TransGrid

TransGrid's Submission to the Australian Competition & Consumer Commission

Revised Transmission Capital Investment Program 2004-2009

Attachment 6F

Background Related Planning Process for Major Network Developments

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BACKGROUND RELATED PLANNING PROCESS FOR MAJOR NETWORK DEVELOPMENTS

DISCUSSION PAPER

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BACKGROUND RELATED PLANNING PROCESS FOR MAJOR NETWORK DEVELOPMENTS

1. INTRODUCTION

The process for developing backgrounds and then carrying this through to establishing a forward capital budget was set out in TransGrid's discussion paper "Development and Application of a Set of Backgrounds Forming the Basis for the Future High Voltage Network Augmentation Program", dated 5th August 2004.

The development of backgrounds requires consideration of, inter alia, the load forecast and possible scenarios of generation development in NSW and other states. Preliminary thoughts on what the backgrounds may constitute were set out in TransGrid's discussion paper "Preliminary Backgrounds Affecting Main System and Interconnection Developments", dated 30th August 2004.

This discussion paper provides detail on the process being used for the major network developments in translating the backgrounds to a stream of reinforcement projects. One example is used to illustrate the process.

2. COMPONENTS OF THE BACKGROUNDS

Each background has the following main components:

- A state load level for each winter and summer over 10 years;
- A set of new power stations or generator upgrades at defined locations, occurring in defined years; and
- A set of interconnector upgrades occurring in defined years.

The load forecast over 10 years is set out in TransGrid's APR 2004.

The new power stations or generator upgrades are defined in the second of the above discussion papers. It should be noted that the backgrounds that are being applied may need to be varied from those in the discussion paper as further thought is given to potential generation scenarios and taking into account recent comments by the ACCC on the paper.

The set of interconnector upgrades is also defined in the second of the discussion papers.

3. OVERALL PROCESS

The overall planning process applied to any single background is shown in broad terms in Figure 1 below. In practice the process may be abbreviated according to the judgement of the planning staff. For some localised developments it is possible to narrow the focus to particular years where there is known to be a shortcoming in the network capability. Similarly for some of the major development projects the past planning work has already identified the conditions under which network reinforcement may be required and hence the system conditions that need to be examined are more limited.

Step 1

The State summer and winter load forecasts are similar and the focus is generally placed on summer loadings. In step 1 one or a number of years will be selected for planning analysis. Each of these load periods are examined in turn.

Step 2

A set of base system conditions or cases is formed corresponding to each background, each year to be studied and each pattern of power flows in the system.

> *There are 37 backgrounds at present:*
>
> > *Up to say 5 selected summers to about 2009/10 are analysed*
> >
> > > *For each summer there may be say 2 or more critical patterns of generation and interconnection flow*

This implies that up to 370 base cases are involved. Hence the process is abbreviated to system conditions of interest according to planning judgement.

The inputs to the system model are:

(a) A network model with parameters for each transmission element derived from standard data. The network model may represent the local network, the NSW main system or the four-state NEM as appropriate for the planning problem.

(b) Loads at each node in the network. The APR load forecast is translated to a load at each node in the network.

(c) The generation and interconnection pattern is assigned in the model based on generator capability and known dispatch patterns and interconnector capability.

(d) Any network developments that are already committed are represented in the network model.

Step 3

Each base case is analysed with respect to a small set of critical network contingencies to assess its adequacy. The level of detail here is variable according to judgement.

The analysis may include:

(e) Power flow analysis to test the loading of network elements against their rating. Reactive power analysis to determine voltage control limitations in the system may also be required.

(f) Dynamic analysis, particularly with respect to performance of interconnections.

Step 4

The shortcomings of the system are identified. In some situations more detailed analysis of a shortcoming is required to define the extent of the problem and help identify appropriate remedial measures (g).

Step 5

Where the system has shortcomings a small number of possible options to reinforce the network is compiled. These are based on a number of considerations including:

- the nature of the system shortcoming;
- technical feasibility and a preliminary view of physical feasibility; and
- long-term requirements of the system

The main options are scoped out to allow costing.

