TRANSPOWER

Review of Generating Unit Risk when Connected in Groups

This document summarises the need to classify the risk of a group of generating units being simultaneously disconnected and proposes a Credible Event Review update for industry feedback.

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Contents

Executive Summary

Increasingly, generation units are being connected in groups such as a string of wind turbines, photovoltaic panels or battery cells. If a fault along this string causes the protection scheme to open the circuit breaker, then all connected generating units will be simultaneously disconnected from the station bus.

As per clause 12.1A of the Policy Statement, we as System Operator have examined this risk and created a new credible event with classification of Contingent Event (CE). This introduces a new category of risks considered in our reserve management tool and may result in instantaneous reserve procurement costs being allocated to stations with a group of generating units exceeding 60 MW capacity.

Following industry feedback, all participants with existing or commissioning generating units (including BESS) are required to self-identify any groups of generating units within their stations and report the MW capacity of each group. The System Operator will be available to support participants through this self-identification process. This new credible event will be implemented by 31st October 2025 and included in the next Policy Statement update due by June 2026.

1.0 Introduction

1.1 The need for a review of generating unit risk

Increasingly, generation units are being connected in groups such as a string of wind turbines, photovoltaic panels or battery cells. These units are often connected in series, with a single circuit breaker connecting them to the station bus. If a fault along this string causes the protection scheme to open the circuit breaker, then all connected generating units will be simultaneously disconnected from the station bus. The risk of this occurring is not currently captured as a Credible Event which only classifies the loss of a single generating unit as a credible event.

As per clause 12.1A of the Policy Statement, we as System Operator have examined this risk and proposed a new credible event with classification of Contingent Event (CE) for industry consultation.

2.0 Key Concepts

2.1 Definitions

Generating unit means all equipment functioning together as a single entity to produce electricity.

Lines means works used or intended to be used to convey electricity.

Main protection scheme means a system that detects one or more types of faults and electrically disconnects a faulted asset from the grid.

First zone of main protection means the first main protection system which will operate to clear a fault.

A **group of generating units** means any line or combination of lines owned by a participant to which at least two generating units are connected, where operation of the first zone of main protection would disconnect all connected generating units, following a fault on any of the generating units or the power system components connecting the generating units to the station busbar.

2.2 Risk Management Policies

As System Operator, we must seek to manage the outcomes of events that may cause cascade failure. We achieve this by identifying potential credible events on the power system from asset failure that may result in cascade failure, these are then assessed to estimate the likely risks based on the potential impact on the power system. Credible events and their classifications are listed in the Risk Management Policies section of the Policy Statement.

3.0 Risk Management Policies

3.1 Overview of existing Risk Management Policies

Following is an extract of Transpower's Policy Statement, this section discusses the Risk Management Policies identified within the Credible Event Review process. Clause 12.1.1 lists the power system components which may result in cascade failure if lost, including the loss of a single generating unit or a transmission circuit. Once identified as credible events, these are then categorised as Contingent Events, Extended Contingent Events or Other Events, each with their own quality targets and mitigation methods.

12. The system operator must seek to manage the outcomes of events that may cause cascade failure by:

*12.1 Identifying potential credible events (each an 'event') on the power system that may result in cascade failure, either as a result of **asset** failure or the inability to maintain **system stability** following a disturbance. At the date of this **policy statement** the **system operator** has identified the following credible events that may result in cascade failure, due to these events causing quality and/or power flow outcomes exceeding **asset** capability*

12.1.1 The loss of one of the following power system components:

- *a **generating unit**; or*
- *…*

3.2 Limitations of existing Risk Management Policies

Historically, most generating stations on the New Zealand power system contained a few generating units, each with their own main protection scheme. The single line diagram (SLD) in Figure 1 below shows an example hydro generating station with two hydro generating units, G1 and G2.

