Stakeholder Information Session

19/08/2020

System Strength Impact Assessment Guideline

Generator and Load Model Guidelines and Change Management Requirements

Agenda

Item	Time
Welcome and introduction	1:30pm – 1:35pm
Overview of draft System Strength Impact Assessment Guidelines	1:35pm – 1:55pm
Q&A session on draft System Strength Impact Assessment Guidelines	1:55pm – 2:15pm
Overview of draft Model Guidelines	2:15pm – 2:35pm
Q&A session on draft Model Guidelines	2:35pm – 2:55pm
Wrap up session and next steps	3:00pm

Welcome and Introductions

- Reserve questions for the Q&A session after each document overview
- Project specific questions will not be discussed and are to be taken offline
- The guidelines have been developed in general alignment with existing practices in NEM and SWIS guidelines

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System strength impact assessment guidelines

Purpose: the *System Strength Impact Assessment Guideline* (SSIAG) provides guidance on undertaking system strength impact assessments (SSIA) to determine if proposed changes to generating systems connected to one of PWC's Regulated Networks will cause adverse system strength impacts.

An SSIA is triggered when a:

- connection enquiry or application to connect is made via clause 3.3 of the Network Technical Code (NTC), or
- request to alter an existing generating system is made via clause 5.3.9 of the NER (NT).

In essence, the SSIA process followed for PWC's Regulated Networks is not different from "Do no harm" framework followed in NEM.

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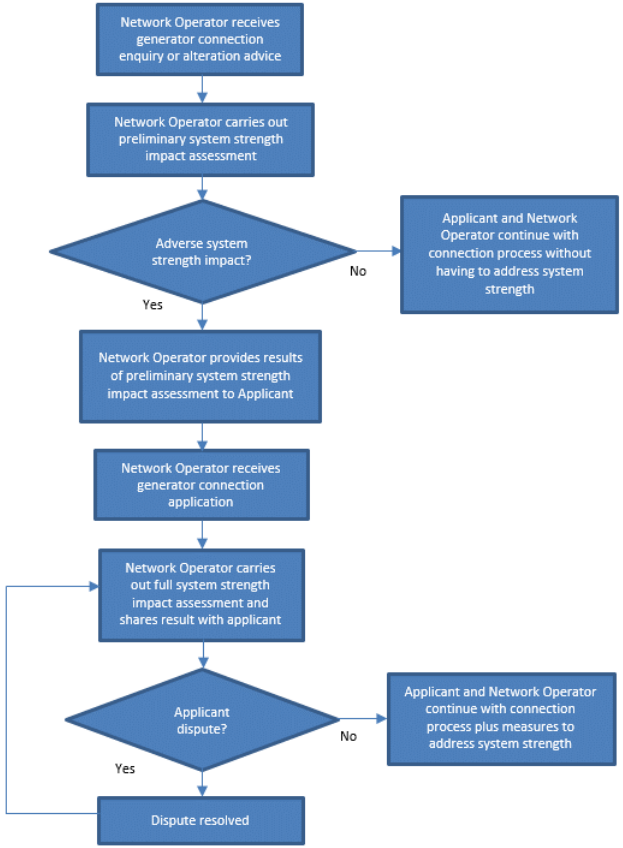
System Strength framework



These guidelines recommend a two stage system strength impact assessment:

1. A Preliminary Impact Assessment (PIA).
2. A Full Impact Assessment (FIA).

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Adverse system strength impacts

Adverse system strength impacts are operating characteristics that prevent the power system from maintaining a secure operating state under all operating conditions.

The key factors assessed for adverse system strength impacts are:

- **Power system stability –** system stability impacts with or without credible contingencies.

  Adverse power quality interactions, control system interaction or control system instabilities caused by a relevant generator connection or alteration can cause a breach to Section 16 – Stability Criteria of the NTC.
- **Generation system stability –** stable operation is determined by whether it can meet its performance standards at any level of power output (MW) under all credible operating scenarios.
- **Network service facility stability –**stable operation is determined by reference to whether it can meet its performance standards under all credible operating scenarios.

