Limits Advice preparation under constrained access

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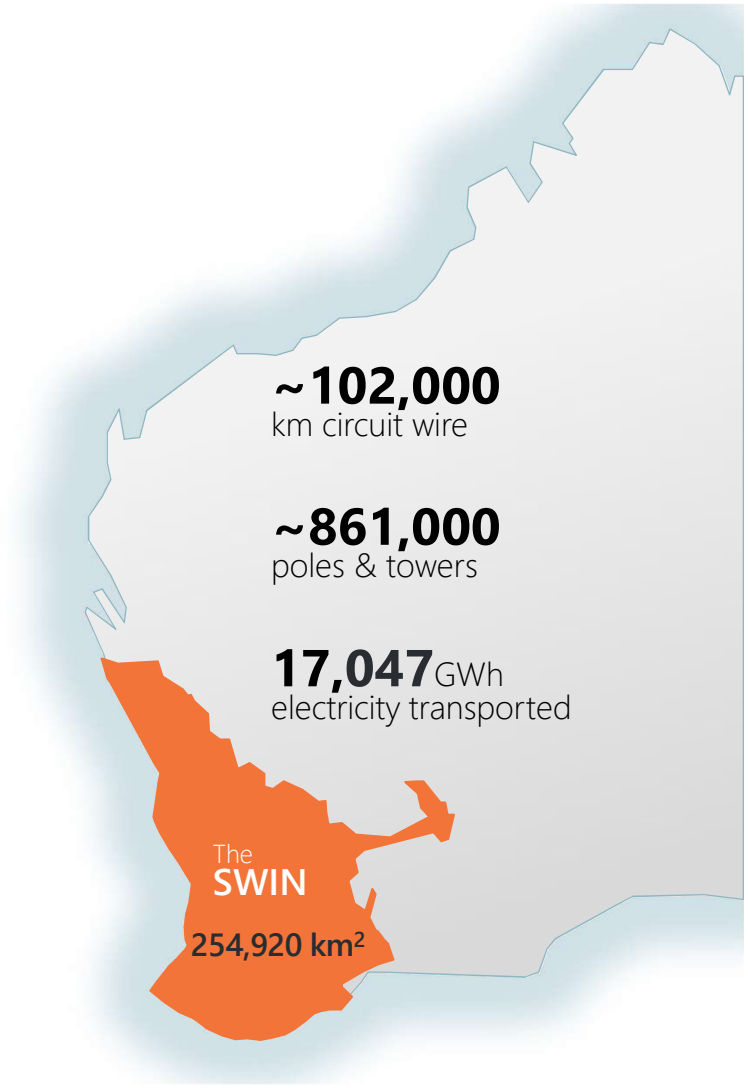
About Western Power

- Build, maintain & operate transmission and distribution assets: South West Interconnected Network (SWIN)
- 1.1+ million customers
- ~264,000 street lights
- ~237,800 solar PV installations*
- ~570 battery systems*

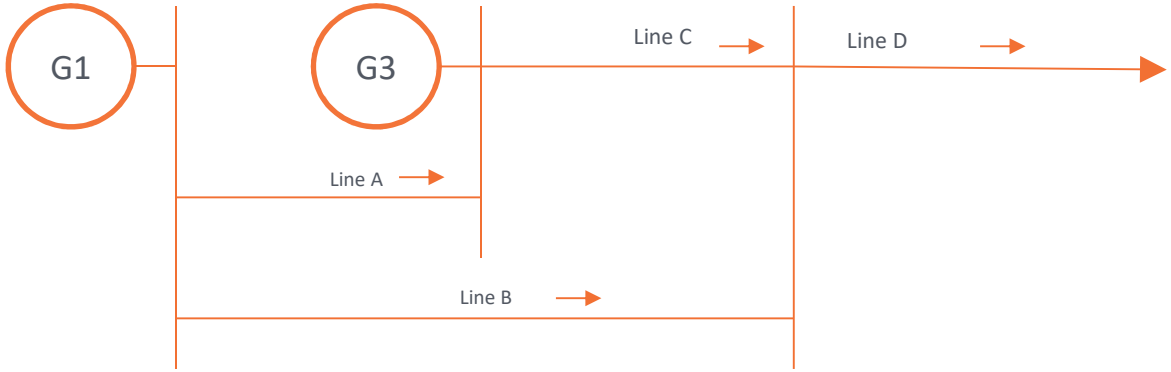


* As at 31/5/18

What is a limit?

- Mathematical expression defining the power transfer capability across a particular transmission element or group of transmission elements
- Can be simple – like an equipment thermal rating (dependent on ambient conditions)
- Can be very complicated – like a non thermal (transient/voltage stability, etc.) limit. It is a function of the many power system variables like generators online, etc.