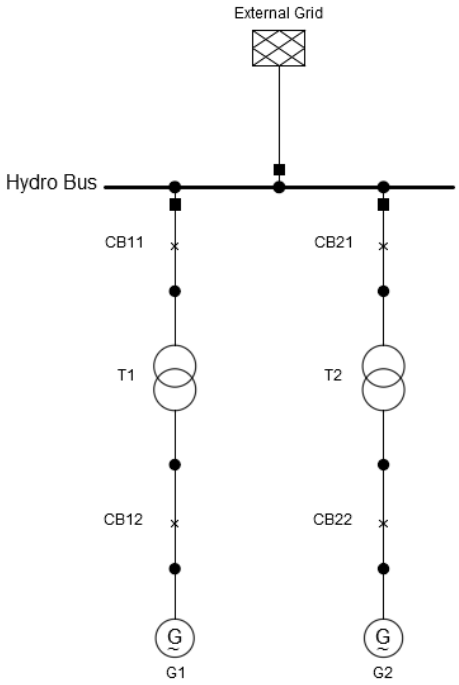

Figure 1 – Example SLD of a hydro generating station

Inverter based generating units are increasingly common and usually have a common connection point and common main protection scheme for multiple generating units. The single line diagram (SLD) in Figure 2 below shows an example wind farm station with six wind turbine generating units, G1-3 are connected to the bus via String 1, while G4-6 are connected to the bus via String 2.

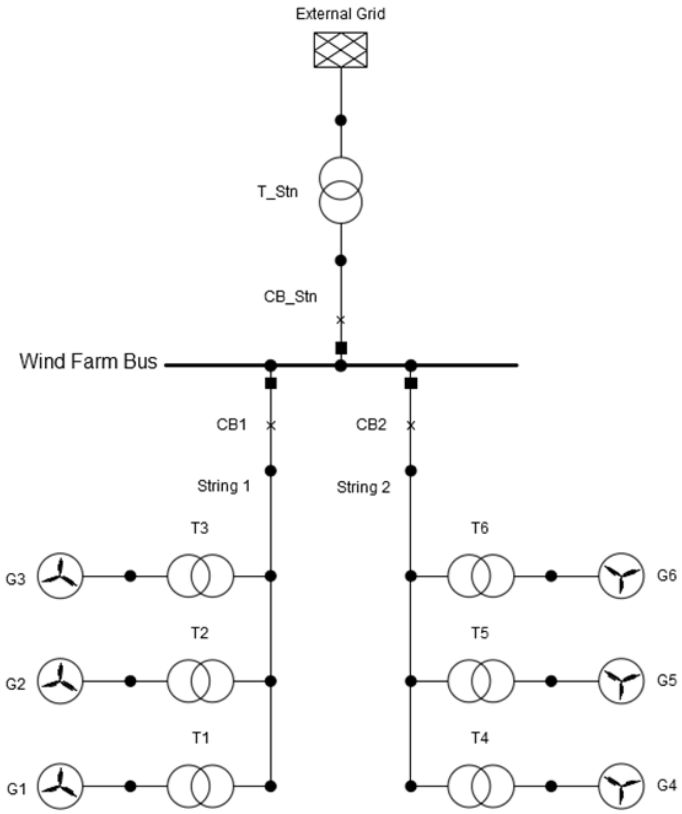

Figure 2 – Example SLD of a wind farm generating station

If circuit breaker CB1 has a main protection scheme, a fault on G1 would cause CB1 to open disconnecting G1-3. Following this logic, it is clear the risk management policy of treating the loss of a single generating unit as the credible event is not accurate for stations with large numbers of inverter based generating units.

3.3 Proposed update for Risk Management Policies

This report proposes a new credible event, the loss of a group of generating units. The proposed changes are highlighted in yellow.

