Swansea North GSP incl. associated 132 kV network

Network Development Report – South Wales

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Electricity Distribution

nationalgrid

Contents

Swansea North GSP & Associated 132 kV Network

1. Network Overview

Swansea North Grid Supply Point (GSP) is the largest of nine GSPs in South Wales and is supplied from the interconnected 275 kV and 400 kV National Grid network. The group supplies a total of 345,000 customers and a further 23,000 customers in the SPEN (Manweb) Aberystwyth and Rhydlydan areas. The existing connected demand and generation at Aberystwyth and Rhydlydan is modelled; however the analysis does not account for projected demand growth on other Distribution Network Operator (DNO) areas.

This network is normally run standalone and has ten outgoing 132 kV circuits supplying numerous Bulk Supply Points (BSPs), whilst also benefiting from points of interconnection to Pembroke GSP, Pyle GSP and Upper Boat GSP. Swansea North GSP comprises three 240 MVA 400/132 kV SGTs, two 180 MVA 275/132 kV SGTs and an interconnecting 400/275 kV SGT.

Under intact network conditions, Swansea North GSP normally operates with three 240 MVA SGTs and one 180 MVA SGT in service which results in a total transformer capacity of 900 MVA.

Swansea North GSP currently has a maximum demand of 541 MVA and under NGED's DFES Best View scenario this is projected to rise over 791 MVA by the year 2034.

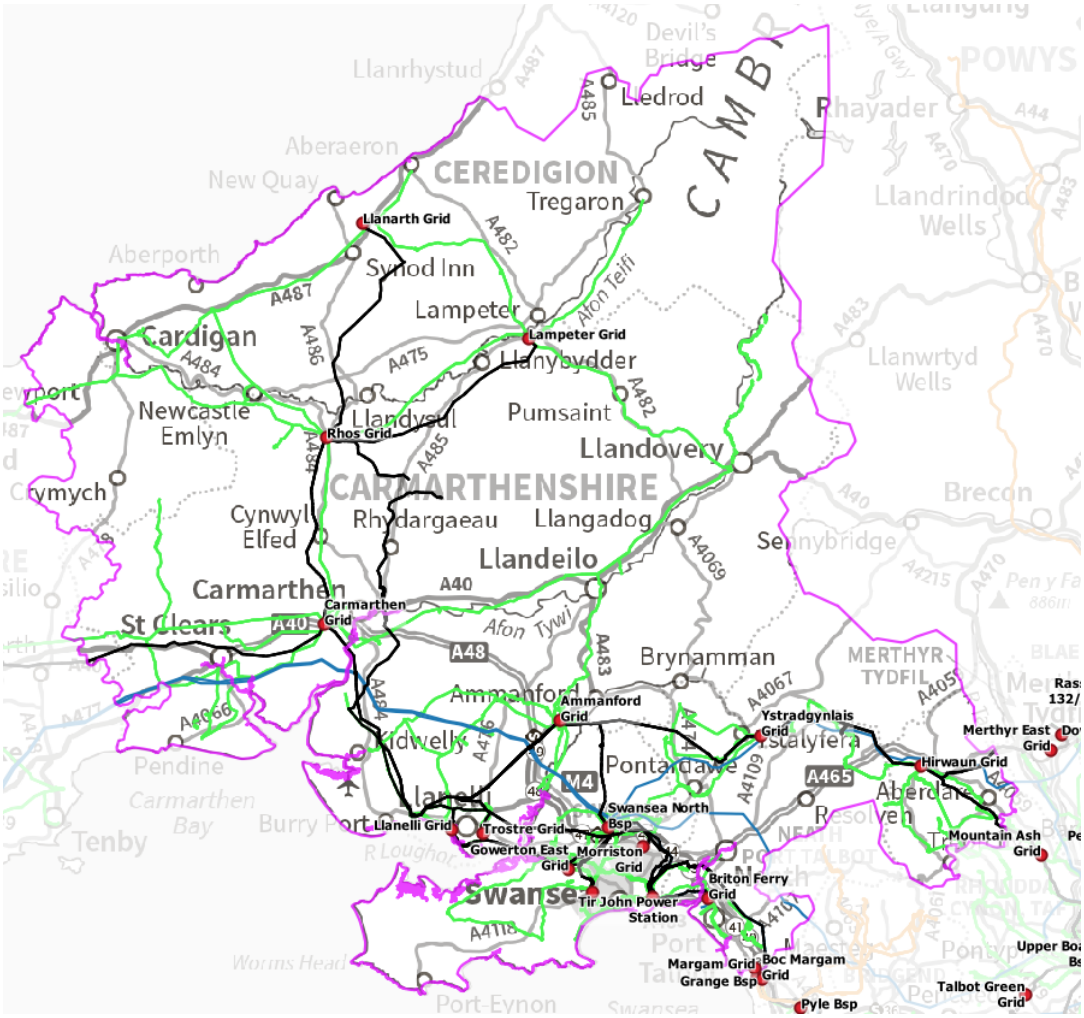

Figure 1.1 - Swansea North GSP geographic network coverage

This report discusses all existing and future network constraints over a 0-10 year horizon associated with the 132/33 kV transformers and 132 kV circuits which supply and are supplied by Swansea North GSP. This uses the methodology outlined in the Network Development Plan Methodology Report with Network Operability Modelling applied as outlined below.

