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Title: **DISTRIBUTION LOSS FACTOR CALCULATION FOR AMCOR GAWLER GLASS FACTORY**

Document Status

Revision	Prepared by	Authorised by	Issue Date	External, Internal or Limited Use
A	Ti-Haur Tan	Ti-Haur Tan	02/03/12	External (Confidential Information Withheld)

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Distribution Loss Factor Calculation

1 Introduction

EnerNOC (formerly Energy Response) is engaged by exempt network operator, Amcor Packaging (Australia) Pty Ltd (APENO) as an intermediary for Amcor's Gawler Glass Factory's embedded generators which are registered as non-scheduled market generators in the National Electricity Market (NEM).

Three embedded generators are connected to APENO's exempt network within the Gawler plant – one generator for each of the 3 stages (production lines) in the glass factory.

The underlying distribution loss factor (DLF) calculation methodology used herewith is the same as that used in Energy Response's earlier Distribution Loss Factor Calculation Methodology (Rev 00C) dated 17/2/2009.

This document will form an addendum to Energy Response's earlier document as mentioned above.

1.1 AMCOR GAWLER EXEMPT NETWORK SERVICE

Figure 1 below shows the location of various connection points within the exempt network.

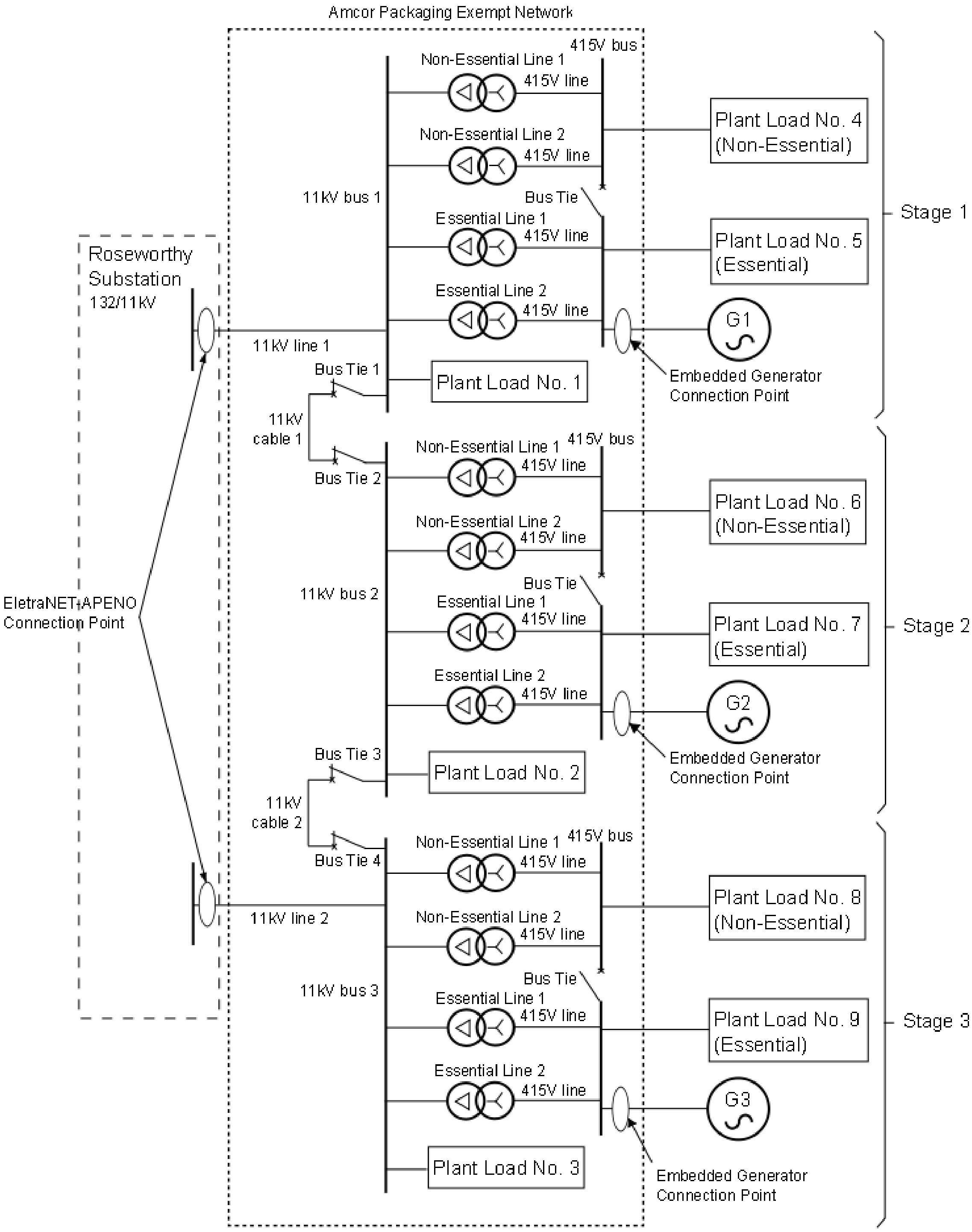

Figure 1 - Simplified representation of the APENO exempt network

1.2 GENERATOR OPERATING STATES

The embedded generators on APENO's exempt network will not be running continuously. They will be run as a peaking plant, in response to high spot prices in the South Australian market. Extrapolating from historical market data, we expect this to be 20-80 hours per year, and would be surprised if it exceeded 150 hours. The generators may also be run at ElectraNET's request to relieve network constraints, or as part of an AEMO reserve programme, or under AEMO's direction. They will also continue to be run for test and maintenance purposes, and as required for plant operations.