*12. The **system operator** must seek to manage the outcomes of events that may cause cascade failure by:*

*12.1 Identifying potential credible events (each an 'event') on the power system that may result in cascade failure, either as a result of **asset** failure or the inability to maintain **system stability** following a disturbance. At the date of this **policy statement** the **system operator** has identified the following credible events that may result in cascade failure, due to these events causing quality and/or power flow outcomes exceeding **asset** capability:*

12.1.1 The loss of one of the following power system components:

- *a **generating unit**; or*
- *a **group of generating units**; or*
- *…*

*12.4 Categorising, at the date of this **policy statement**, the following credible events:*

- ***Contingent events**:*

a) …
*c) The loss of a single **generating unit**.*
d) …
*i) The loss of a **group of generating units**.*

Glossary of Terms

*167A. **First zone of main protection** means the first **main protection system** which will operate to clear a fault.*

*169AA. A **group of generating units** means any line or combination of lines owned by a **participant** to which at least two **generating units** are connected, where operation of the **first zone of main protection** would disconnect all connected **generating units**, following a fault on any of the **generating units** or the power system components connecting the **generating units** to the station busbar.*

3.3.1 Implications of proposal

The examples below show the effect this addition will have on different generating stations.

Figure 3 shows an example wind farm generating station, for this example the generating units G1-6 are 5 MW each.

Example A: If circuit breaker CB1 has a main protection scheme, this would be the first zone of main protection for the power system components on String 1 because it would operate before the main protection scheme at the station circuit breaker, CB_Stn. In this case a fault on any of the power system components on String 1 would cause CB1 to open, disconnecting G1-3.

The generating units G1-3 are categorised as a group of generating units and the risk associated with its loss is 15 MW.

Example B: If circuit breakers CB1 and CB2 do not have main protection schemes and are simply circuit breakers which can be manually opened for maintenance, the first zone of main protection for the power system components on String 1 and 2 would be located at the station circuit breaker, CB_Stn. In this case a fault on any of the power system components on String 1 or 2 would cause CB_Stn to open, disconnecting G1-6.

The generating units G1-6 are categorised as a group of generating units and the risk associated with its loss is 30 MW.

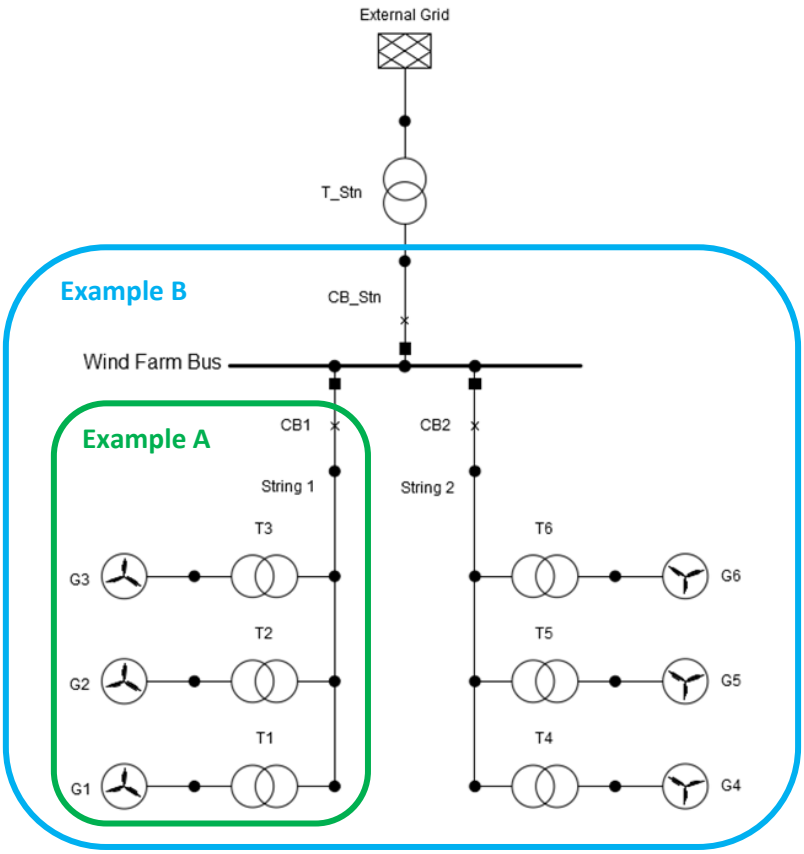

Figure 3 – Example of different main protection schemes for a wind farm generating station

Figure 4 below shows an example solar and battery energy storage station, for this example the solar PV units PV1-4 and BESS units BESS1-4 are 5 MW each.