Step 6

In some situations the options may need to be subjected to further planning analysis to examine how well the option meets the system requirements (h). Each option may also be further assessed in planning with respect physical feasibility and environmental acceptability (i). At this stage of the process this will be a judgement only.

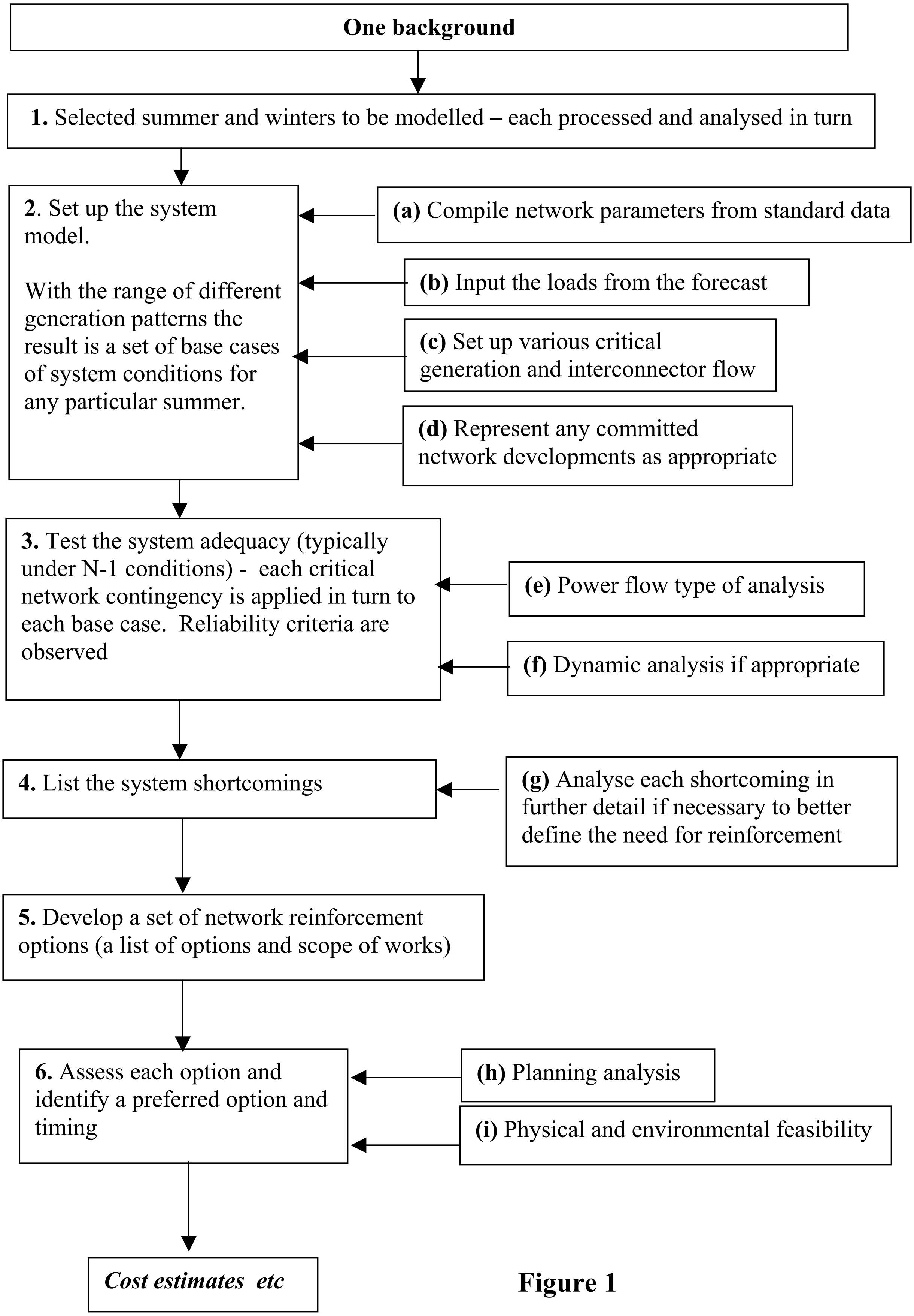
One background
1. Selected summer and winters to be modelled – each processed and analysed in turn
2. Set up the system model.
With the range of different generation patterns the result is a set of base cases of system conditions for any particular summer.
(a) Compile network parameters from standard data
(b) Input the loads from the forecast
(c) Set up various critical generation and interconnector flow
(d) Represent any committed network developments as appropriate
3. Test the system adequacy (typically under N-1 conditions) - each critical network contingency is applied in turn to each base case. Reliability criteria are observed
(e) Power flow type of analysis
(f) Dynamic analysis if appropriate
4. List the system shortcomings
(g) Analyse each shortcoming in further detail if necessary to better define the need for reinforcement
5. Develop a set of network reinforcement options (a list of options and scope of works)
6. Assess each option and identify a preferred option and timing
(h) Planning analysis
(i) Physical and environmental feasibility
Cost estimates etc

