Chapter 3

# Design requirements and considerations

This section outlines key design requirements and issues to consider when designing your plant and preparing a Connection Application. Early consideration of these matters can help avoid redesign and reassessment requirements and support a more efficient connection assessment process.

## 3.1 Voltage Control Strategy (VCS)

### 3.1.1 Transgrid's recommended voltage control strategy

Your Supplementary Report will include details of the recommended VCS and the nominated Voltage Control Point.

#### What you need to do

- Where the nominated Voltage Control Point specified is located on the HV side of a Transgrid substation and the Connection Point is located on the MV side:
  - include all relevant electrical plant and equipment between the Connection Point and the Voltage Control Point – the substation transformers and associated OLTC models, underground cables, overhead lines and substation reactive plant – in the submitted SMIB model.
  - set up the SMIB study to consider historical voltage profiles at both the Connection Point and the nominated Voltage Control Point, together with the applicable OLTC voltage setpoint.
- Where Connection Point differs from the nominated Voltage Control Point, or if the historical voltage data for the Connection Point is not provided, ask for guidance and additional information through the RFI process.

See Section 4.9.3 for further guidance on SMIB case setup.

### 3.1.2 Alternative voltage control location considerations

- To minimise implementation complexity and project delivery risk, design the plant in accordance with the recommended VCS and Voltage Control Point nominated in the Supplementary Report (preferred approach).
- If you intend to propose an alternative Voltage Control Point, such as controlling voltage at the HV side of the project's main transformer rather than at the Connection Point:
  - ensure the proposed alternative is at the same voltage level as the originally nominated Voltage Control Point
  - provide a clear justification for the proposed alternative, including why the recommended approach is not practical.

## 3.2 Plant Capacity and Physical Connection Arrangement

The size of the largest credible contingency is a key consideration in maintaining the security and reliability of the NEM. The current contingency limits are around 700 MW for generation trips and around 500 MW for load trips. During planned outages of certain line sections, multiple BESS units and generators may be at risk of tripping. As a result, FCAS constraints in the NEM will impose limits on their operation.

#### What you need to do

To avoid increasing the size of the largest credible contingency and the associated impacts on power system security, multiple feeders and physical connection points are required when connecting:

- Generating systems with a rated capacity exceeding 700 MW at the Connection Point or
- BESS with maximum demand exceeding 500 MW at the Connection Point

Multiple feeders and connection points ensure that the loss of a single connection asset, busbar, transformer or network element does not result in the simultaneous disconnection of the entire facility.

Your CER will include project-specific requirements and guidance on acceptable connection arrangements to support early consideration of plant connection arrangement.

## 3.3 Power Plant Controller (PPC) design considerations

A PPC malfunction can result in significant and rapid changes to a plant's active and reactive power, potentially impacting power system security and stability. While hardware redundancy can mitigate the risk associated with PPC hardware failures, in certain malfunction scenarios (for example, those caused by software anomalies or configuration errors) the switchover logic designed to respond to hardware failures may fail to activate. This can prevent automatic transfer of plant control to a redundant controller.

### What you need to do

- To reduce the risk of a single point of failure affecting a large proportion of plant output, limit the aggregate installed capacity of production units controlled by an individual PPC to 350 MVA. This requirement applies to both uni-directional and bi-directional plants.
- For connecting plant with an installed capacity exceeding 350 MVA, use multiple PPCs to mitigate the risk of a single controller failure affecting the entire facility. If you are considering using a single PPC, submit your proposed design to Transgrid as soon as possible and obtain approval before proceeding.

## 3.4 Remedial Action Schemes

### 3.4.1 Runback schemes

Network congestion and thermal loading constraints are now managed through AEMO's dispatch processes via the National Electricity Market Dispatch Engine (NEMDE). The use of runback schemes to alleviate network congestion has been discontinued across Transgrid's network, due to increased system security concerns.

### What you need to do

- Do not rely on runback schemes to address network congestion and thermal loading constraints associated with your proposed connection.

### 3.4.2 Transfer trip schemes (TTS)

Transfer trip operation may result in adverse system impacts, including rapid changes in power flows, which can lead to unacceptable voltage disturbances for nearby network users.

Transgrid will only consider a low Short Circuit Ratio (SCR) transfer trip scheme following a credible contingency event (N-1) where:

- The contingency results in an unacceptable low-SCR condition
- Studies demonstrate that a TTS is necessary to maintain system stability and security after all other feasible solutions have been exhausted; and modelAEMO approves the scheme.

Note: if the capacity of existing transfer trip schemes within the Transgrid network is already fully utilised, it may not be feasible to accommodate additional schemes.

Transfer trip schemes or other remedial action schemes are not appropriate solutions for static limitations, such as insufficient reactive power margin to support the transfer of the connecting plant's output.

### What you need to do

- Design, size and tune your plant to operate stably and meet the performance standards for fault levels corresponding to system intact (N) and credible contingency (N-1) network conditions, as specified in the Supplementary Report.
- Do not rely on transfer-trip schemes to propose or demonstrate compliance with Performance Standards, unless agreed by both Transgrid and AEMO.
- Use the CER information to undertake early assessments and identify potential reactive power margin limitations. Early identification will help you to:
  - appropriately size the plant for the proposed network location;
  - understand the risk of constraints being applied under system normal conditions; and
  - investigate alternative solutions, such as increasing the plant's reactive power capability through equipment oversizing or installing additional reactive support equipment to support the desired power transfer to the network.
- While preparing the CA package, if your assessment identifies the need for a TTS, Transgrid must agree the proposed TTS before you finalise tuning and plant design. Ask your Transgrid CPM to connect you with the Network Planning and Network Connections teams for consultation. You will need to provide:
  - relevant studies specified in Section 3.4.2, where applicable.
  - OPDMS study results for credible contingency events (N-1) demonstrating the need for the TTS. This should typically include pre- and post-contingency fault levels at the plant connection point (CP) and nominated nearby system strength nodes, together with relevant study results.