Example C: If circuit breaker CB1A has a main protection scheme, this would be the first zone of main protection for the power system components on String 1A because it would operate before the main protection scheme closer to the bus at CB1. In this case a fault on any of the power system components on String 1A would cause CB1A to open, disconnecting PV1-2 and BESS 1-2.

The generating units PV1-2 and BESS1-2 are categorised as a group of generating units and the risk associated with its loss is 20 MW.

In this example there is a section of line between CB1A and CB1, namely String 1, which could also experience a fault and would result in both String 1A and 1B being disconnected. Where this configuration exists in a station, the System Operator will perform an analysis with considerations for type of line (cable/overhead line), environmental exposure, etc to determine whether it should be included for identifying a group of generating units. If the length of this section of line is less than 500 m, it will normally be excluded for the purposes of identifying a group of generating units.

Example D: If circuit breakers CB1A and CB1B do not have main protection schemes, the first zone of main protection for the power system components on Strings 1A and 1B would be located closer to the bus at CB1 because it would operate before the main protection scheme at the station circuit breaker, CB_Stn. In this case a fault on any of the power system components on String 1, 1A or 1B would cause CB1 to open, disconnecting PV1-4 and BESS1-4.

The generating units PV1-4 and BESS1-4 are categorised as a group of generating units and the risk associated with its loss is 40 MW.

