Coleraine Capacity Upgrade

Needs Report

November 2025

Castlereagh House, 12 Manse Road, Belfast BT6 9RT
Telephone: +44 28 9079 4336 • www.soni.ltd.uk

Version	Purpose of document	Authored by	Reviewed by	Approved by	Review Date
1	Needs Report	Mark Irwin Graduate Engineer, Networks NI Rónán Davison-Kernan, Senior Lead Engineer, Connections & Strategy	Michael McClure, Manager,Future Networks	Eimear Watson, Head of Function, Networks Gerard Carlin, Director, Networks & Innovation	November 2025

1 Table of Contents

2 Summary

There are two 110/33 kV transformers at Coleraine Main Substation, both of which are rated at 60 MVA. There is 119 MW of generation connected to the 33 kV substation at Coleraine, consisting mostly of wind. Currently the substation is made N-1 secure through wind generation constraints and also through the use of a Special Protection Scheme (SPS) which trips the 42 MW Dunbeg wind farm in the event of the unplanned loss of one of the 110/33 kV transformers. For planned transformer maintenance, the wind farms are constrained on a pro-rata basis.

A need has been identified to increase the 110/33 kV transformer capacity at Coleraine due to:

- the high existing connected generation capacity relative to the existing transformer capacity; and
- the risk of a large voltage step when the SPS operates under a high wind scenario.

3 Introduction

There is a significant capacity of generation, largely renewable generation, connected to the distribution network throughout the north and west of Northern Ireland. This capacity will increase to comply with the legal target of delivering 80% of electricity from renewable energy sources (RES-E) by 2030 set in The Climate Change Act (Northern Ireland) 2022.

As this generation capacity increases, the flow of power from generation connected to the distribution system onto the transmission system will increase. Coleraine Main is a Bulk Supply Point (BSP) which is an interface between the transmission and distribution systems. There is already a significant quantity of generation connected to the distribution network downstream of this BSP.

This project was not originally included in the SONI Transmission Development Plan for Northern Ireland (TDPNI) 2023-2032 as the project was initiated after the freeze date of that document. However, it has been included in the Draft TDPNI 2025-2034.

An overhead image of Coleraine Main 110/33 kV substation is shown in Figure 1 below, with the single line diagram in Figure 2.

