substation in Ireland.

400 kV GIS Development for Ireland - background

- Irish government committed to 40 % of electricity generated from renewable sources by 2020.
- The TSO for Ireland has established the Grid 25 programme to combine government target and anticipated needs of existing and future Grid users.
- Wind energy is main source of renewable electricity generation.
- Current total wind capacity over 2,000 MW generated from over 190 wind farms. (North-west and South-west of the island).
- Redevelopment of Moneypoint 400 kV GIS substation is the key gateway to deliver this wind generation from the south west of the country to the main load centres in the east of Ireland.

400 kV GIS Development for Ireland

- **INTRODUCTION**
  - Moneypoint is the largest power station in Ireland.
  - Built in the 1980's, generating capacity of 900 MW.
    - Connected to Moneypoint 400 kV substation through three 330 MVA 17 kV / 400 kV step up transformers.
    - Substation then connected to the main load centre by two 400 kV lines.
    - Existing Moneypoint 400 kV substation redeveloped to cater for the large increase of wind generation primarily located in the south-west.
    - New 220 kV and 110 kV GIS substation are also being constructed as part of this redevelopment.


2014

400 kV NETWORK ISSUES IN IRELAND

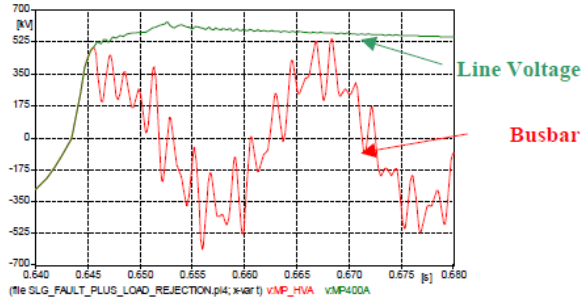
- Ireland - a weak 400 kV transmission system, two 400 kV lines connecting a large generating station on the west coast to the main load center on the east coast
- Normal IEC BIL requirement for 400 kV is 1425 kV, calculation and experience resulted in a policy requiring a BIL of 1550 kV, value normally associated with 550 kV, for equipment used on the Irish 400 kV system.
- Easiest would have been to buy a 550 kV systems available on the market.
  - Would have resulted in a higher cost and much bigger footprint
  - Substantially bigger building.
- Specification was written to obtain 400 kV GIS with additional performance requirements in stead of the default alternative of 550 kV.

400 kV NETWORK ISSUES IN IRELAND – cont'd

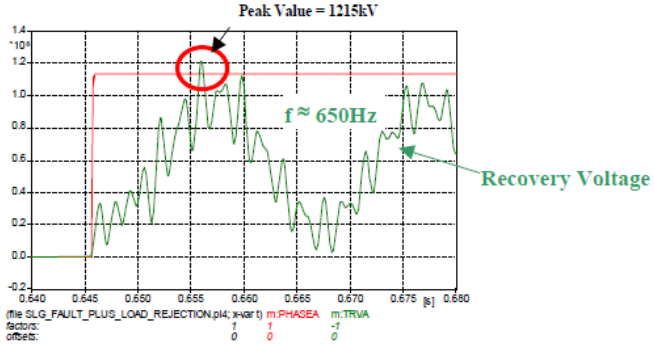
- Specification also required that TRV be specified in as per IEC62271-100 except for first-pole-to-clear factor of 1.5 for all test duties.
  - TRV peak value stated as 624 kV and pole clearing factor of 1.3,
  - 720 kV for a pole clearing factor of 1.5 in line with IEC 62271-100 values assigned for 420 kV rated equipment.
- As per customer specification, first pole to clear factor of 1.5 required for TRV of circuit breaker to meet insulation requirements. Circuit breaker had to be rated for peak TRV of **943 kV**.
- The rated insulation levels of the high voltage equipment shall be as follows as per IEC62271-203:
  - Lightning impulse withstand voltage (BIL) 1550 kV phase to phase & phase to earth
  - Switching impulse withstand (SIL) 1175 kV phase to earth & across switching device

Simulation

- The BIL level was determined by a Power System Study of the entire 400 kV network system, and the results found were equivalent to IEC specified values.