Figure 1

3. EXAMPLE

The following is an example of the process for one background (with one selected year only). Values shown in the modelling are for illustrative purposes only.

For example the Background M1 contains the following components:

Load	medium load growth forecast
Interconnection	The Vic/Snowy to NSW network has been reinforced with progressive minor works from 2005/6 to maintain the existing interconnection capability QNI has also had minor works from 2007/8 to maintain its capability of about 1100 MW QNI has also been upgraded in 2008/9 by about 150 MW – to a capability of 1250 MW
Generation	Existing units only are available for dispatch. There is no new generation in NSW. Only the Bayswater units have been upgraded to 700 MW, the other 660 MW units remain at 660 MW.

Step 1

We look at a number of summers of interest, in this case one year of interest – say 2007/8 is selected.

Step 2

A number of particular generation / interconnector flow patterns may be of interest. One of these is shown in Figure 2 in terms of a power flow map.

Figure 2 has the following characteristics:

Load	The load for summer peak 2007/8 has been assigned at each node according to the load forecast.
Interconnection flows	About 1000 MW import to NSW over QNI (shown as a power flow from Dumaresq (“Duma”) to Armidale (“Armd”) . This power flow is below the maximum capability of 1250 MW. Directlink is off line Vic to Snowy transfer is about 400 MW (sum of the power flows from Vic to the Snowy region). Snowy to NSW transfer is about 2500 MW (sum of the power flows form Snowy to NSW)

Generation	Bayswater and Liddell generators near maximum output. All 660 MW units on the central coast at maximum output All western units are in service at maximum output Redbank generator is in service Snowy – about 2100 MW generation with selected units operating Kangaroo Valley and other hydro stations off line Munmorah units off line

The map shows an abbreviated picture of power flows and voltages on the NSW main system. Power flows in other states, on subsystems and through the major transformers are not shown on this map.

Location names are cryptic but the map is semi-geographical with Dumaresq ("Duma") on QNI at the top and Dederang ("Dedr") in Victoria at the bottom.

For most lines the MW loading and its direction are shown (the MW loading is the first value given on each line). The second figure alongside each line preceded by "j" is the line Mvar loading.

At each location the voltage in per unit of nominal is shown.

NSW generation and major SVC output is listed in the top right hand corner.

The top left table shows some statistics for the system.

Step 3

A set of contingencies is applied to this system condition.

For example the outage of the Liddell – Tomago line ("Lidd" to "Tom") is shown in Figure 3.

Step 4

The outage causes the following:

- an overload of the Liddell – Newcastle line ("Lidd" to "Newc" line carries a load of 1577 MW compared to a rating of about 1430 MW)
- voltage control problems that cannot be readily described by this map and require additional analysis.

The system shortcomings are dependent on generation dispatch and hence the problem requires more extensive analysis than can be observed from one particular system condition.

Step 5

A number of options are devised to remedy the problem. One solution may be a new line from Bayswater to the Newcastle area for example.

This and other options are then scoped out.

Step 6

The options are modelled in a similar fashion to above and tested under contingency conditions. A view is formed on physical and environmental feasibility. The practical lead-time for a development is considered.