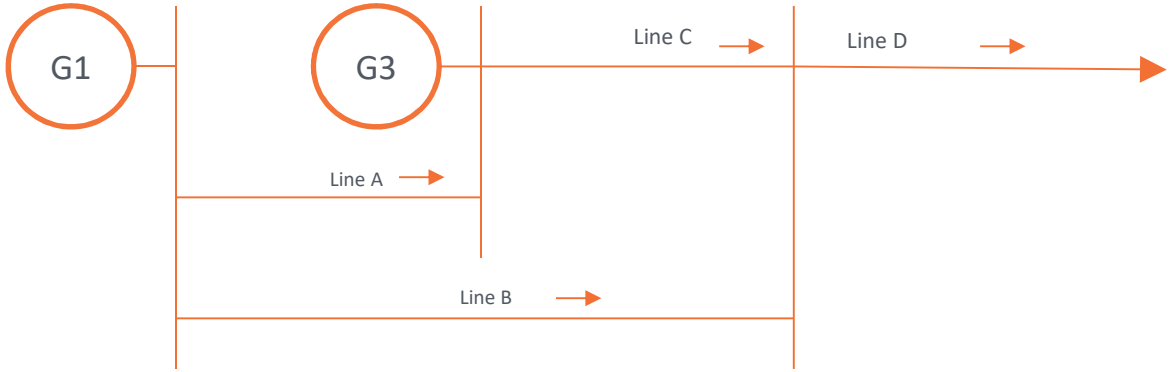
Thermal limit example



Thermal limit of Line C = 200 MW

Non thermal (voltage stability, etc.) limit example

Something a little more complicated



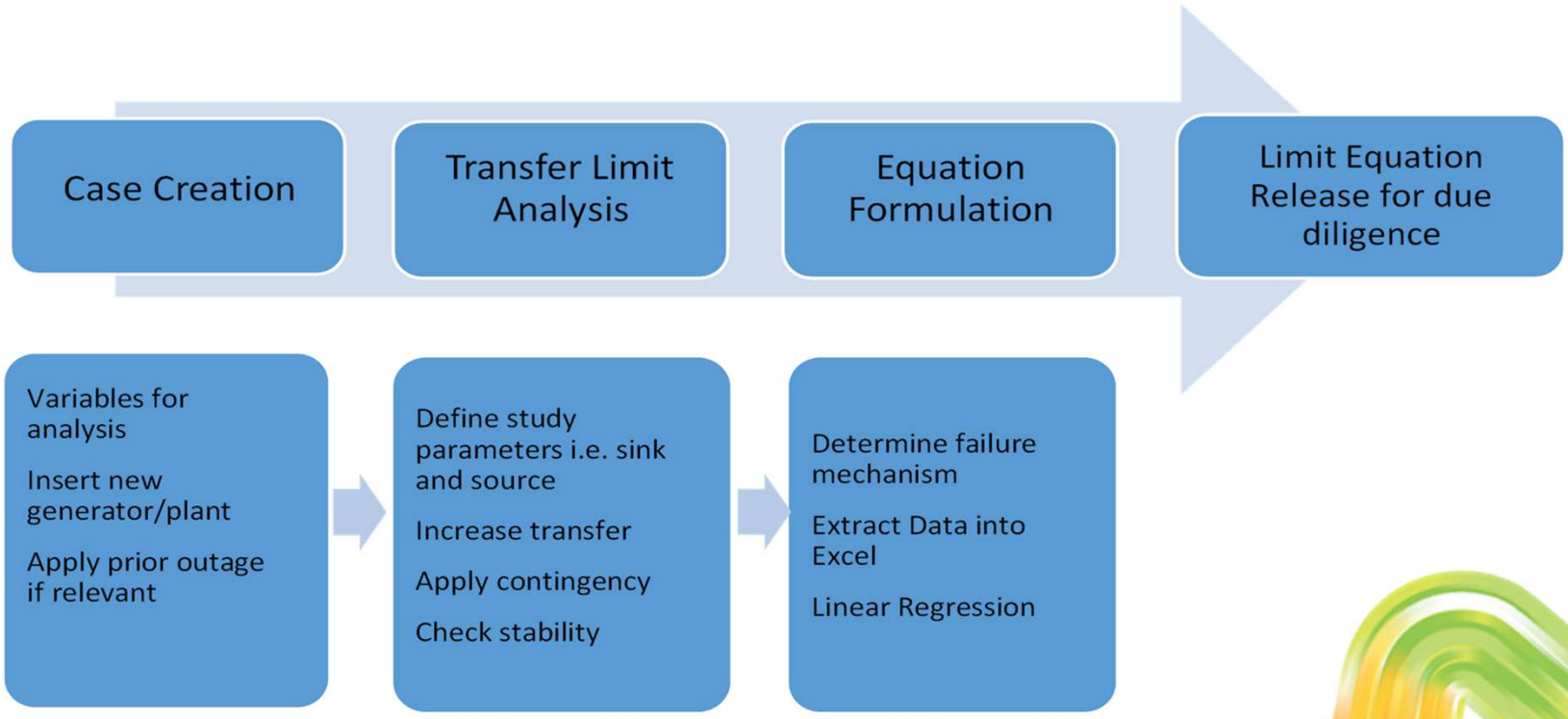
Lines C & B Stability Limit = count units online(G1, G2, G3) * 30

+ 0.25 x G1 (MW)

+ 0.21 * G2 (MW)

+ 0.12 x G3 (MW)

Non thermal limit determination process



Voltage stability limit example

NSW to Vic transfer limits under system normal to prevent voltage collapse in southern NSW and northern Vic following loss of Basslink or the loss of the largest Vic generator.

