Power System Controller Reference

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Title	Secure System Guidelines		
Authorised by:	Power System Controller		
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Content

1. Scope

This Reference Document details Guidelines setting out the principles for determining whether a Power System operated under Licence from the NT Utilities Commission is in a Secure State.

This Document is produced under the auspices of the System Control Technical Code. Should any conflict arise between this document and the System Control Technical Code, the Code shall prevail.

For further understanding or resolution of issues relating to this document, please refer all matters to the Power System Controller.

Where potentially commercial-in-confidence information is necessary to ensure the Guidelines are sufficiently clear, the relevant information will be detailed in Participant-specific attachments and are negotiated separately. The attachments, such as SC R.6.1B1, are separate documents to reduce the risk of inadvertent disclosure.

Prepared by	Power System Controller Ken Lewis

2. Definitions

Base Capacity	That load as advised by the System Participant that a unit is capable of achieving in continuous operation for a period of 4 hours.
Peak Capacity	That load as advised by the System Participant that a unit is capable of achieving in continuous operation for a period of 30 minutes.
Reactive Power Reserve	As defined in the SCTC
Regulating Reserve	As defined in the SCTC
Responsive Reserve.	At an individual unit level :The difference between actual load and notified transient capacity of a unit that can be achieved within one minute of a system disturbance. At a system level : the sum of all individual unit responsive reserve amounts for a power system.
Interruptible Load	As defined in the SCTC
SCTC	System Control Technical Code
Shall, will	Mandatory
Should, may	recommended
Spinning Reserve	As defined in the SCTC
Standby Plant	Plant not connected to the grid, but available within an agreed time period and able to achieve base load capacity output within 90 minutes of a request to do so.
Standby Capacity	Total of notified Base load Capacities of all Standby Plant in the system.

3. References

System Control Technical Code

Network Connection Technical Code

SC R.6.1A1 Secure System Guidelines PWC Generation Specifics

SC R.6.1B1 Secure System Guidelines PWC Network Specifics

4. Determining Base Capacity

Base capacity of generating units for the purpose of system loading shall not take into account use of facilities that might provide short term (defined as four hours or less) capacity gains.

Base Capacity will be according to advice from the System Participant to the Power System Controller. Such advice shall distinguish Base Capacity variation at all likely ambient conditions.

The Power System Controller may request tests to prove these capacities and liaise with a System Participant representative to arrange this. The System Participant shall nominate new capacity requirements as a direct result of those tests.

The Power System Controller is cognisant of the business requirements to minimise such tests. Continued operation according to notified capabilities will establish adequate and ongoing performance criteria that may remove the need for such tests.

Related SCTC References : 3.3.1, 3.4.3, 3.5.1, 3.10.1

Regional Application

Darwin/Katherine

Refer Attachments for company specific elements.

Tennant Creek

Refer Attachments for company specific elements.

Alice Springs

Refer Attachments for company specific elements.

5. Determining Peak Capacity of generation units

Loading of generating units at Peak Capacity would only be expected to be utilised during and immediately following power system contingency events.

Peak capacity may take into account use of facilities that might provide short term capacity gains if they are currently or automatically turned on.

Peak Capacity will be according to advice from the System Participant to the Power System Controller.

The Power System Controller may request tests to prove these capacities and liaise with a System Participant representative to arrange this. The System Participant shall nominate new capacity requirements as a direct result of those tests.

The Power System Controller is cognisant of the business requirements to minimise such tests. Operation at Peak Capacity in contingency situations will establish adequate and ongoing performance criteria that may remove the need for such tests.

Related SCTC References : 3.3.1, 3.4.3, 3.5.1, 3.10.1

Regional Application

Darwin/Katherine

Refer Attachments for company specific elements.

Tennant Creek

Refer Attachments for company specific elements.

Alice Springs

Refer Attachments for company specific elements.

6. Determining Standby Reserve

There must be sufficient standby plant available to ensure that, with the loss of the highest loaded online unit, there is sufficient Standby Reserve available to compensate and recover this complete load loss.