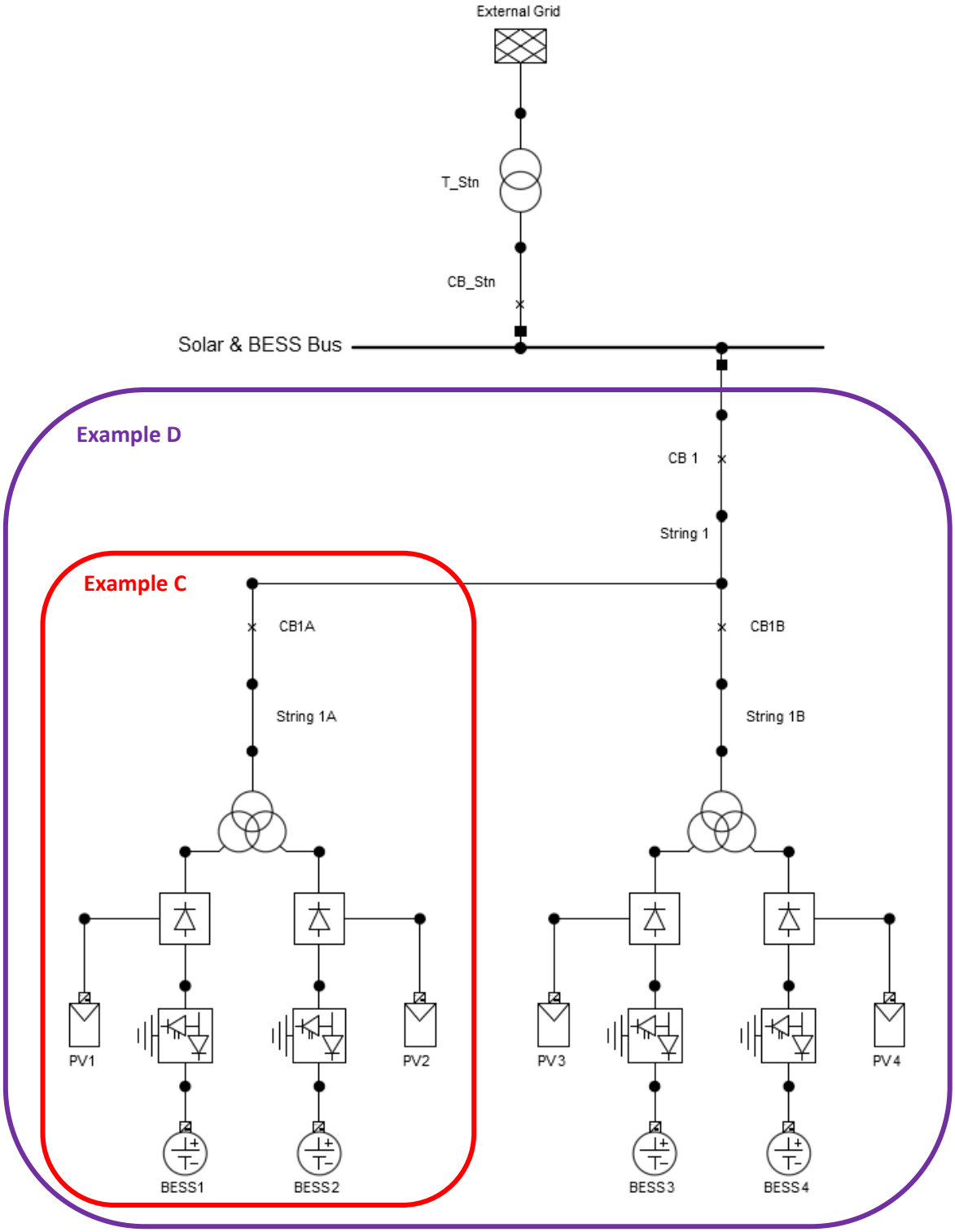

Figure 4 – Example of different main protection schemes for a solar & BESS generating station

Figure 5 below shows an example hydro generating station, for this example the generating units G1-2 are 50 MW each.

Example E: If circuit breaker CB11 has a main protection scheme, this would be the first zone of main protection for the power system components connecting G1 to the station busbar. In this case the definition of a group of generating units does not apply because operation of the first zone of main protection only disconnects G1. Instead, the risk is captured by the existing 'loss of a single generating unit' event and the risk associated with its loss is 50 MW.

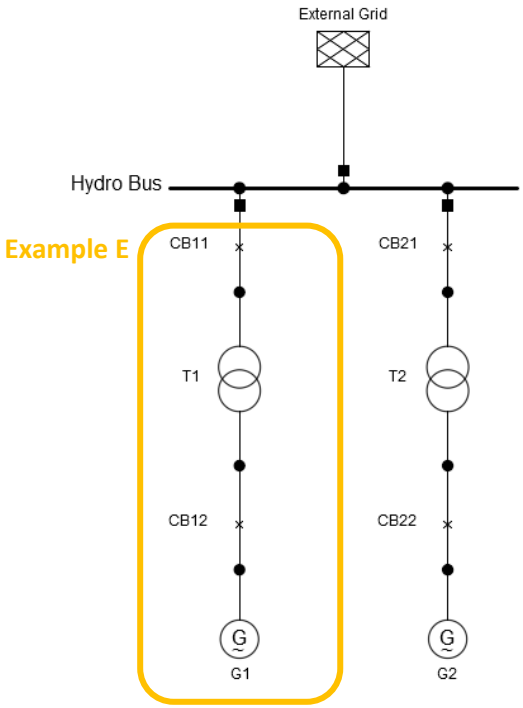

Figure 5 – Example main protection scheme for a hydro generating station

4.0 Conclusion and implementation

This report creates a new credible event for the defined term, group of generating units, to capture the risk of multiple generating units being simultaneously disconnected by a common first zone of main protection. This introduces a new category of risks considered in our reserve management tool and may result in instantaneous reserve procurement costs being allocated to stations with a group of generating units exceeding 60 MW capacity.

Following industry feedback, all participants with existing or commissioning generating units (including BESS) are required to self-identify any groups of generating units within their stations and report the MW capacity of each group. The System Operator will be available to support participants through this self-identification process.

This new credible event will be implemented by 31st October 2025 and included in the next Policy Statement update due by June 2026.