Technical Issues arising from the Rules Change Proposal for New Generators

- Assumptions
  - Rule S5.2.5.3 revised to allow new generators entry with proposed Hydro Tasmania (HT) frequency standards
  - The new generators trip
    - Alinta
      - Combined Cycle Gas Turbine (CCGT)
        - for under-frequencies at 47Hz
        - for over-frequencies at 52Hz
      - Open Cycle Gas Turbine (OCGT)
        - for under-frequencies at 46Hz
    - Gunns
        - for under-frequencies at 46Hz
        - for over-frequencies at 51.5Hz

Issues in under-frequency area

- All the new generators can remain connected for the proposed HT credible contingency frequency range (>47.5Hz)
- The new Alinta CCGT generator cannot remain connected for the proposed HT non-credible frequency range (<47.5Hz, >46Hz)
- The UFLSS will need to be re-designed to manage non-credible events plus loss of the new Alinta CCGT generator for many non-credible events

Re-design of UFLSS

- UFLSS needs to be designed to maintain at least a rump of the system for as many non-credible contingencies as possible
- Tasmanian UFLSS needs significant loads initially to stop frequency going below 46Hz for large contingencies and low inertia systems
- UFLSS needs to avoid excessive overshoot as a result of its operation, restricting the maximum block size
- UFLSS needs to cater for system splits and resultant low inertia sub-systems
- New UFLSS will have to shed further large amounts of load below 47Hz to cater for loss of new 210MW Alinta CCGT generator. This load will need to stop frequency going below 46HZ.
  - for system splits resulting in much less inertia, new load must be in North of the State

Re-design of UFLSS

- Many identifiable non-credible scenarios can result in a 400MW or greater loss of generation
  - West coast, Gordon, split at Palmerston with high south to north transfers, Loss of Chapel street, loss of Sheffield.
- Many of these will increase by 210MW due to new Alinta CCGT generator tripping at 47Hz
- NEMMCO require the UFLSS to be designed for a 540MW generation loss (equivalent to a west coast generation loss) on light system loads
- This contingency will most probably be increased to 750MW at 47Hz.

Re-design of UFLSS

- On a light to moderate system virtually impossible to shed 750MW of load and
  - stop frequency by 46Hz
  - Recover frequency to near 50Hz.
  - Avoid voltage problems
  - Avoid cascading failures
- On 900MW system, shedding 750MW leaves only 150MW. Will this remaining system be stable? Voltage an issue?
- On 900MW system there is currently about 680MW of load in the Tasmanian UFLSS (83% of system load).
- Gunns will provide about a further 75MW of load shed in the north
- Procuring additional load other than Gunns for the UFLSS will most probably involve tripping loads designated by the JSSC as high priority (i.e. Hospitals, police stations and emergency services)

Re-design of UFLSS

- Another issue
  - Take a moderate system load with
    - 400MW of generation supplied to the North sub-system from Poatina and Southern generators
    - 100MW Basslink export (say)
    - 210MW of New CCGT thermal generator
    - Other generators in the north meeting some demand and providing some FCAS.
  - System splits at Palmerston resulting in 400MW generation deficiency in north.
  - Only 165MW of load shedding currently available in the north above 47Hz. Therefore CCGT will trip.
  - At least a further 450MW of load will need to be shed(and possibly considerably more because of low inertia) in the north below 47Hz.
  - Only about 350MW of load remains in the UFLSS in the north.
  - Gunns will provide additional load for the UFLSS of around 75MW, but possibly only some years after Alinta is connected.
  - Sourcing another 100MW+ (without Gunns) in the north to be shed early enough to stop the frequency before 46Hz will be very difficult.
- This issue may meet the objectives of the UFLSS, in that a southern sub-system remains, but the north could collapse without the Gunns load.

Re-design of UFLSS

- Another issue
  - Take a moderate system load with
    - 540MW of generation on west coast (NEMMCO require load shed of about this amount)
    - 440MW Basslink import
    - 210MW of New thermal generator
    - Other generators meeting some demand and providing FCAS
  - UFLSS operates on loss of west coast generation
  - At 47HZ new thermal generator trips
  - Voltages at George Town unstable
  - Basslink trips
  - FCSPS loads have already tripped
  - Result System Black
- This issue does not meet the objectives for the UFLSS
- I think it will prove very difficult (if at all possible) to re-design a robust UFLSS to cater for all possible load scenarios, dispatch scenarios (with Basslink and wind), and system splits and avoid cascading failures or total system blackouts for reasonably foreseeable non-credible contingencies

Re-design of UFLSS

- The following issues arise from the previous slides
  - Is the Alinta CCGT entry into the NEM to be linked with the Gunns load under this scenario?
  - What happens to the time difference in these two projects?
  - What would happen if the Gunns project were to not proceed?
  - If Alinta is not linked to the Gunns project, where is the extra load in the north required for the UFLSS to be sourced?
  - Some northern loads will probably have to be initiated earlier in the UFLSS. What process and agreements will be needed to allow this?
  - Will the changes still comply with the JSSC priority for load shedding in Tasmania?

Re-design of UFLSS

- The above scenarios do not include wind dispatch. When wind is taken into account it generally decreases inertia, increases rate of change of frequency and load shedding required for the same system load and contingency.
- All current wind generators (Woolnorth and Studland Bay) are in the northern sub-system.
- The proposed Mussleroe wind farm is also in the northern sub-system.

Re-design of UFLSS

- Conclusions
  - For the HT scenario involving limited frequency standard changes and Rules changes, it may not be possible to add thermal plant as proposed by Alinta and avoid total system collapse for all reasonably foreseeable non-credible contingencies through the UFLSS design.
  - Under the HT scenario of Rules changes for new generation entry no further CCGT plant similar to the Alinta proposal could be connected to Tasmania into the future.

Over-frequencies

- FCAS often set by load events and do not go beyond 51Hz for these events – no issues arise
- Network events can have frequencies up to 52Hz (HT proposal).
- New Alinta thermal generators trip at 52Hz.
- New Gunns thermal generator trips at 51.5Hz.
- The Gunns trip would most probably stop frequencies exceeding 52Hz.
- Loss of both Alinta and Gunns at 51.5Hz and 52Hz may send frequency into UFLSS operating range for some systems (same issue for the frequency standard change)
  - this issue could probably be fixed by staggering the trips of the generators in the frequency domain, possibly avoiding the second trip.

Over-frequencies

- There are some other issues that would need to be clarified and the details worked out
  - Is the new Gunns generator providing an FCAS(L6) service whenever the network event band sets the requirement for FCAS(L6)?
  - When load events set the FCAS(L6) requirement and a network event occurs then the FCAS(L6) will operate, but frequency could still exceed 51.5Hz. The new Gunns generator will then trip.
  - Are there any registration issues?
  - Does Gunns have to bid as the service would always be enabled?
  - Does NEMDE operate appropriately in this environment?