## 3.4.3 the proposed TTS design, including the tripping arrangement (voltage level and sections to be tripped), post-contingency PPC parameters and dispatch considerations, circuit breakers proposed to initiate the TTS, estimated communication delays, and model implementation instructions. Anti-islanding schemes

Sometimes, following a contingency event, the part of the network to which a production system is connected becomes separated from the national grid and forms an island supplying load. In these circumstances, the plant must be automatically disconnected by a local or remote anti-islanding scheme.

### What you need to do

- Use anti-islanding to protect the power system against voltage instability, extreme voltage fluctuations and large frequency deviations.

## 3.5 Submission of multiple connection applications for capacity considered under a Single CER

If you plan to submit multiple Connection Application Submissions covered by a single CER, you need to account for the requirements of the overall facility, even if individual plants will be developed in stages.

### What you need to do

- Use the same fault levels specified for the common Connection Point in each application. The system strength does not change when one or more generating systems are offline.
- Allocate the overall facility limits between individual generating systems as per the guidance in the CPTSR. This includes limits for harmonic voltage emission, negative sequence voltage unbalance and fault current contributions.
- Confirm your proposed allocation with Transgrid before starting detailed studies or preparing Connection Application submissions if you are unsure how the limits should be shared. This will help to avoid unnecessary rework.

## 3.6 Metering design requirements and considerations

Metering arrangements serve different functions throughout the connection process, including market settlement, GPS compliance demonstration during commissioning, R2 model validation and ongoing compliance monitoring, and plant control.

### What you need to do

- Design metering systems to meet the requirements of the NER, relevant AEMO procedures and Transgrid's connection requirements (see Table 3-1, which discusses meters specifically related to GPS performance).
- Contact AEMO and Transgrid's Protection and Metering Design team for further guidance on revenue and to check meter requirements.

Table 3-1 Requirements and functions of meter types

| Meter Type | Description |
|---|---|
| Compliance meters | Should be installed at the Connection Point.<br><br>Transgrid only accepts measurements obtained at the Connection Point for compliance demonstration, unless performance is proposed and assessed at an alternative location under the agreed GPS. Depending on the agreed performance standards, multiple compliance meters may be installed, such as at the Connection Point and other agreed locations as per the GPS.<br><br>Transgrid does not provide measurements from its own metering systems to demonstrate compliance, except in limited circumstances where benchmarking against an applicant's metering may be required.<br><br>For plant with several physical Connection Points with single PPC under single GPS, each physical Connection Point should be individually metered. Facilities should also be provided to obtain real-time total plant measurement.<br><br>For plant with multiple PPCs under single GPS, each PPC output should be individually metered. Facilities should also be provided to obtain real-time total plant measurement.<br><br>CT summation arrangements are acceptable to Transgrid for obtaining total quantities for compliance metering purposes. A design may be submitted with the application package for Transgrid to review |
| Control meters | Used by plant control system to regulate the voltage, active power and reactive power at the Connection Point, or at an alternative location as nominated by Transgrid in the Supplementary Report and specified in agreed GPS. Customer can select a suitable location to install control meters. |

## 3.7 Dispatch Unit Identifier (DUID) Design considerations

DUID requirements are primarily driven by AEMO Registration requirements and can have a significant impact on plant design, control architecture and metering arrangements.

### What you need to do

- Engage with AEMO early in the Connection Process to understand your project-specific DUID requirements.

If you are proposing multiple DUIDs:

- Provide a high-level operational and control philosophy for the facility, together with a preliminary single-line diagram identifying:
  - connection point(s)
  - active power control point(s)
  - Voltage Control Point
  - CT and VT arrangements

- proposed DUIDs
- PPC arrangement.

This information will assist Transgrid in assessing the proposed plant architecture and identifying any connection, control, metering, or compliance considerations at an early stage of the connection process.

- Consider these design requirements:
- Continuous Uninterrupted Operation (CUO) compliance
- As CUO compliance must be demonstrated at the Connection Point, consider the implications of the proposed DUID arrangement and plant control strategy. Your design must demonstrate that CUO compliance can be maintained at the Connection Point under all relevant operating conditions.
- Aggregated Dispatch Conformance (ADC) participation

Hybrid facilities have the option to participate in ADC. See the *AEMO Fact Sheet on Aggregated Dispatch Conformance* for details.

## 3.8 Transformer Energisation Study

Transformer energisation can result in high inrush currents and associated voltage dips that may adversely affect the network and other network users. Early assessment and identification of these potential impacts can influence transformer selection, switching arrangements, energisation methodology, and any mitigation measures required to manage transformer energisation impacts.

### What you need to do

To assess these impacts and identify relevant mitigation strategies:

- Undertake a transformer energisation study in accordance with Transgrid's *Attachment 1 - Transformer Energisation Guideline* in your Data Response – and include the report with your Connection Application submission package.
- If transformer data, connection arrangements, or energisation methodology are updated at the detailed design stage, review the study and, where necessary, repeat it as part of the Registration Capability Assessment.