[Project Name]

Steady State Grid Impact Assessment

9th Month Year

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# Revision History

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| --- | --- | --- | --- | --- | --- |
| **Revision** | **Description** | **Author** | **Review** | **Approval** | **Date** |
| F0 | Initial release by OX2 Australia |  |  |  |  |

# Defined Terms

|  |  |
| --- | --- |
| **Term** | **Definition** |
| AC | Alternating Current |
| AVR | Automatic Voltage Regulator |
| DC | Direct Current |
| HV | High Voltage |
| kV | Kilovolt, equivalent to 103 volts |
| LV | Low voltage |
| MVA | Megavolt-ampere, equivalent to 106 volt ampere |
| MVAr | Megavolt-ampere reactive, equivalent to 106 volt-amperes reactive |
| MW | Megawatt, equivalent to 106 watts |
| OH | Overhead Conductor |
| OLTC | Onload Tap Changing/Changers |
| ONAN | Oil Natural Air Natural cooling method |
| OOS | Out of Service |
| PCS | Power Conversion System |
| PF | Power Factor |
| POC | Point of Connection |
| PSS®E | Power System Simulator for Engineering from SIEMENS |
| pu | Per Unit |
| SLD | Single Line Diagram |
| Tx | Transformer |
| UG | Underground Cable |
| UGOH | Underground to Overhead Connection |
| VC | Voltage Control |
| VDC | Voltage Drop Control |
| Vk | Impedance Voltage |
| V1 | Positive Sequence Voltage |
| VnLL | Nominal Line to Line Voltage |
| ZS | Zone Substation |

# Generators Nomenclature

|  |  |
| --- | --- |
| Generator Name | Nomenclature in the report |
| [Project Name Short] | [Project Name] – [Total Plant MW at POC]MWac |

# Executive Summary

[Developer] is proposing to connect [Project Name] ([Project Name Short]) into the [Network Service Provider] network in [Town] [State]. The proposed plant will have a maximum export capacity (active power) of [Total Plant MW at POC] MWac. The connection type will be a [Connection type] connection connecting to the [Network Service Provider] [POC Feeder] with connection point voltage of [Nominal POC voltage (kV)] kV.

This report forms a part of the [Project Name] connection application to [Network Service Provider] and AEMO. This report aims to assess the steady state requirements for the proposed generator. The studies were conducted as per the [Network Service Provider] data pack in [PSSEversion] version. This includes thermal loadings, voltage levels, generation change and loss of line voltage fluctuations, and fault level analysis.

The aim of the report is to

* Provide network modelling and study execution details.
* To demonstrate that the proposed plant will meet the automatic access requirements for steady state reactive power capability.
* To show the proposed plant impact on the network capability.

[Fill In Your Findings]

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# Introduction

## Project Details

[Developer] is proposing to develop [Project Name] ([Project Name Short]) with maximum active power output of [Total Plant MW at POC] MWac in [Town] [State] connecting to [Network Service Provider] network. This report presents the steady state analysis consisting of the following assessment:

1. Reactive power capability
2. Thermal loading assessment
3. Load flow and voltage analysis under system normal and N-1 conditions
4. Fault level calculation for three-phase faults and single phase to ground faults.

[Figure1]

Figure Proposed location of the [Project Name] with [Network Service Provide] network. Source: [Network Service Provider]

## Site Information

Table Site Information

|  |  |
| --- | --- |
| Variable | Value |
| Lot/DP | [Lot/DP] |
| Address | [Address] |
| LGA | [LGA] |

## Connection Details

Table Connection Details

|  |  |
| --- | --- |
| Variable | Value |
| NSP | [Network Service Provider] |
| Supply Area | [Town] |
| Point of Connection Voltage | [Nominal POC voltage (kV)] |
| Feeder Name | [POC Feeder] |
| Relevant Zone Substation | [POC Substation] |

# Model Construction

This chapter’s emphasis is on the input data required and the methodology used to construct the network model integrated with [Project Name]. Software used for the network modelling and the analysis is [PSSEversion].