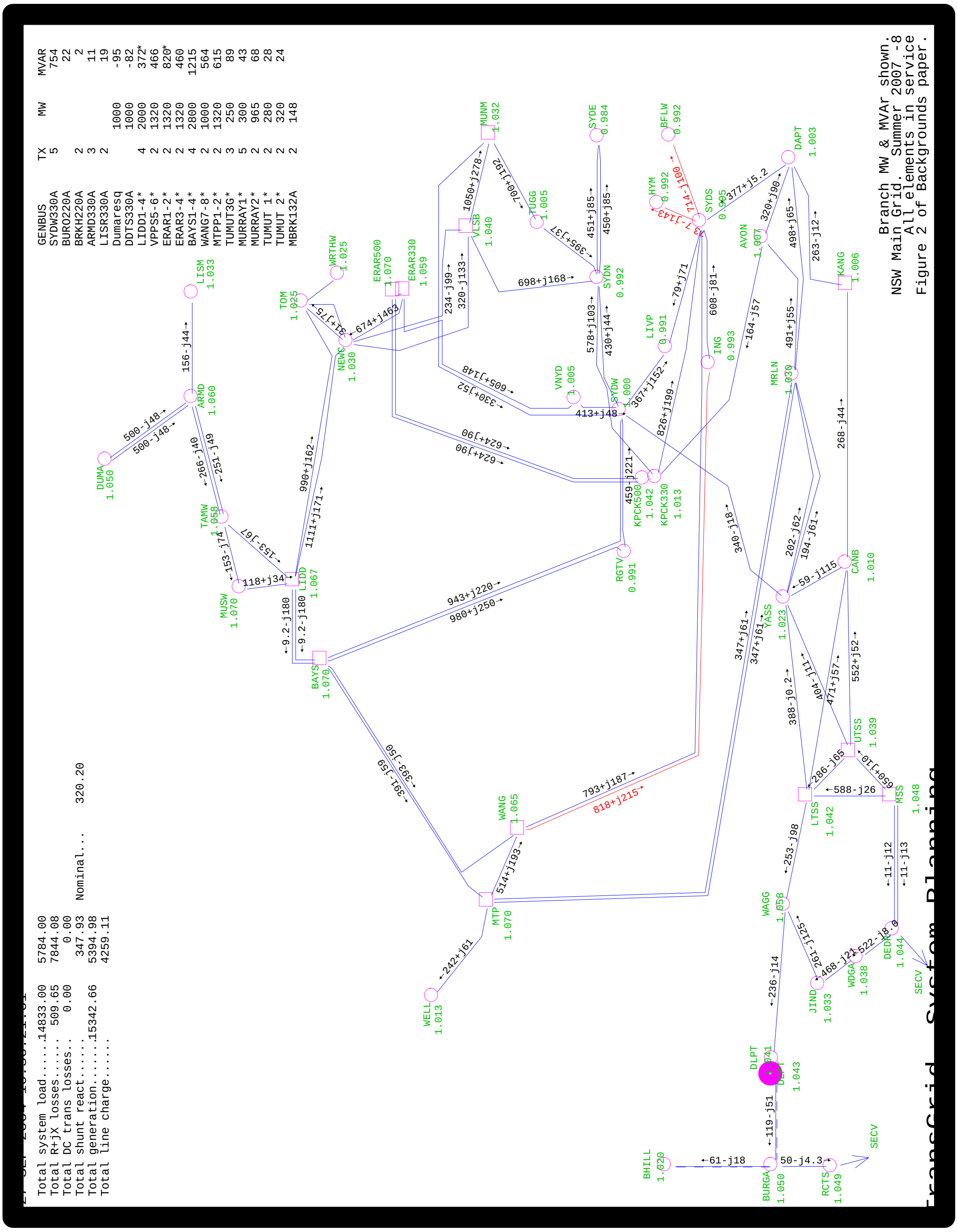
Branch MW & MVAr shown.
NSW Main Grid. Summer 2007 -8
All elements in service
Figure 2 of Backgrounds paper.