Busbar and line Voltages on phase A (fist pole to open) at Moneypoint end

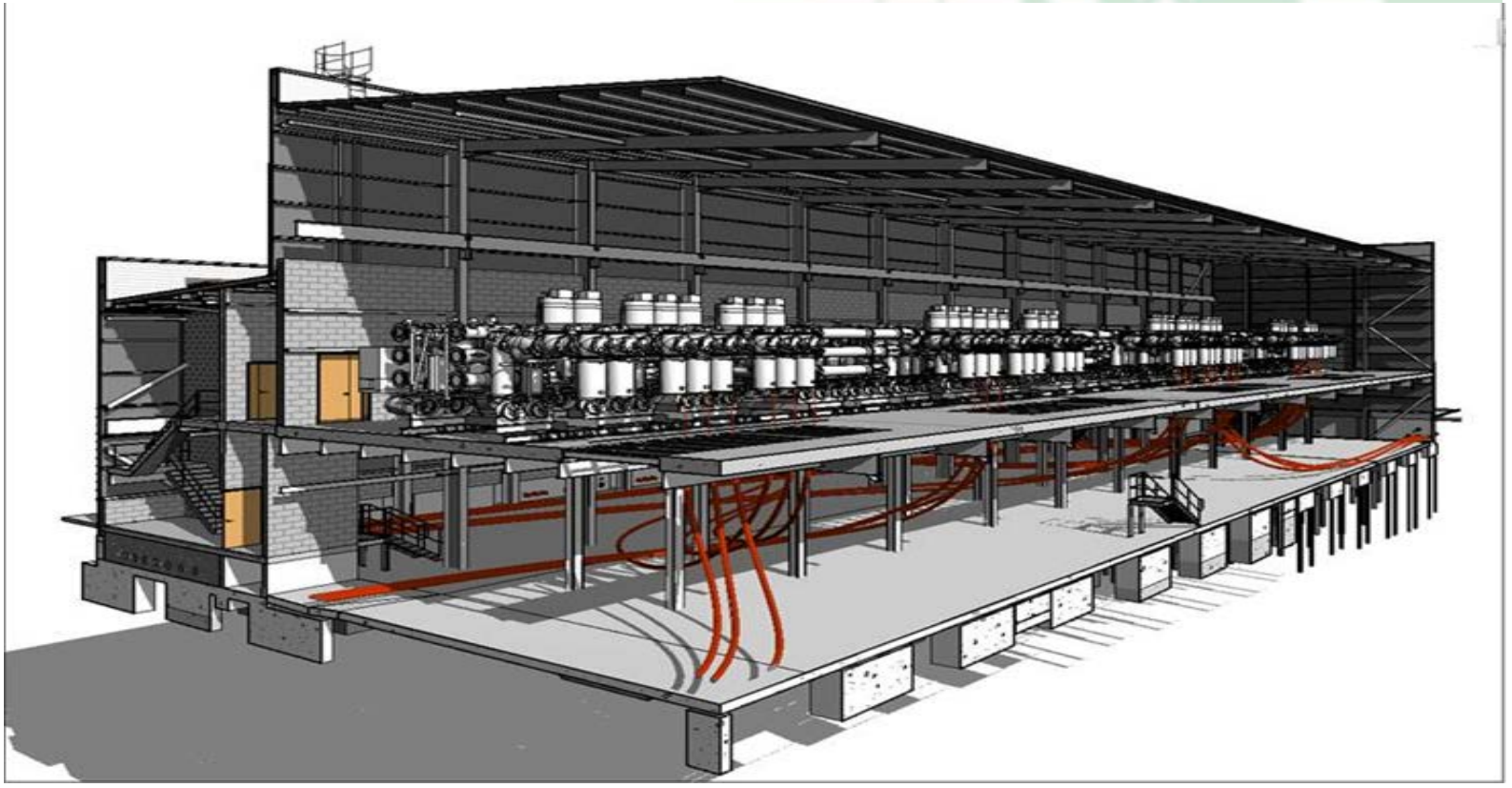


Recovery Voltage across Moneypoint CB pole, Phase A (interrupting line charging current)

- Above - Simulation Results

BIM

- Revit a BIM (Building Information Modelling) software package was used to design GIS building and switchgear supplier's 3D model was inserted into this package.



Building cont'd

- With the compact GIS largely assembled off-site, 3D model of building and GIS allowed positioning the switchgear in the building, ensuring correct alignment of cable openings, avoiding HV cable clashes, ensuring access for maintenance and that measuring devices like pressure gauges and position indication displays were easily accessible once the switchgear was assembled on site
- Model also used at weekly project design meetings
  - to review civil building design in 3D and to enable all design disciplines to feed in to the building design process and review collectively design issues that could not be foreseen on a simple 2D model.

INSTALLATION OF SWITCHGEAR

- GIS delivery to site over a ten week period, two bays per shipment.
- Due to GIS preassembly off site, a full bay, excluding voltage transformers and cable boxes was transported in one unit.
  - Each bay offloaded from truck on to designated landing area, transport packaging removed, craned on to the temporary rails on the landing platform.
  - Then each bay pushed in by hand to its designated position by manufacturer's track and rail system.
  - Bays, once in position, were coupled together.
  - Due to preassembly, significant time savings gained, installation considerably faster than traditional 400 kV switchgear that's not delivered preassembled to site.
  - On average two/three days to install each bay and a further one/two days to couple adjoining bays together.

Equipment Installation

Switchgear being moved into position

Delivery of switchgear

Installation cont'd

- Further benefits of GIS preassembly off site included reduction in safety risks on site, reduced assembly of heavy components and working at height requirement.
- Also, reduction in the manpower required on site.
- With bay offloading from the delivery truck to inside the switchroom on day of delivery, no requirement for large storage area for the GIS material.
- GIS accessories, eg. tools, cable boxes and VT's stored underneath landing platform and in switchroom itself.
- Compared to previous 220 kV 20 bay installation - same site - 650 boxes stored externally, additional site security needed,
- Careful coordination to ensure all equipment was available when required.

Installation cont'd

Conclusion

- 400 kV GIS installed and passed the HV test in 2015.
- The 400 kV substation is currently being commissioned with a planned energisation date in Q3 2016.
- GIS chosen met the technical requirements for the Irish 400 kV transmission system and due to its compact nature resulted in programme and financial savings for the project.