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Identifying adverse system strength impacts

System strength is measured by reference to the available Synchronous Three Phase Fault Level at the point of connection in the network, assuming that the power system is operated within secure operating limits.

The NO must consider whether the following outcomes may arise from the proposed generator connection or alteration, resulting in an adverse system strength impact:

- Existing generating systems unable to meet any aspect of their performance standards, due to the generator that is proposed to be connected or altered
- Proposed generator connection or alteration unable to meet its proposed performance standards
- Network stability cannot be maintained in accordance with Section 16 of the NTC
- Reduced ability for a network to supply load that cannot be fully restored by reducing the active power of the proposed generator to zero, while all existing generating units within the system remain connected to the power system.

There is no materiality threshold below which an impact may be disregarded when determining the need for a system strength remediation scheme or system strength connection works.

Summary of system strength obligations

Network Operator (NO)	Power System Controller (PSC)	Applicant
• Undertake SSIA to evaluate whether the proposed changes to generating systems will have adverse system strength impacts. • Assessment must consider inputs from the PSC.	• Provide operating scenarios to the NO for the SSIA.	• Provide the NO with an EMT model detailing their generating system and proposed alteration before the full impact assessment is undertaken.
• Advise applicant of the min. 3 phase fault level at the connection point and results of the PIA when responding to an enquiry or notification of alteration. • Advise applicant of any adverse impacts and the results of its full assessment.		
• Determine whether adverse system strength impacts will be addressed by a remediation scheme or connection works. • Ensure the applicant implements any agreed remediation scheme as part of the generation system • Undertake any required connection works.		For remediation: • Pay for connection works undertaken by the NO to address any adverse impact caused by their proposal, or • Implement any agreed remediation scheme and provide evidence to the NO that the requirements are satisfied.

Facilities to be considered for SSIA

The NO must take into account the following types of plant connected (or to be connected) to the same network as the proposed generator connection or alteration :

- all existing networks, generating units and other plant;
- all committed projects for new generating units, generating systems or network service facilities; and
- all proposed network facilities or proposed retirements of network facilities if the consultation period of the project assessment conclusion report during the RIT-T for the proposal has concluded

Preliminary impact assessment (PIA)

- PIA identifies the likelihood of an adverse impact caused by the proposed generator change through a relatively simple metric.
- The PIA is based on steady state analysis, using a limited subset of power system modelling data for the proposed generator connection or alteration, and relies on the MSCR Method.
- MSCR method is based on comparison of the Available Fault Level after the proposed generator connection or alteration against the minimum SCR/fault level. Based on experience in NEM (AEMO) and internationally, the use of a minimum SCR of 3 at the connection point as a screening tool is found appropriate.
- Due to a lack of sufficient data and models used during the PIA, the NO would interpret its SCR outcomes conservatively and deduct 10%; for example, an SCR outcome of 3 should be interpreted as 3 minus 10%, or 2.7, which will necessitate a FIA, giving all parties more confidence in the outcome.

PIA process

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Assess the likelihood of adverse impacts caused by the proposed connection / alteration. Use the MSCR Method.

The NO to consult with the PSC regarding the results of the PIA in a timely way. Consultation to occur prior to a response to an applicant's enquiry.

Via the connection enquiry response advice if FIA is needed. FIA needed if the NO concludes that:

- An adverse system strength impact will exist if the proposed generator connection or alteration proceeds, or
- The PIA is inconclusive

If FIA is required, the NO must provide applicants with:

- Details of the studies undertaken and assumptions used by the NO
- FIA modelling requirements
- Scope of necessary studies required for FIA

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Full impact assessment (FIA)

- FIA determines whether the proposed generator connection or alteration will have an adverse system strength impact.
- FIA employs a wide range of studies and require the use of EMT simulation tools.
- EMT models must meet the Generator Modelling Guidelines, as published by the NO.
- Two major streams of studies:
  1. Contingency induced stability impact assessment
  2. Control system induced stability impact assessment
- Prerequisites of FIA:
  - Network Operator (NO) is satisfied that performance requirements as per clause 3.3.3 of the NTC requirement are met
  - NO has accepted a detailed EMT model
  - NO has received all information from the applicant, and
  - NO and PSC have not objected to any assumptions about the existing plant, to the extent that EMT models are not readily available

FIA process

Assess

NO to undertake:

- Contingency induced stability impact assessments
- Control system induced stability impact assessments

With scenario analysis and considering contingency events

Consult

The NO to consult with the PSC regarding the results of the FIA in a timely way. Consultation to occur prior to a response to an application.

