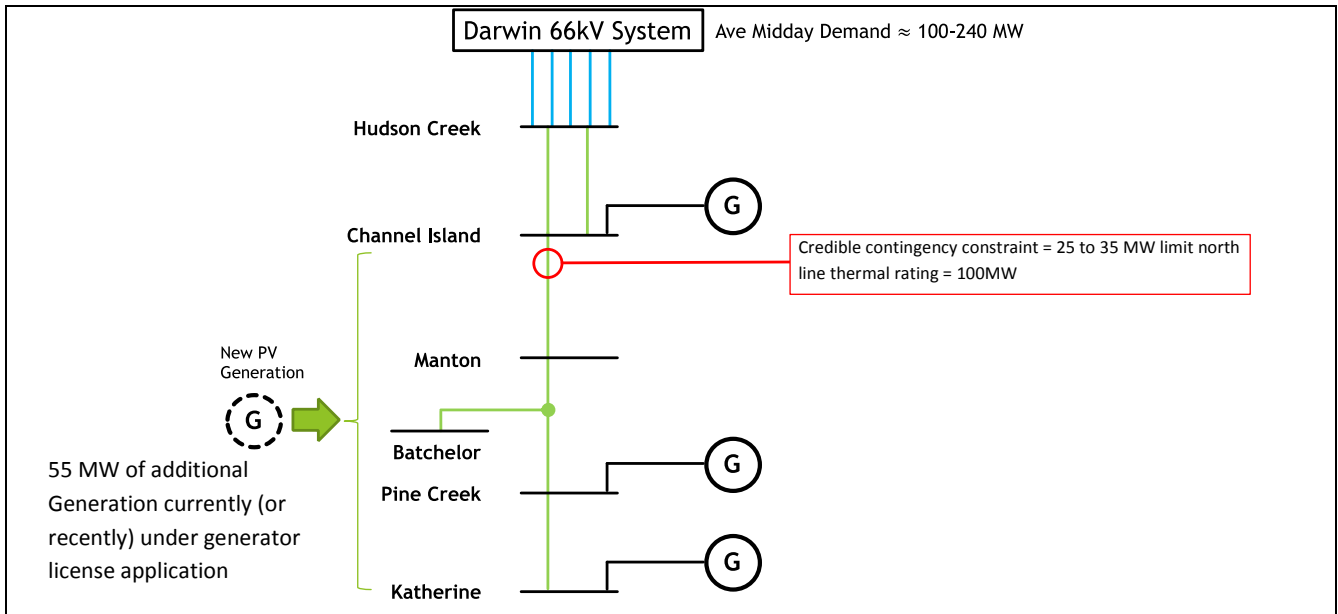


Attachment C: 132kV Channel Island to Katherine Line Constraint:

The 132kV transmission line from Channel Island to Katherine is operated in a manner where the loads supplied south of Channel Island may be unsupplied for the line contingency, but the impact of the line contingency will not result in load shedding north of Channel Island.



The local load in the region is limited with and has varied between ~6 MW to 31 MW over the 2017-2018 Financial Year (refer to table below). With the technical implementation of Frequency Control Ancillary Services, the constraint on this transmission line will be dynamic with the limitation on the load flow (ΔP_{CI-MT}) into Channel Island set by the FCAS and inertia reserves within the northern region. See equation below for calculation of the load flow to be constrained and proportionality on the constrained load flow.

$$\Delta P_{CI-MT} = \sum_{Gen} (BA + MT + PC + KA) - \sum_{Load} (BA + MT + PC + KA)$$

$$C(\Delta P_{CI-MT}) \propto \frac{FCAS_{Fast\ Raise\ Darwin\ region}}{H_{Darwin\ region}}, \quad C(\Delta P_{CI-MT}) \propto FCAS_{Slow\ \&\ delayed\ raise\ Darwin\ Region}$$

Under recent normal dispatches the amount of inertia and FCAS raise dispatched can accommodate $\Delta P_{CI-MT} \leq (25\ to\ 35)$

Capacity of generation currently installed at sites:

Zone Substation	Generation Capacity Existing (MW)	Generation Capacity Proposed ¹ (MW)
Katherine	36.5 ²	25
Pine Creek	26.5 ³	0
Manton	0	10
Bachelor	0	20

¹ Generation currently or recently under license application with Utilities Commission.

² Typically only dispatched for system security or islanding events.

³ Typically dispatched baseload at maximum output.

Load characteristics at each site over 2017-2018 Financial Year:

Zone Substation	Min	Average	Max
Katherine	5.91	14.04	26.64
Pine Creek	0.24	3.26	8.12
Manton	0.05	0.21	1.52
Bachelor	0.05	0.49	3.88
Combined	5.91	17.99	31.27

With the total proposed generation operating with the existing generation from pine creek all operating at maximum output, unconstrained load flows to Channel Island would range between ~50 to 75 MW. Based on the existing FCAS reserves, constraints would apply to this generation output. Note that dispatch of generation in the constrained area do not contribute to the FCAS reserves required to alleviate the constraint, but also displace other generation that could alleviate the constraint.

Opportunity: Generation Proponents considering connection south of Channel Island could consider development of delocalised FCAS resources (e.g. a battery installation) north of Channel Island to alleviate this constraint. Given economies of scale, it is strongly recommended that proponents consider a cooperative approach to the development of these delocalised FCAS resources such as a centralised part owned battery.