## Input Data

The network models and the steady state studies are based upon the AEMO summer high and spring low cases together with data outlined in the table below.

Table Input data references

|  |  |  |
| --- | --- | --- |
| Variable | Value | Source |
| PCE Response |  | [Network Service Provider] |
| DCE Response |  | [Network Service Provider] |
| PSS®E Models | High:  Low: | AEMO |
| Steady State Brief |  | [Network Service Provider] |
| RUGS |  | AEMO |
| Inverter/Plant Model |  | [Plant Model] |

## [Project Name Short] Plant Model

## Integration of the [Project Name Short] Plant into the Network

# Generators within proximity

# Study Execution

This chapter outlines the steady state assessment criteria and the methodology employed by the proposed generator to fulfill the criteria.

## Monitored Elements

Following network elements were monitored during the steady state analysis

## Study requirements

The steady state consists of four key components, each of which illustrate the findings of the respective part of the study:

1. Plant reactive power capability
   1. This criterion is based on the reactive power requirement from the automatic access standard S5.2.5.1(a) i.e. that the proposed plant should be capable of supplying or absorbing the reactive power which is at least 0.395 of its intended active power value.
2. Impact on thermal network capability for standard configuration and contingency events
   1. This part of the steady state analysis investigates line loading and transformer loading under network normal and N-1 conditions, with and without the proposed generator. This reveals the pre-existing issues as well as issues caused by the inclusion of the proposed generator.
3. Impact on network voltage capability for standard configuration and contingency events. This part further divided into three parts
   1. The first part looks at Bus voltages under system normal conditions (i.e. no line outages or other contingencies. Adding generation to a bus or a line may shift the voltage levels at that bus or surrounding buses due to the impact it has on the power flows in the area. The normal operating band of the NEM is between 0.9 p.u. voltage and 1.1 p.u. voltage. The results presented in results section will highlight the changes in relevant bus voltages due to the addition of the newly proposed generator.
   2. The second part of this assessment explores voltage fluctuations for a change in the generation output. This includes voltage fluctuations due to generation output variation considering a change from 100% output to 75%, 50% and 25% with all network transformer taps locked. This also includes voltage fluctuations due to trip of the proposed plant, considering a change from 100%, 75%, 50% and 25% output to no output (plant trip) with all the network transformer taps locked. This is quantified and compared against the Table6 IEC 61000.3.7:2012 (p.33) applicable thresholds.
   3. The third part of this assessment focusses on voltage stability under credible contingencies. The voltage changes due to loss of line with fixed tap load flows on the network should not be worse than the system without the proposed plant.
4. The last part of the Steady State analysis investigates Fault current at buses of interest. These fault levels are required to not exceed planning levels. This item is unlikely to be problematic in most instances as the contribution from inverter-based resources behind transformer and cable impedances is generally normally small compared against existing headroom.

## [Project Name Short] steady state grid impact assessment summary

Table [Project Name Short] steady state grid impact assessment summary

|  |  |  |  |
| --- | --- | --- | --- |
| Assessment | Assessment criteria | Notes | Assessment results |
| Generator reactive power capability | Automatic access standard | Tap changers enabled | **Criterion met** |
| Impact on thermal network capability for standard configuration and contingency events | ≤ 100% Thermal limit; or not exacerbated by given exacerbation value from NSP where already>100% | Tap changers enabled | **Criterion met** |
| Impact on network voltage capability for standard configuration and contingency events | 1. Voltage levels between 0.9 to 1.1pu 2. ≤ 3% voltage fluctuations GenChange 3. ≤ 5% voltage fluctuations GenTrip 4. Voltage changes are not worsened with the addition of plant in loss of line contingencies   Note: Existing out of bound voltage fluctuations | Tap changers disabled | 1. **Criterion met** 2. **Criterion met** 3. **Criterion met** 4. **Criterion met** |
| Fault level studies | ≤ Provided fault level limits | NCSFCC for current source generators and ASCC function in PSS®E | **Criterion met** |

# [Project Name Short] Plant Control Strategy and Optimistaion