Notify results

NO must advise applicants of outcome of FIA and provide the following information:

- Details of studies undertaken by NO, including all assumptions made
- Modelling details including the extent of the network modelled
- Whether FACTS devices were included, and
- Adequacy of capability under prevailing system strength conditions

Mitigation measures

Adverse system strength impacts can be addressed via Mitigation Measures*:

- **System strength connection works –** these are network solutions.
- **System strength remediation schemes –** these are solutions by generators.

The NO must carry out power systems modelling and simulation studies to demonstrate whether these mitigation activities can mitigate all identified adverse impacts.

NOTE: Plant installed by the NO in the wider network, rather than just at the proposed or altered generating system's connection point, can provide additional benefits and may be subject to agreed cost-sharing arrangements between the Applicant and other parties

*** Mitigation measures are similar to NEM requirements and are at the cost of the proponent in line with "Do no harm" framework**

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Use of post-contingency control schemes

- Post-contingency control schemes have been successful in the NEM and allowed power system operation beyond N-1 security limits.
- These schemes require careful design and assessment to ensure that their operation does not result in other adverse network impacts.
- Any post-contingency control scheme proposal intended to mitigate an adverse system strength impact must demonstrate that the scheme results in no wider power system security or operability impacts.
- Widespread use of such control schemes across a broad network area comprising several generating systems can introduce significant operational risks.
- The veracity of any proposed post-contingency control scheme would not only need to be demonstrated by power system modelling and simulation, but also confirmed by end-to-end commissioning tests.

Questions and Answers

System Strength Impact Assessment Guidelines

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Generator and Load Model Guidelines and Change Management Requirements

Purpose

The Generator and Load Model Guidelines clarify Power and Waters approach to developing and maintaining accurate computer models, and User requirements for the provision of computer models and associated information for new connections or modifications to existing facilities.

In summary, this document is prepared to assist User understand the connection process and requirements.

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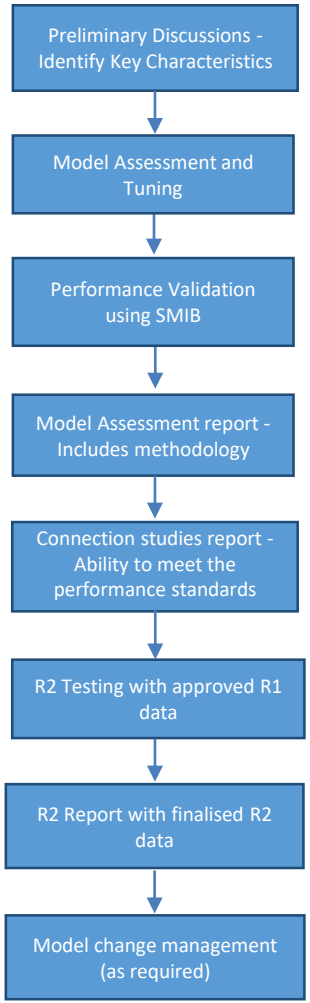
Model Process Flow



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Application

These guidelines apply to all generating systems (including inverter and converter coupled generating units), dynamic reactive control devices and loads, and to both new connections and modifications to existing facilities.

Generating system

- Generally computer model is required to all generating systems with a rating > 2 MW
- Power and Water will assess the requirement of computer models for smaller generating systems. If deemed to be required, the same model requirements as for generating systems > 2MW will apply.

Loads

- Power and Water will assess the load characteristics (including load size, motor composition, harmonic emissions etc.), connection point, and capability of the local transmission or distribution system in the vicinity of the connection point to determine the extent of modelling information required

Model requirement overview

- All models must represent plant full operating envelope
- Must be suitable for short circuit studies
- For non – synchronous generators, harmonic current and flicker emissions must be included
- Loads directly connected to 11 kV or higher and greater than 1 MW should be modelled explicitly. Starting method parameters should be defined. Must include the harmonic emission parameters.