Figure 1 - Overhead image of Coleraine Substation. Transformers outlined in red

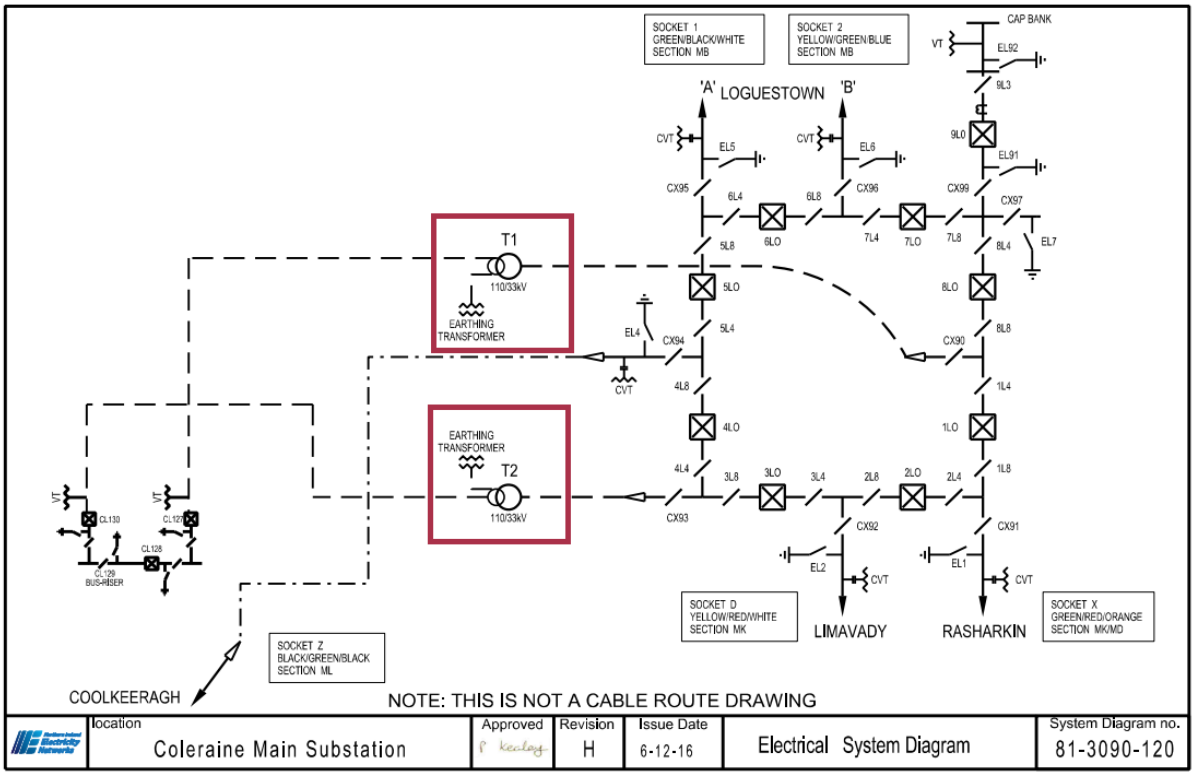

Figure 2 Single Line Diagram of Coleraine Main Substation (Transformers Highlighted)

Currently there are five large scale wind farms connected on the 33 kV (distribution) side of Coleraine Main substation. These are listed in table 1 below along with their Maximum Export Capacities (MEC).

Table 1 - Large Scale Wind Farms Connected at Coleraine Main

Large Scale Wind Farms	Maximum Export Capacity	
	MW	MVA (assuming 0.95 PF)
Dunbeg	42	44.2
Gruig	25	26.3
Dunmore	21	22.1
Garves	15	15.8
Rigged Hill	5	5.3
Total	108	113.7

Table 2 shows the total connected and committed generation capacity connected to the Coleraine distribution system, including both small-scale and large scale generation.

Table 2 - Installed and Proposed Distribution Connected Generation at Coleraine Main

Technology Type	Current Generation Capacity (MW)
Large Scale Wind	108
Small Scale Wind	9.6
Small Scale Solar	0.4
Small Scale Biomass	0.9
Small Scale Hydro	0.6
Total	119.5 (125.8 MVA)

The current generation capacity is significantly higher than the firm transformer capacity of 60 MVA. The risk of an unplanned transformer outage is managed through constraints and a SPS which trips Dunbeg in the event of a loss of a 110/33 kV transformer at Coleraine Main.

Dunmore, Gruig, Rigged Hill and Garves windfarms have received full Firm Access Quantity (FAQ) which is currently resulting in high constraint costs due to the insufficient transformer capacity at Coleraine. These costs are set to increase after the remaining wind farm (Dunbeg) becomes firm in the future. The Associated Transmission Reinforcement (ATR) for these units is the new North-South interconnector, which will give full FAQ to many generators across Northern Ireland, including Dunbeg wind farm at Coleraine. This highlights the priority and need for increased generation capacity.

For a planned transformer outage, the large-scale wind at Coleraine is pre-fault constrained on a pro-rata basis.

The current and future demand at Coleraine can be seen in the forecast in Table 3 below.

Table 3 – Coleraine Main Demand Data from TYTFS 2024

Bus Code	Bus Name	Power Factor	Demand Forecast (MW) – Winter Peak									
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
COL (N)	Coleraine	0.99	39.28	39.32	39.83	41.48	42.44	42.9	43.7	44.54	23.23	47.02
Bus Code	Bus Name	Power Factor	Demand Forecast (MW) – Summer Valley									
			2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
COL (N)	Coleraine	0.99	11.5	11.52	11.67	12.15	12.43	12.56	12.8	13.04	6.8	13.43

Demand at Coleraine is lower than the capacity of the transformer, and given the capacity of the generation connected at Coleraine, it is unlikely there will be firm capacity issues related to increasing demand. Rather, the issues are related to reverse power flows resulting from the low minimum demand with respect to the output of the 33 kV connected generation.