Amcor Gawler Glass Factory has a fairly consistent energy consumption profile 24 hours a day, 7 days a week, and 365 days a year. This is confirmed by the historical meter data obtained from the ElectraNET-APENO connection point, as well as from the plant's Energy Management System records. An energy consumption profile of the plant for the period 1 Jan 2011 till 31 Dec 2011 is provided as Attachment 1 to this document.

For the corresponding one-year period, the 3 embedded generators ran for a total of less than 15 hours each. Based on metered generator output, when instructed to run:-

(a) Stage 1 generator, on average, supplied 603kW to Stage 1 Essential Switchboard;

(b) Stage 2 generator, on average, supplied 953kW to Stage 2 Essential Switchboard;

(c) Stage 3 generator, on average, supplied 946kW to Stage 3 Essential Switchboard.

(On each Essential Switchboard, 100kW load is still supplied by the grid as a buffer to prevent reverse power from the embedded generator to the grid in the event of sudden load drops; hence the average connected loads on each Essential Switchboard are 703kW, 1053kW and 1046kW respectively.)

The Marginal Loss Factor for the embedded generator connection points is calculated based on the net reduction in distribution losses within the APENO exempt network when the generators run.

2 Amcor Gawler Generator DLF Calculation

2.1 IDENTIFICATION OF DISTRIBUTION LOSSES

Based on the layout for APENO's exempt network as shown in Figure 1, the distribution losses were derived as follows:-

2.1.1 11kV Incomer Network (Stage 1, Stage 2 & Stage 3)

The main contributions to losses on the 11kV incomer network have been identified as follows:-

- Copper Losses across the 11kV cables from the Roseworthy substation to the 11kV switchboard
- Copper Losses across the 11kV cables connecting the bus ties between Stages 1, 2 & 3 11kV Main Switchboards
- Copper Losses across the 11kV Main Switchboard Incomer and Bus Tie Circuit Breakers

It has been assumed that negligible losses are developed across the 11kV main switchboard busbars; therefore those losses are ignored.

2.1.2 Essential Line No. 1 & No. 2 (Stage 1, Stage 2 & Stage 3) - 11kV Feeder, 11kV/415V Transformers, 415V Busduct & 415V Incomer

The main contributions to losses on the Essential Lines No. 1 & No. 2 have been identified as follows:-

- Copper Losses across the 11kV Main Switchboard Feeder Circuit Breakers
- Copper Losses across the 11kV cables from the 11kV switchboards to the 11kV/415V transformers
- Copper Losses across the transformer winding
- Iron Losses in the transformer core
- Copper Losses across the 415V Busduct from the transformer to the 415V Essential Switchboard
- Copper Losses across the 415V Essential Switchboard Incomer Circuit Breakers

It has been assumed that negligible losses are developed across the 415V essential switchboard busbars; therefore those losses are not considered.

Attachment 2 lists the technical details obtained from Amcor Packaging (Australia) Pty Ltd.

3 Modelling of Distribution Losses

Based on the sources of losses identified in (2.1), we can calculate the parameters for the equivalent network model of the APENO exempt network as detailed in Attachment 1 and Attachment 2.

The load flow on the 11kV Incomer Network loop can then be calculated using the Superposition Theorem to find the current values across the elements of the network.

Subsequently, the equivalent network as referred to 11kV can be obtained as shown in Figure 2 for load flow with generators stopped; and Figure 3 for load flow with generators running.

(NOTE: Cable, busduct & transformer inductances are not included in the equivalent network because we are only interested in the active power losses of the APENO exempt network.)

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4 Calculation of Distribution Loss Factors

We can arrive at the distribution losses without and with generators running as follows:-

[Confidential Network Information Withheld]

4.1 MLF & DLF Calculation

We can obtain the MLF for the embedded generator connection points as follows:-

MLF = **1.0059**

[Confidential Network Information Withheld]

Converting the MLF to DLF:-

DLF = $\sqrt{(1.0059)}$

= **1.0029**

References

1 Distribution Loss Factor Calculation Methodology for Amcor Gawler Glass Factory (Revision 00C) dated 17/2/09 EMB-DLF-GLR-01

Version Management

Version	Date	Reason For Change	Author	Approved
A	02/03/2012	First issue	Ti-Haur Tan	Ti-Haur Tan

ATTACHMENT 1: Summary of Amcor Gawler Plant Consumption Details for the period 1/1/2011 till 31/12/2011

[Confidential Network Information Withheld]

ATTACHMENT 2: Amcor Gawler Plant Technical Details

[Confidential Network Information Withheld]