In determining the highest loaded online unit, the effective load of an online combined cycle unit is deemed to be the load of the open cycle unit plus the inferred load derived from its associated HRSG.

LOS1 is declared when actual or expected Standby Reserve is less than 75% of the load of the highest loaded online unit.

LOS2 is declared when actually or expected Standby Reserve is less than 50% of the load of the highest loaded online unit

LOS3 is declared when actually or expected Standby Reserve is less than 25% of the load of the highest loaded online unit

LOS Conditions are declared by the Power System Controller.

Related SCTC References: 3.2.2, 3.3.1, 3.3.2, 3.7, 4.6

Regional Application

Darwin/Katherine

LOS1 : typically <36MW standby plant capacity.

LOS2 : typically <24MW standby plant capacity.

LOS3 : typically <12MW standby plant capacity.

Tennant Creek

LOS1 : typically 3.0MW

LOS2 : typically 2.0MW

LOS3 : typically 1.0W

Alice Springs

LOS1 : typically 7.5MW

LOS2 : typically <5.0MW

LOS3 : typically <2.5MW

7. Determining adequate Regulating Reserve

Regulating Reserve is that capacity of a generating unit or units available to regulate frequency to within the defined normal operating limits.

Following load shedding, Power System Controller will ensure that there is sufficient regulating reserve to meet the system demand pickup on load restoration. There should be regulating reserve equal to twice the amount of load lost on any distribution feeder prior to load shedding before that feeder may be restored. Where this is not practicable, the Power System Controller will determine the appropriate course of action.

The Power System Controller will appoint the regulating power station, define which unit or units will operate to regulate frequency, and determine the governor control mode for all grid connected power stations.

The Power System Controller will ensure regulating reserves are such that normal load variations do not result in frequency deviations outside the normal operating frequency band.

Related SCTC References : 3.3.1, 3.3.4, 3.10.1, 5.2,

Regional Application

Darwin/Katherine

Regulating units must be able to respond to a load increase or decrease of 5MW in total in each direction without the system frequency moving out of the normal operating band.

Tennant Creek

Regulating units must be able to respond to a load increase or decrease of 500kW in total in each direction without the system frequency moving out of the normal operating band.

Alice Springs

Regulating units must be able to respond to a load increase or decrease of 1.5MW in total in each direction without the system frequency moving out of the normal operating band.

8. Determining adequate Spinning Reserve for the Power System*

Spinning Reserve provides a means for the Power System to respond to meet expected customer demand and to ensure that the power system can respond to some disruption resulting from an unexpected disconnection of generating units or items of transmission equipment.

At a generating unit level, Spinning Reserve is calculated as the difference between the current load and Peak Capacity of a generator.

At system level, Spinning Reserve is the sum of all individual generating unit Spinning Reserve amounts.

Adequate Spinning Reserve is achieved by ensuring that, at a system level, a minimum amount of spinning reserve is maintained.

This system level Minimum Spinning Reserve represents a compromise between economics of plant operation, perceived power system risk level and community accepted standards of cumulative quantity of load shedding events.

The Power System Controller may vary the amount of Minimum Spinning Reserve and direct the allocation of unit Spinning Reserve, to accommodate the perceived risk level of the power system or sub-network at the time.

Related SCTC References: 3.2.2, 3.3.1, 3.3.2, 3.3.5, 3.3.6, 41, 4.2

Regional Application

Darwin/Katherine

Minimum Spinning Reserve : typically 13MW

Tennant Creek

Minimum Spinning Reserve : typically 600kW

Alice Springs

Minimum Spinning Reserve : typically 2.0 MW

* **Note : There is no obligation under the SCTC for individual Generators to keep any Spinning Reserve. There is an obligation under the SCTC for the Power System Controller to ensure adequate Supply Reserve. Supply Reserve is a combination of power system Spinning Reserve and contracted Interruptible Load. In the NT Power Systems, there is currently no contracted Interruptible load, reducing the obligation to one of achieving adequate power system Spinning Reserve.**

9. Determining adequate voltage levels for the System

System Voltage is a distributed phenomenon, and its limits are defined in various Acts, Regulations, Codes and Standards.