NSW to Vic ≤ -1 * Sum [Term Values * Coefficients]

Example of some terms and coefficients in this transfer limit

Term	Coefficient
Intercept	-1693
Contingent MW	0.9601
SW_NSW	0.8622
NSWd-SW_NSW	0.01787
STH_NSW_GEN	-0.09652
UTUM1SC+UTUM2SC	-15.88
LTUM3SC	-59.42

What is a constraint equation?

- Constraint equations are also mathematical equations
- They combine an equation representing flow along with the limit equation to produce a constraint equation
- A constraint equation in its simplest form:

$$Flow \leq Limit$$

Flow equation

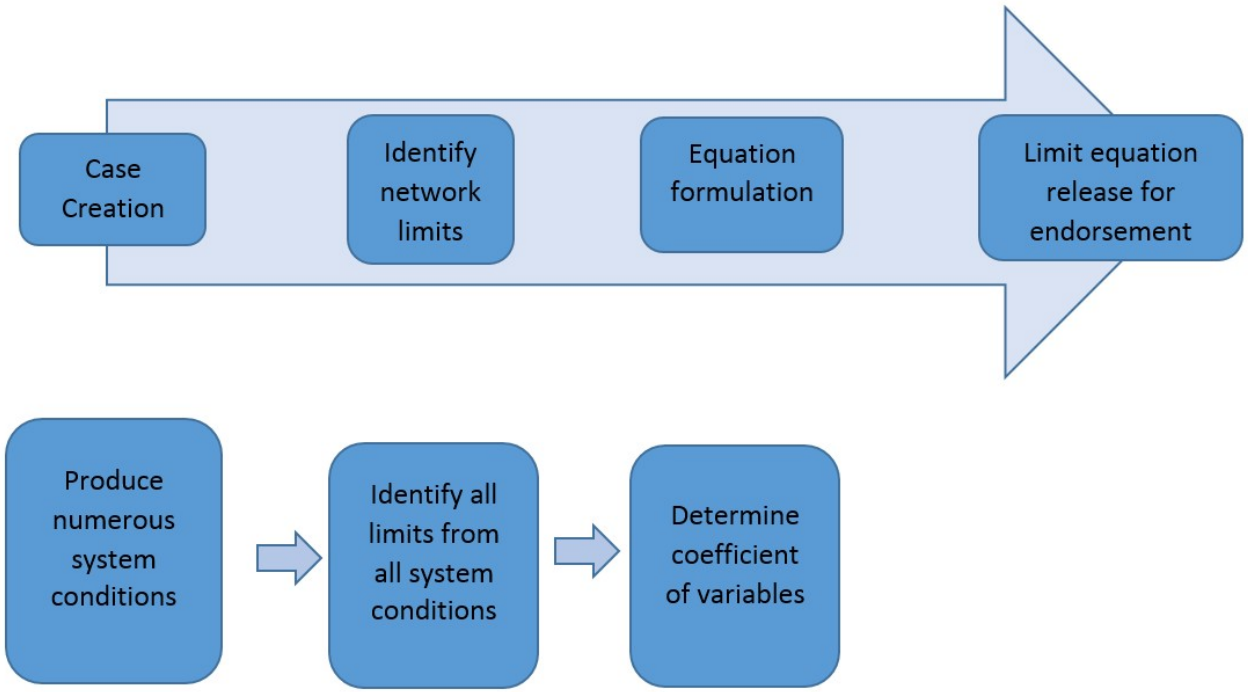
Limit equation

What are coefficients?

- Both the flow equation and limit equations can have terms for all generators

- As the topology of the power system changes over time so too can the relative contribution of each generating unit to particular line flows or limits. As a result coefficients can change over time
- Generally a generator will have a different coefficient in every constraint equation as each constraint equation is controlling a unique network limit

Thermal constraint equation determination process



Data used & available from limit determination process

1. TNSPs determine equipment thermal limits in accordance with the relevant standards
2. Network model used to set up thousands of system conditions
3. Network model made available under confidentiality agreement (WA) or to market participants (NEM)
4. All generator models validated against generator performance tests
5. All equipment data validated against test records and commissioning data
6. AEMO's due diligence to make sure the non thermal limits advice received from a TNSP is reasonable
7. Approved non-thermal limits published by TNSPs

Questions

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