Case Study - 80 kA Gas Insulated Substation
Bergen Switching Station - New Jersey

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Agenda

- PSE&G facts
- History of Bergen Switching Station
- GIS is the answer
- GIS ratings and design
- Installation phases
PSE&G Facts

- Public Service Electric and Gas Company (PSE&G) is New Jersey’s largest electric and gas utility and has been in business for 110 years

- PSE&G serves 2.2 million electric customers and 1.8 million gas customers

- The service territory is home to 70% of New Jersey’s population and has a peak summer load of over 11,000 megawatts

- PSE&G has 245 switching stations and substations covering the range of voltages from 4-kV to 500-kV

- Until 2011 PSE&G had no Gas Insulated Substations (GIS) in service
History of Bergen Switching Station

<table>
<thead>
<tr>
<th>1950</th>
<th>1970</th>
<th>2010 - 2013</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constructed as 138-kV straight bus station</td>
<td>230-kV, 2 bay breaker and a half AIS was built - non-interconnected - Stand alone</td>
<td>New transmission lines and new generation was driving increased fault duties</td>
</tr>
<tr>
<td>2 x 138-kV transmission lines</td>
<td>Later interconnected to the PSE&amp;G 230-kV system via several 230-kV lines</td>
<td>Merchant transmission line into New York City required the rebuild of the station</td>
</tr>
<tr>
<td>Output from a -2 unit coal fired gen station (2 x 325 MW) - 138-kV/26-kV 120 MVA sub transmission station - 26-kV/4-kV 30 MVA distribution station</td>
<td>PSEG started to convert the system from 138-kV to 230-kV</td>
<td>80 kA fault duty was required for ultimate station design</td>
</tr>
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GIS is the Answer

- Wetlands difficult for AIS permitting
- Very active and heavily loaded station
- Substantial part would need to be built and energized to permit cutovers
- With growing load and the interconnection to New York City this station requires highest security and reliability level
- Surrounded by major roadways

A GIS solution would meet all requirements
230 kV/ 80 kA GIS – Technical Overview

- Arc assist switch units and spring/spring drives
- Remote TV monitoring of disconnects/ ground switches
- SF6 central monitoring
- UHF partial discharge measurement equipped
- Flat layout mimics AIS

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>Rated voltage</td>
<td>245 kV</td>
</tr>
<tr>
<td>Nominal operating voltage</td>
<td>230 kV</td>
</tr>
<tr>
<td>Rated current</td>
<td>4000 A Breakers and Bay (Main Bus 5000 A)</td>
</tr>
<tr>
<td>Frequency</td>
<td>60 Hz</td>
</tr>
<tr>
<td>BIL</td>
<td>1050 kV</td>
</tr>
<tr>
<td>Short circuit duty</td>
<td>80 kA</td>
</tr>
<tr>
<td>Date of construction / service year</td>
<td>2012/2013</td>
</tr>
<tr>
<td>Number of circuit breaker positions</td>
<td>31</td>
</tr>
<tr>
<td>Switching scheme</td>
<td>9 breaker and a half bays, 4 section breakers</td>
</tr>
<tr>
<td>Type of encapsulation</td>
<td>Single phase (Isolated Phase Bus)</td>
</tr>
</tbody>
</table>
Laying the Foundation

- Foundation on 400 steel piles 80 – 100 ft deep
- Cable raceways embedded in concrete slabs
- 3’6” ft concrete
- 220 ft x 100 ft
- Control building 60 ft x 80 ft
Erecting the Building

- Metal frame building with steel panels
- Translucent upper panels
- Two cranes each 5 tons
- Hurricane wind resistant
GIS Installation

Installation of the 31 breaker positions

Two teams working from inside out

Preassembly of components shortened installation time
Platforms to Access Equipment

Erection of permanent platforms to eliminate unsafe climbing when accessing equipment
Gas Insulated Bus Sections

GIB assembly coordinated with outages of the existing substation (left)

Total single phase GIB length 8200 ft
Bergen Switching Station

Conclusion

An 80 kA high performance GIS delivers energy to the New Jersey and New York Metropolitan Area

Milestone in PSE&G’s history as innovator

Significant adjustment for people and processes within PSE&G, AIS to GIS

The Bergen Switching Station demonstrates GIS capabilities where AIS solutions are limited