Handouts for SRC Meeting 18 August 2011 – discussion on GRS

Deterministic versus probabilistic standards within the GRS

Deterministic standards

Until relatively recently, the development of transmission networks in most jurisdictions has largely been undertaken in accordance with deterministic GRS. For example, "deterministic" standards are often based on levels of network redundancy such as providing for continued supply under a "k" contingency criterion (often referred to as N-k). For instance:

- *(N) criterion* denotes that the transmission system is planned such that, with all transmission facilities in service, the system is in a satisfactory state and loads may have to be shed to return to a satisfactory state for a credible contingent event;[1] and
- *(N-'k') criterion* denotes that the transmission system is planned such that, with all transmission facilities in service, the system is in a secure state and for any 'k' credible contingency event(s) the system moves to a satisfactory state. If any further contingency events were to occur, loads may have to be shed to return to a satisfactory state.

The N-1 deterministic standard is applied to the core grid,[2] typically covering the loss of a single transmission circuit, a single generator, an HVDC pole, a single bus section, an interconnecting transformer, or a single shunt capacitor. These are defined as "contingent events". If the system cannot survive the "single credible contingency" this is a signal that grid investment (or an alternative) is required to restore the required standard.

Probabilistic standards

The alternative to this approach is a "probabilistic" reliability standard. This is applied in the non-core parts of the grid. Probabilistic reliability standards encompass the possibility of load shedding after a contingent event, and therefore attempt to take into account the probability of contingencies and the likely cost consequence of those contingencies. This requires setting a VoEUE and estimating the quantum of expected unserved energy that might arise from each contingent event, then incorporating this in the cost-benefit analysis undertaken when considering transmission/transmission alternatives investments (i.e. currently the GIT, but soon to be replaced by an input methodology developed by the Commerce Commission).

1 An N security policy results in a system that is not secure against contingent events.

2 Defined in the Code as a list of transmission assets but generally applying to any transmission assets servicing over 150MW of load.

A summary of the advantages and disadvantages of the two types of reliability standards is shown in the table below.

Table 1: Summary of possible advantages and disadvantages of a probabilistic approach

Potential advantages of the probabilistic approach	Potential disadvantages of the probabilistic approach
• It enables a single economic approach to be adopted for all transmission investments and a consistent evaluation of reliability benefits provided by transmission alternatives • It has the potential to enable improved network utilisation (but through acceptance of the risk of the possibility of load shedding for credible contingency events) • It avoids subjective adjustments to deterministic standards, as all reliability investment decisions for all circumstances are able to be analysed using a single modelling approach • It enables users' valuation of unserved energy (including different users' valuation of unserved energy in different parts of the grid) to be explicitly taken into account • It reduces the potential for Transpower to shift investments between investment categories (i.e. between transmission and transmission alternatives)	• Its application requires a large database on performance of the grid and its components, and on the value of unserved energy for different classes of electricity consumers • It leads to increased analysis costs, given the need to establish and evaluate the various probabilistic scenarios • There is a perception that the process is a "black box" and is more difficult to validate (whereas deterministic standards are intuitively easier to understand) • There is a perception that the possibility of load shedding for credible contingency events may be unacceptable (although there may be situations where the probability of loss of load from utilising N-1 may be higher than would be acceptable if modelled on a probabilistic case, for example, long radial load with high forced outage rate lines)

Source: *Consultation paper on Draft Transport Rules, ECEU, MED, 4 November 2003*

Schedule 12.2 of the Electricity Industry Participation Code

Grid reliability standards

1 Preamble

*Clause 12.55 of this Code, requires the **Authority** to determine the most appropriate **grid reliability standards** and in so doing must have regard to the purposes in clause 12.56 and the principles set out in clause 12.57, as required by clause 12.55.*

Compare: Electricity Governance Rules 2003 clause 2 schedule F3 part F

2 The grid reliability standards

*(1) The purpose of the **grid reliability standards** is to provide a basis for **Transpower** and other parties to appraise opportunities for transmission investments and **transmission alternatives**.*

*(2) For the purpose of subclause (1), the **grid** satisfies the **grid reliability standards** if—*

*(a) the power system is reasonably expected to achieve a level of reliability at or above the level that would be achieved if all **economic reliability investments** were to be implemented; and*

*(b) with all **assets** that are reasonably expected to be in service, the power system would remain in a **satisfactory state** during and following a **single credible contingency event** occurring on the **core grid**.*

*(3) For the purpose of subclause (2)(a), the expected level of reliability of the power system must be assessed at each and every **grid exit point** and **grid injection point** (wherever located on the **grid**).*

(4) For the purpose of subclause (2)(a) and (b), the expected level of reliability, and state, of the power system must be assessed using the range of relevant operating conditions that could reasonably be expected to occur.

Compare: Electricity Governance Rules 2003 clauses 3 to 6 schedule F3 part F

3 Interpretation and definitions

*(1) For the purposes of these **grid reliability standards**, unless the context calls for another interpretation—*

(a) the terms defined in Part 1 of this Code take that defined meaning; and

(b) the term defined in subclause (2) takes that defined meaning; and

(c) a reference—

(i) to the singular includes the plural and conversely; and

(ii) to a person includes an individual, company, other body corporate, association, partnership, firm, joint venture, trust, or Government Agency; and

(d) the word including or includes means including, but not limited to, or includes, without limitation; and

(e) the other grammatical forms of the term defined in subclause (2) have a corresponding meaning.

*(2) **Economic reliability investments** means investments in the **grid** and **transmission alternatives** that would satisfy the economic test for an investment proposal applied by the Commerce Commission under Part 4 of the Commerce Act 1986—*

*(a) assuming that the economic test was applied to both investments in the **grid** and **transmission alternatives**; and*

*(b) having regard to Parts 7 and 8 (including the **policy statement**).*

Compare: Electricity Governance Rules 2003 clauses 7 and 8 schedule F3 part F

4 Value of expected unserved energy

*(1) The value of **expected unserved energy** is—*

*(a) $20,000 per **MWh**; or*

*(b) such other value as the **Authority** may determine.*

*(2) The **Authority** may determine different values of **expected unserved energy** for different purposes and for different times.*

*(3) If the **Authority** determines a value of **expected unserved energy** under this clause, the **Authority** must **publish** its determination.*