Software requirement

- Generators are required to provide both RMS (Root Mean Square) and EMT (Electromagnetic Transient) models.
- Loads will generally be required to provide sufficient information to appropriately integrate in to PWC regulated network.
- PWC will determine the need for an EMT model for larger loads.

RMS models	EMT models
• RMS models provide a simplified representation of controllers • RMS models are proven for modelling power systems dominated by synchronous generators • In the case of non-synchronous generators, RMS type models are typically not capable of accurately modelling the generators interactions with the power system, in particular under certain conditions including low system strength	• Provide more accurate representation of how the power system will react in various situations, including the fast acting controls and protection systems • All three phases can be assessed separately • In areas of low system strength EMT studies may be required to demonstrate the ability to meet the performance standards.

Model format

RMS model format - DIgSILENT PowerFactory

- Encrypted and native unencrypted version including functional block diagram.
- Encrypted version may be provided to other Users to meet the information provision requirement as per NTC

EMT model format - Power and Water intends to select either DIgSILENT PowerFactory or PSCAD™/EMTDC™

- As the models can be provided to other Users, black box, compiled or encrypted portions of an EMT model are acceptable.

* Power and Water as seeking feedback on EMT model format preference and an reasoning behind preference

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Pre-connection (R1) model assessment

- User should seek details of the characteristics of Power and Water's Regulated Network at the nominated connection point and tune the model to best meet the performance requirements of the NTC.
- Perform a thorough investigation of the suitability of RMS and EMT computer model in a SMIB model.
- Verify Generator capability to meet the performance requirements mainly relying on the RMS model.
- User must provide a complete model assessment report which includes the tuning methodology and the study assessments undertaken to meet the performance requirements.

Model documentation requirement

- Model block diagrams
- Two separate Releasable User Guides for RMS and EMT models
- Equipment data sheets
- Protection settings and model tuning report
- Pre-connection (R1) model assessment report

Due Diligence

- Power and Water undertakes a due diligence assessment (model assessment) of the User supplied computer model to assess its performance against the requirements of the NTC.
- Typical assessment methodology is included in the guidelines.
- PWC will verify the generator's capability to meet the agreed performance standards at all operating levels.

Post-connection (R2) model validation and performance

Pre-requisites for commissioning

- Approved computer models and control system parameters
- Approved test procedures and commissioning plan

During commissioning

- Hold point approvals for each stage before progressing to higher output level

  (This is to ensure that the plant performs as modelled and no negative impact on system security. If plant does not perform as modelled, plant constraints or even disconnection may apply)

Post commissioning

- User submits R2 validated data and models
- R2 data and model validation and performance report
- Continuous monitoring program to demonstrate the model accuracy

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Generator modelling change management requirement

A revised model and supporting documentation is to be provided to Power and Water and will be subject to additional studies to be conducted at User's expense, including in cases where

- Changes during connection process (updates of model code, additional functionality provided with newer versions, etc)
- Proposing to alter a commissioned/operational generating system

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Questions and Answers

Generator and Load Model Guidelines and Change Management Requirements

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Specific Feedback Sought

The Network Operator is interested in receiving feedback on the draft System Strength Impact Assessment Guidelines and the Generator and Load Modelling Guidelines, and would particularly value feedback on the following questions:

- Are the draft Guidelines aligned with the obligations outlined in the Technical Code?
- Does the draft SSIAG provide sufficient detail to enable Users to understand how system strength impact assessments will be conducted and the data and models required for each assessment?
- Do the draft Modelling Guidelines provide sufficient detail regarding model validation and accuracy requirements?
- User feedback is sought regarding whether there is a clear preference between using PSCAD or DIgSILENT PowerFactory for EMT models and the reasoning behind the preference?

Next Steps

- Seek feedback on guidelines – Submissions due 28th August 2020
- Consultation with Utilities Commission progressing in parallel
- Relevant NTC compliance periods will commence following finalization of these guidelines

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