The minimum demand at Coleraine in 2024 was 11.5 MVA, and the potential reverse power flow is calculated as follows:

$$Capacity = Installed\ Generation - Minimum\ Demand$$

$$107.6\ MVA = \ 119.1\ MVA - 11.5\ MVA$$

As the minimum demand occurs overnight, any contribution from PV generation is discounted.

The calculation shows that there is 107.6 MVA potentially flowing from 33 kV to 110 kV which exceeds the firm capacity of the 60 MVA Coleraine transformers by 51 MVA.

4 Transmission Network Issues

With installed generation capacity less the minimum demand greater than the rating of the 110/33 kV transformer at Coleraine means that controllable renewable generators must be either pre-fault constrained or tripped for the loss of a transformer to mitigate overload risks under low load and high renewable conditions. This remains the case even after the operation of the SPS which trips Dunbeg wind farm.

The maximum cyclic overload rating of the existing Coleraine transformers is 72 MVA in Winter (depending on operating regime). This is significantly lower than the potential flows seen in Section 3 above. Although these potential flows or 100% wind would be extremely rare, a 90% output of wind generation during low load periods could see flows in excess of 72 MVA on the transformer even after operation of the SPS. Any further increase in generation capacity at Coleraine (whether small scale or large scale) or a decrease in demand could present a risk of a transformer overload during periods of low load, in the absence of either pre-fault constraint or an expanded SPS.

Small scale generation cannot be added to the SPS as it would not be economically feasible to install the required means of communication and control. Furthermore, existing generation cannot retrospectively be added to the SPS as this would reduce their network access. There would therefore be an increased need for constraint of large scale controllable generation to manage this issue, with associate constraint costs.

5 Distribution Network Issues

Ballymoney West 33/11kV primary substation is fed by two parallel 33 kV circuits from Coleraine Main and supplies 9,723 customers in the town of Ballymoney and surrounding rural areas in County Antrim. Gruig wind farm (25 MW) and Garves wind farm (15 MW) are directly connected to the same 33 kV network via the 33 kV overhead mesh at Ballymoney West.

With approximately 3.57 MW of connected and committed generation connected to the 11 kV network supplied from Ballymoney West, reverse power flows onto the 33 kV network are currently mitigated by the substation's minimum electrical demand. At present, local generation supplies the local demand and reduces the potential magnitude of reverse power flow. With ongoing customer energy efficiency drivers and the increase in customers wishing to install non-export generation, erosion of this local demand is resulting in increased reverse power flows. In a reduced load based scenario, if a fault occurred on one 33 kV circuit, the thermal rating of the remaining 33 kV circuit from Coleraine Main will be exceeded during periods of high generation output from Gruig wind farm.

NIE Networks have an allowance to address this issue under their RP6 price control to construct a third 33 kV circuit. However, challenges in design and consenting have delayed this and presented a need to consider other options.

6 Conclusions

The connected generation capacity at Coleraine is significantly higher than the substation's firm capacity, which is resulting in high constraints of wind generation and requiring the use of a SPS to prevent a risk of transformer overload. This SPS does not allow any additional generation to connect at Coleraine without risking transformer overload. Currently this is masked by existing backbone network constraints but these will be resolved by future transmission network reinforcement. In the absence of taking action at Coleraine, wind generation will have to be constrained specifically to prevent a transformer overload. Increasing capacity here is also unlikely to be chargeable to any proposed generators as such a reinforcement can only be charged to a connecting customer if the need for reinforcement still exists when all other flows are ignored (as per section 5.2 of the SONI Transmission Connection Charging Methodology Statement), which is not likely.

There are also issues with wind farms embedded in the 33 kV network downstream of Coleraine that could lead to overloading risks on the Coleraine distribution system. It may be possible to address this issue with works at transmission level.

The options to address the issues identified here will be examined in an accompanying Options Report.