The Network Connection Technical Code requires that all plant be designed to operate with minimum and maximum steady state voltages to 90% and 110% of nominal design voltage respectively, unless specifically designed and approved. Generally, contestable customers are expected to design their plant to accept voltage levels of +/- 5% of nominal voltage.

The Network Connection Code also defines :

- Maximum voltage perturbation for a routine switching step (excluding de-energising) +/- 3.7% nominal voltage before reactive control responses and
- Maximum voltage perturbation for an infrequent switching step (excluding de-energising) +/- 6% nominal voltage before reactive control responses.

System Voltage Reduction is a credible means of reducing load under emergency conditions, but has the impact that customers at feeder extremities may suffer out-of-standard limit voltages. Only the Power System Controller approves Voltage Reduction strategies.

Related SCTC References : 3.3, 3.5.1, 3.10.2, 5.1,

Regional Application

Darwin/Katherine

Normal voltage control limits for all regulated voltage nodes regulated by OLTC transformers shall be +/-1.5% of a specifically defined nodal voltage value.

LDC (Line Drop Compensation) usually provides benefits for very long feeders with relatively large loads at the ends of the feeders. Typically, fixed value (no LDC) regulated voltage set-points are set slightly higher than nominal to allow for voltage drop at the ends of the feeders. The latter type is in most common use in PWC .

Control balance points are as follows :

Nominal voltage	Typical Voltage Setpoint	Tolerance
132kV	Not controlled by OLTC	+/- 10% nominal
66kV	67.6kV	+/- 10% nominal
33kV	33.8kV	+/-5% nominal
22kV	22.5kV	+/-5% nominal
11kV	11.1kV	+/-5% nominal

SC R.6.1

Tennant Creek

As per Darwin Katherine Region

Alice Springs

As per Darwin Katherine Region

10. Determining adequate Reactive Power Reserve for the System

There are defined acceptable voltage bands at each voltage level. The system voltage at each node and corresponding reactive power requirements are determined by power system local loading demands and the reactive impedance of the various sections of the power system.

Measures of adequate reactive power reserve include:

- Adequate voltage levels for the System are present
- there is no bulk supply OLTC transformer that has reached maximum or minimum tap and regulated voltage is within normal control deadbands
- voltage collapse situations are not imminent
- no generator is operating close to maximum or minimum excitation level and under automatic control

Power System Controller will issue advice to all affected System Participants when :

(LORR1) : Any OLTC transformer is operating at Top or Bottom tap and regulated voltage remaining outside normal control deadbands OR any scheduled generation unit is operating within 5% of maximum or minimum excitation level (based upon notified capability curves) and under automatic control OR 2 scheduled generating units are operating under manual voltage control

(LORR2) : Any system voltage controlled node operating outside of statutory voltage limits OR any system node operating outside of unstable voltage control limits OR any generation unit operating at maximum or minimum excitation level (based upon notified capability curves)and under automatic control OR 3 or more scheduled generating units operating under manual voltage control.

Power System Controller may initiate commensurate actions including Directions, Load shedding, load transfer, or generation plant adjustments before or at any of these stages.

Related SCTC References : 3.3.2, 3.3.6, 3.5.1, 5.1,

Regional Application

Darwin/Katherine

As described above

Tennant Creek

As described above

Alice Springs

As described above

11. Determining adequate frequency levels

Normal Operating Frequency Band is 50.00 +/- 0.2 hz, with a deadband of +/- 0.05hz. Emergency Operating Frequency Band is 50.00 +/- 0.5 hz.

For the specific purpose of establishing the size of a load change that will allow the Emergency Operating Frequency Band to be employed, an emergency is defined as sudden large load change of >5% summer peak system load.