For the purposes of this analysis the NGED Best View Distribution Future Energy Scenario (DFES) has been used to study the years 2022 (baseline), 2028 and 2034, with consideration given to how proposals could change under the other scenarios. The two most onerous half-hours have been studied for each of the five representative days considered: Winter Peak Demand, Intermediate Warm Peak Demand, Intermediate Cool Peak Demand, Summer Peak Demand and Summer Peak Generation.

1.1 Network Topology

The Swansea North 132 kV network is arranged as follows:

- At Swansea North GSP, there is a 400 kV double busbar that supplies three 240 MVA 400/132 kV Super Grid Transformers (SGTs), SGT5, 6 and 7. On a separate 400 kV circuit, there is a 400/275 kV SGT4A which feeds a further two 275/132 kV SGTs (SGT3 and 4B).
- The five 132 kV connected SGTs supply a 132 kV double busbar arrangement. This 132 kV board runs with a bus section split with SGT5 and SGT6 connected to the Main 1 and Reserve 1 bars and SGT3 and SGT7 connected to the Main 2 and Reserve 2 bars.
- Ten outgoing 132 kV circuits from Swansea North GSP supply the following Bulk Supply Point (BSP) substations: Carmarthen, Llanarth, Lampeter, Ammanford, Rhos, Morriston, Tir John, Briton Ferry, Ystradgynlais, Hirwaun, Llanelli, Trostre, Gowerton East and Swansea West.
- Swansea North GSP has three local 132/33 kV Grid Transformers fed directly from the 132 kV double busbar arrangement within the GSP compound, supplying a 33 kV network.

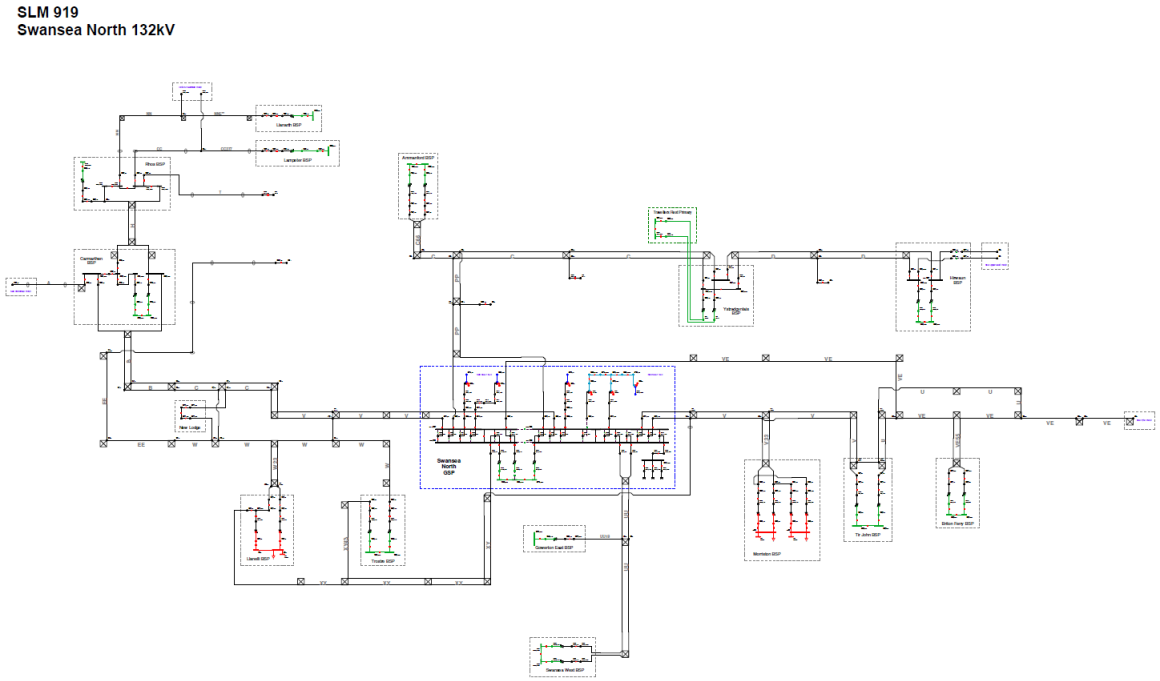

Figure 1.1.1 Swansea North 132 kV network single line diagram

1.2 Network Operability Modelling

The following network automation and manual switching schemes have been modelled in the analysis of this area, aligning to how the network is currently operated.