FIGURE 2

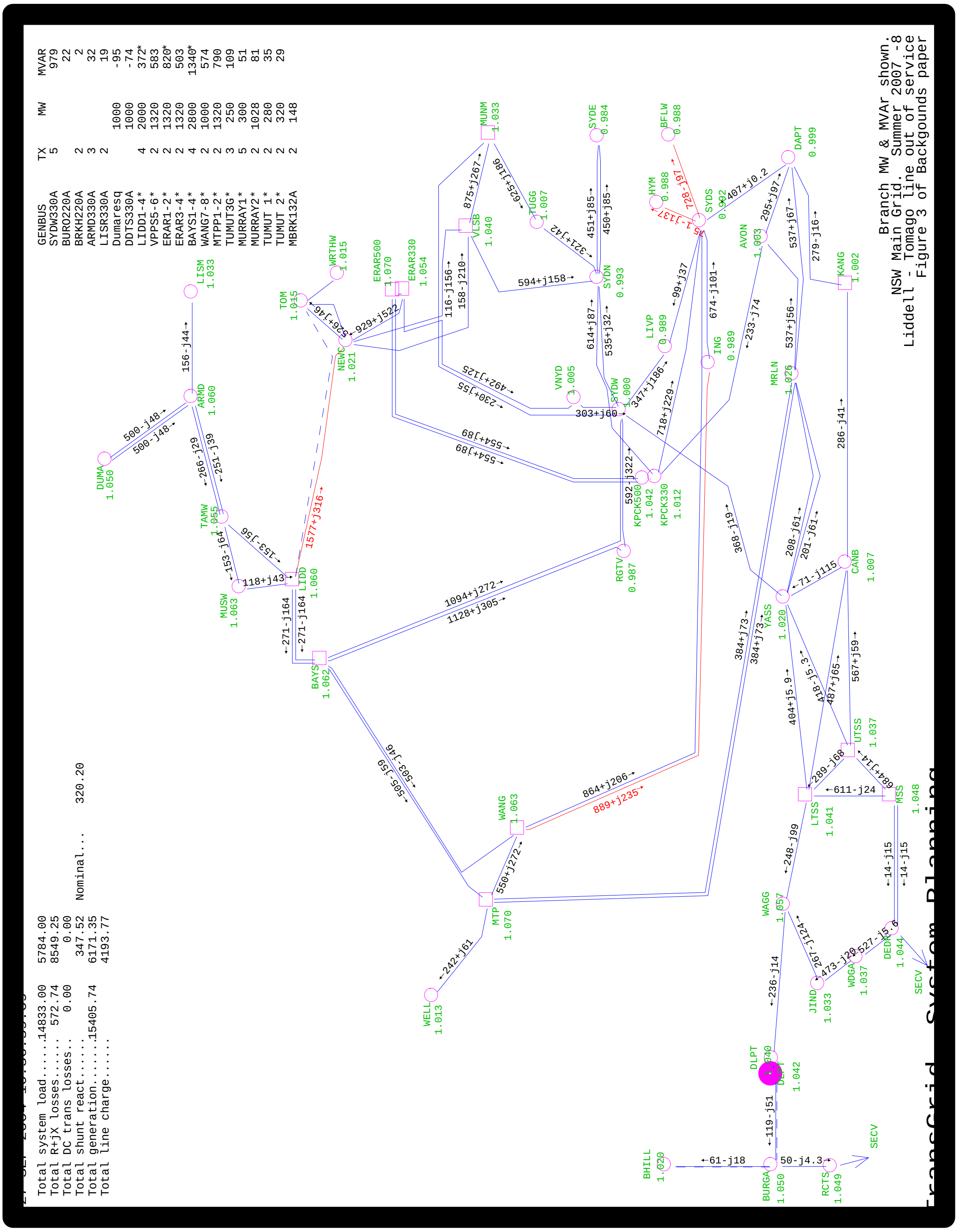
Branch MW & MVAr shown.
NSW Main Grid. Summer 2007 -8
Liddell - Tomago line out of service
Figure 3 of Backgounds paper
TransGrid System Planning

FIGURE 3

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