The Emergency Operating Frequency Band may also be employed upon sudden disconnection of a generating unit, occurrence of a credible fault situation, occurrence of a non-credible fault situation.

An emergency is considered complete once frequency has returned to within the normal operating frequency band for 1 minute.

Cumulative frequency induced Time Error must be within +/- 15seconds at all times, with no time correction action required if the error is within +/- 2 seconds.

Related SCTC References : 1.7.4, 3.3.3, 3.3.4, 3.3.5, 3.4.1, 3.5.1, 4.3, 5.2, 5.4

Regional Application

Darwin/Katherine

Emergency load change tolerance limit 13MW

Tennant Creek

Emergency load change tolerance limit 400kW. A typical feeder carries more than this load and hence a feeder fault will normally initiate Emergency Operating Frequency Band tolerances.

Alice Springs

Emergency load change tolerance limit 3MW. Many feeders routinely carry more than this load during system daily peaks, and hence a feeder fault at daily peaks is likely to initiate Emergency Operating Frequency Band tolerances.

12. Determining adequate energy for the System

Energy supply adequacy is generally measured by quantities of fuel reserves available for use at each power station. Generators and independent agencies such as NT Gas, are required to notify the Power System Controller when an accessible fuel level falls below nominated Alert Levels

Alert levels are defined in terms of availability to use the fuel at expected load levels for the next 8 hours, assuming no further fuel becomes accessible. When an accessible fuel level falls below nominated Alert Levels, or normal capability to use the alternate sources is compromised, the Power System Controller may then deem that complete loss of the power station is a credible contingency and initiate measures to mitigate this risk.

The Power System Controller will advise all System participants when fuel level is below Alert Level or an inability to use the alternate fuel if there is insufficient standby reserve at other power stations to meet system demand in the next 8 hours.

Related SCTC References : 3.3.2, 3.5.1, 3.8

Regional Application

Darwin/Katherine

Refer Attachments for company specific elements.

Tennant Creek

Refer Attachments for company specific elements.

Alice Springs

Refer Attachments for company specific elements.

13. Determining capacity of transmission facilities

The Network Operator is responsible for determining limits of operation of the network and associated equipment. The Network Operator will advise the Power System Controller of these limits.

Related SCTC References :3.2.1, 3.3.2,3.3.4, 3.4, 3.9, 5.5,

Regional Application

Darwin/Katherine

Refer SC R.6.1B attachments

Tennant Creek

As per Darwin Katherine Region

Alice Springs

As per Darwin Katherine Region

14. Determining adequate fault level capacity

The calculated fault levels in the network may not exceed 95% of the equipment fault ratings (Network Connection Technical Code requirement).

Related SCTC References : 2.7, 3.4.1,

Regional Application

Darwin/Katherine

Refer above

Tennant Creek

Refer above

Alice Springs

Refer above

15. Determining system stability

A Voltage Instability has occurred if any voltage at any node does not or cannot return to within normal limits following a power system disturbance.

A Frequency instability has occurred if the system frequency does not return to within normal limits following a power system disturbance and either UFLS, UVLS or protection action.

All oscillations of any power system parameter are to be damped, with a halving time of no more than 5 seconds.

Under normal operating conditions at least 75% of all load in each region is to be selected for graded UFLS and/or UVLS.

Related SCTC References : 3.3.5, 3.3.6,

Regional Application

Darwin/Katherine

Refer above

Tennant Creek

Refer above

Alice Springs

Refer above

16. Adoption of Reliability Criteria for networks

For the purposes of simplicity, Power System Controller adopts the following reliability criterion for network primary plant. Such criterion will be employed for maintenance planning and coordination :

Equipment operated according to N Criteria :

All pole mounted or pad mounted transformers

All distribution feeders

DKTL for unplanned outages when the power system is in a Satisfactory Operating State or better

66kV radial feeders

Transformers in single transformer zone substations

Equipment operated according to N-1 Criteria

DKTL for planned maintenance and when the power system is insecure

All other 132kV plant and equipment except substation buses

All 66kV plant and equipment except for radial feeders and substation buses

Transformers in multiple transformer zone substations

All express feeders

Related SCTC References 3.2.1

Regional Application

Darwin/Katherine

Refer above

Tennant Creek

Refer above

Alice Springs

Refer above

17. Determining adequate capacity for maintenance planning

At all times, all plant must operate within its defined technical envelope, with capacity defined according to this document. In approving plant outages for such things as maintenance, the capacity of the remaining plant must be considered before the outage can be approved, including the next credible contingency.