- SGT3 is currently run on hot standby with an auto-close scheme in place to operate for the loss of any of the remaining SGTs.
- For an arranged outage of either SGT5, SGT6, SGT7 or SGT4A, the 132 kV double busbar arrangement is to be run solid with the remaining three SGTs running in parallel.
- Pyle GSP and Swansea North GSP are run independently at 132 kV, with the VE-route circuit offering interconnection between the two GSPs, which is held normally open on line breaker 405 at Pyle GSP. This is to support the Pyle group for a Pyle SGT outage.
- Upper Boat GSP and Swansea North GSP are run independently at 132 kV, with the D-route offering interconnection between the two GSPs, which is held normally open on line breakers 305 and 405 at Hirwaun BSP. Interconnection is primarily used to improve supply security.
- Pembroke GSP and Swansea North GSP are run independently at 132 kV, with the A-route circuit offering interconnection between the two GSPs, which is held normally open on line breaker 405 at Haverfordwest BSP.
- For an arranged outage of an SGT at Pembroke or for the loss of two of the three 132 kV circuits between Pembroke GSP and Milford Haven 132 kV, this interconnecting circuit (between Haverfordwest 405 and Carmarthen 805) is switched in to parallel Swansea North and Pembroke at 132 kV. The circuit breaker at Haverfordwest is fitted with overload protection, which is intended to operate when the circuit loading is above 500 A (Definite Time (DT), 3 seconds), a condition which could happen for a double SGT outage Second Circuit Outage (SCO) condition at Pembroke GSP.
- Due to the 132 kV interconnection afforded between both GSPs, in a similar manner, for an arranged outage of the circuit between Swansea North-Carmarthen-Rhos (which is carried on numerous 132 kV circuits), the normally open A-route circuit between Carmarthen and Haverfordwest is switched in to provide support to the Carmarthenshire network from Pembroke. When this arranged outage is followed by a circuit fault between Carmarthen and Llanelli, both of the 132 kV circuits from Swansea North to Carmarthen are lost and the group is entirely fed via Pembroke at 132 kV.
- For the loss of an infeed to a transformer at any of the primaries fed from within the Swansea North 132 kV network under arranged outages, the lower voltage side circuit breaker is opened to prevent back-energisation.
- Curtailment of all connected load management schemes within the group are modelled at a variety of outage conditions, as outlined in customer connection agreements. In addition to such sites that are required to participate in a Swansea North GSP Transmission Active Network Management (TANM) scheme to manage the reverse power flow through the associated SGTs.
- Various winter arranged outages not permitted due to SCO overloads.
- Various SCO overloads solved by network reconfiguration for arranged outages.

2. Summary of Network Constraints

The following constraints were identified for the Best View Scenario, for which mitigation options will be discussed:

- Demand Security compliance for the West Wales 33 kV network

3. EHV Reinforcement Schemes Progressing

The following list contains the EHV reinforcement schemes that are currently in active development in this area to overcome a number of constraints facing the network, these include:

- Establishment of a new 400/132 kV Grid Supply Point (GSP) in the Llandyfaelog area.
    - Seven BSP substations are expected to be transferred across from Swansea North. Five from the West Wales 33 kV network: Ammanford, Carmarthen, Rhos, Llanarth and Lampeter. Two from within the SP Manweb licence area: Aberystwyth and Rhydlydan.
    - Llandyfaelog GSP and all associated works required to facilitate this reinforcement scheme have been included in all studies from 2028 onwards.
- Establishment of a new 400/132 kV Grid Supply Point (GSP) in the Hirwaun area.
    - Two BSP substations are expected to be transferred across from Swansea North: Ystradgynlais and Hirwaun.
    - Hirwaun GSP and all associated works required to facilitate this reinforcement scheme have been included in all studies from 2034 onwards.
- It is proposed that all three GSPs will operate independently under intact network conditions.

4. Network Constraint Details and Solution Options

4.1 Swansea North 132 kV Group

The table below summarises the scale of the demand and generation forecast to connect to the Swansea North 132 kV network up to 2034 under NGED's DFES Best View scenario.

Table 4.1.1 Maximum demand forecast to connect to the Swansea North 132 kV network

DFES Scenario	Demand		
	Baseline	2028	2034
Best View	541 MW	674 MW	791 MW

By 2034, this figure takes into account an additional 30 MW due to the anticipation of hydrogen electrolysis projected to connect in this area.

Table 4.1.2 Maximum generation forecast to connect to the Swansea North 132 kV network

DFES Scenario	Generation		
	Baseline	2028	2034
Best View	475 MW	807 MW	1148 MW

With several new developments proposed to connect within the group at 132 kV, 33 kV and at 11 kV in the near future, the demand and generation forecast is expected to increase. However, this will vary depending if such developments materialise.