For generation outage planning, the LOS 1 minimum standby reserve levels will not be violated for the next credible contingency for the remaining plant in service, except by specific approval of the Power System Controller.

For transformer outages the 24 hour cyclic capacity shall be used. (Network Connection Technical Code obligation).

For short term feeder outages, the relevant seasonal rating in still conditions to suit the anticipated load for the times and days of the outage may be used. (Network Connection Technical Code requirement)

The Power System Controller may define specific requirements for all other situations, and/or accept appropriate contingency plans to ensure power system security is not compromised.

Where the next credible contingency in the outage consideration results in no supply or commensurate load shedding such that all in-service plant remains within its technical envelope, power system security is not compromised.

Approval of outages that meet these capacity guidelines is not automatic, however power system security will be deemed adequate for the intended works. Other Guidelines, such as Commercial or Corporate guidelines will then determine whether the outage may proceed.

For example, an extended time outage for maintenance of a radial feeder supplying a small community might be adequate in terms of Power System Security obligations, however other Corporate and or Commercial guidelines for outages might prevent such an outage proceeding.

Related SCTC References : 3.2.1, 3.3.4, 3.4.1,

Regional Application

Darwin/Katherine

Refer above

Tennant Creek

Refer above

Alice Springs

Refer above

18. Determining adequate protection integrity

A Generator must advise the Power System Controller whenever any major protection system is not operating correctly or out of service. A major protection system is defined as any protection scheme that operates to preserve the integrity and safety of people or equipment. Any such scheme is to be promptly and diligently repaired or have alternate protection put in place.

A Network Operator must advise the Power System Controller if any of its HV protection equipment relating to its high voltage network is not operating correctly or unavailable for service. Any such equipment is to be promptly and diligently repaired or have alternate protection put in place.

A System Participant (this definition includes a Generator and a Network Operator) must advise the Power System Controller if the System Participant becomes aware that one of two primary protection systems is not operating correctly or unavailable for service. Any such equipment is to be promptly and diligently repaired or have alternate protection put in place.

One protection scheme of two independent protection schemes protecting a network element may be out of service for up to 24 hours for maintenance and repair purposes. (Network Connection Technical Code requirement).

The Power System Controller shall make a determination regarding the continued serviceability of affected HV equipment for any of the situations described herein, and initiate any additional operational actions to mitigate the perceived risks.

Related SCTC References : 3.6.3, 6.7

Regional Application

Darwin/Katherine

Refer above

Tennant Creek

Refer above

Alice Springs

Refer above

19. Document Control

Revision	***Date***	***Officer***	***Action***
Draft 2	11 August 2006	Ken Lewis	draft
Draft 2.1	23 October 2006	Ken Lewis	Draft 2 incorporating comments and responses received.
Draft 2.2	7 January 2007	Ken Lewis	Additional comments received
Draft 2.3	April 2008	Ken Lewis	Document aligned with Version 2 of SCTC. Comments removed and document readied for publication.
Draft 2.4	April 2008	Ken Lewis	Document aligned with version Version 2, draft 2 of SCTC
Draft 2.5	July 2008	Ken Lewis	Document aligned with UC approved SCTC version 2.0.
Draft 2.6	July 2008	Ken Lewis	Minor amendments received from System Participant PWC Generation
Final 2.6	August 2008	Ken Lewis	Draft 2.6 changed to Final 2.6 and ready for publication. No substantive amendments.