These figures comprise the entire Swansea North group as it is currently configured. The establishment of proposed GSPs neighbouring this group will share these growth projections.

4.2 Demand Security compliance for the West Wales 33 kV network

Constraint Overview

Generation | Demand

The table below outlines the nature of the network constraints identified in the network analysis, with the worst overloads seen at winter peak.

Table 4.2.1 constraint(s) and condition under which constraint occurs

Constraint	N-1 Condition	Subsequent N-2 Condition	First studied year constraint is observed in each season under Best View			
			Winter	Int Cool	Int Warm	Summer
Required demand restoration under P2	A Main 1 or Main 2 132 kV outage at Carmarthen BSP	The remaining 132 kV circuit into Carmarthen BSP	2026	2027	2028	n/a

Uncertainty under other Distribution Future Energy Scenarios: Under the Leading the Way scenario the thermal constraints are forecast by 2025, under Consumer Transformation by 2025, under System Transformation by 2026 and under Falling Short by 2028.

Solution Options

A list of each of the options considered for this constraint is given in the table below.

Table 4.2.2 solution options to solve constraint(s)

Solution Options	Description	Solves Constraint	Wider Benefit	Potential to be cost effective	Viable or Discounted
0	No Intervention	×	×	×	Discounted
Reinforcement					
1	Construct a third 132 kV circuit	✓	✓	✓	Viable
Operational Mitigation					
2	Transfer demand at 33 kV	×	×	×	Discounted
Load Management Schemes					
3	Post-fault transfers	×	×	×	Discounted
Flexibility services					
4	Procure flexibility across the group	✓	×	✓	Viable

Solution Development

These options have been assessed on their technical viability and their likely cost-effectiveness pending a full cost benefit analysis (CBA). This CBA will be subsequently carried out by the DNO to determine the optimal reinforcement solution, which will then be tested against market provided flexibility by the DSO as part of the Distribution Network Options Assessment (DNOA) process.

Option 0 – No Intervention

Capacity Released for constraint(s) considered: 0MVA — Discounted

Detailed description: Doing nothing to mitigate the constraint would result in overloads for the conditions described above. This would lead to an inability to meet the Security of Supply requirements of Engineering Recommendation P2 for the West Wales 33 kV group.

New limiting factor for constraint(s) considered: N/A

Option 1 – Construct a third 132 kV circuit

Capacity Released for constraint(s) considered: 100 MVA+ — Viable

Detailed description: Of the seven grid transformers (eight by 2028 – see West Wales Report section 1.1) in the West Wales 33 kV Group, five (six) are normally supplied by just two 132 kV circuits into Carmarthen BSP. This is not including the demand of the Manweb network which is also connected to this network. There is a third 132 kV circuit from Pembroke GSP however it is possible that the arranged outage would prevent the use of this circuit. Whilst it is possible that the

132 kV at Carmarthen could be rearranged to improve this constraint, a better solution would be to build a third 132 kV circuit into the group from Swansea North GSP.

Fortunately 132 kV connected generators have brought with them circuit sections radiating from Swansea North GSP and Rhos BSP respectively which pass within 1,300 m of each other. By joining the two together, a 132 kV circuit between Rhos BSP and Swansea North GSP could be created. Some additional 132 kV busbar and switchgear works will be required to ensure the topology is satisfactory.

New limiting factor for constraint(s) considered: A fully rated 132 kV circuit being available in service following the N-2 will likely allow the group to grow towards P2 Class E (300 MW) without further unresolvable P2 concerns. Network integrity concerns within the group (see West Wales report) will subsequently be more pressing.

Option 2 – Transfer demand at 33 kV

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: This network area does not have adequate 33 kV transfers available and the adjacent networks are both quite distant and have constraints of their own.

New limiting factor for constraint(s) considered: N/A

Option 4 – Post-fault transfers

Capacity Released for constraint(s) considered: 0 MVA

Discounted

Detailed description: As with Option 2, there are inadequate available transfers to provide a long term solution

New limiting factor for constraint(s) considered: N/A

Option 6 – Procure flexibility across the group

Estimated Flexibility Required (MVA): 110 MVA by 2034 (Best View)

Viable

Detailed description: Flexibility services could be procured to alleviate projected overloads and could defer reinforcement. Given the complexity due to constraints in the wider area and the desire for a single solution, some degree of Flexibility could be quite practical. It is unlikely that flexibility will provide an enduring solution due to the magnitude of the requirement.

Solution Recommendation

It is recommended to fashion the third 132 kV circuit between Swansea North GSP and Rhos BSP however flexibility may well be useful for deferring or enabling the works to be undertaken.

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