Constraint Management

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Operations and Trading

National Grid

Agenda

- **What is a Transmission Constraint**
- **How we manage constraints**
- **Thermal Constraint - Example**
- **Summary**

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What is a Transmission Constraint (i)

- **The Transmission System has a finite capacity for the transmission of power.**
- **Depending on the generation/demand pattern and system outages constraints may arise.**
- **Three types of Constraints**
  - **Thermal**
  - **Voltage**
  - **Stability**

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What is a Transmission Constraint (ii)

- **Thermal Constraints**
  - **Relate to thermal capacity of transmission assets.**
  - **Failure to manage may result in damage to transmission assets**
  - **Failure to manage may result in infringement of clearance.**
  - **In extreme situations could lead to cascade tripping (Aukland!).**

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What is a Transmission Constraint (iii)

- **Voltage Constraints**
  - **Reactive Power Related**
  - **Generally Localised**
  - **Insufficient MVAr reserves may result in unacceptable voltage deviations and in extreme situations voltage collapse.**

What is a Transmission Constraint (iv)

- **Stability Constraints**

  Two Types:

  Transient - post fault - keeping generators in synchronism

  Dynamic - steady state oscillation between generators

  - Caused by weak links to high generation export groups.

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How we manage constraints (i)

- **Co-ordinate outages (OC2 data)**
- **Transmission options**

  - Modify substation running arrangements

  - Rating Enhancements (MORE, CTM, Hot Wire)
- **Change demand pattern:**

  Balancing Services Contracts
- **Change generation pattern:**

  BOAs, Schedule 7, BS Contracts

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How we manage constraints (ii)

- **Flexible working:**

  Live Line

  Extended working hours

  By-pass arrangements

  Defer Outage

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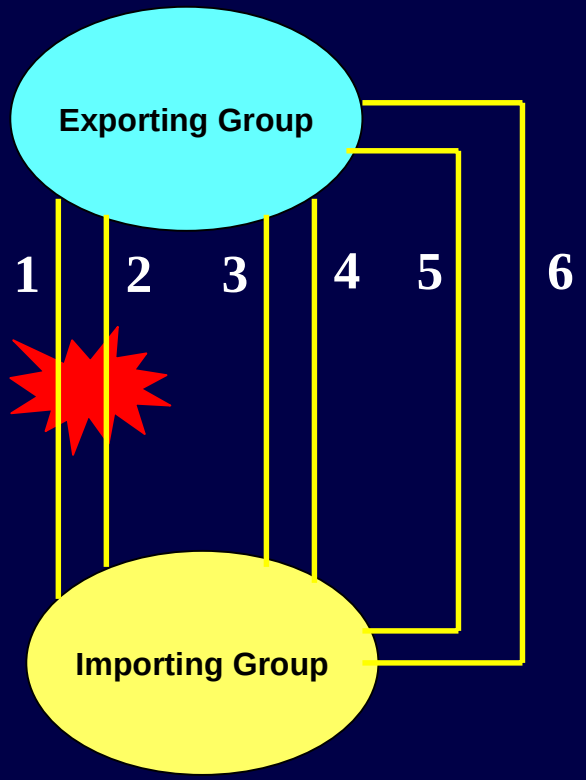
Thermal Constraint - Example

Circuit	Pre Fault Flow/MVA	Post Fault Flow/MVA	10 Minute Rating/MVA	Continuous Rating/MVA
1	700	0	2800	2600
2	700	0	2800	2600
3	600	1250	2800	2600
4	600	1250	2800	2600
5	300	350	1500	1200
6	300	350	1500	1200



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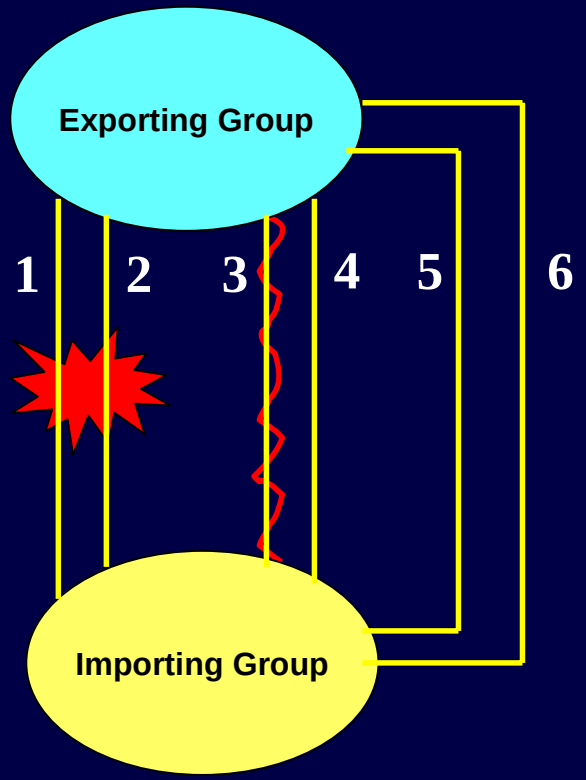
Thermal Constraint - Example

Circuit	Pre Fault Flow/MVA	Post Fault Flow/MVA	10 Minute Rating/MVA	Continuous Rating/MVA
1	900	0	2800	2600
2	900	0	2800	2600
3	700	2000	1900	1700
4	0	0	0	0
5	350	600	1500	1200
6	350	600	1500	1200



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Thermal Constraint - Example

- **Credible fault results in unacceptable Loading of Circuit 3**
- **If sufficient ‘post fault’ actions available need to restrict overload to 10 minute rating + further action in 10 minutes to reduce to continuous rating**
- **If no post fault actions need to restrict overload to continuous rating**

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Options Available

- Can we re-configure the system to reduce overload
- Defer Outage - can the work be accommodated at some other time
- Can we reduce the outage duration
- Can we enhance the circuit rating
- Can we reduce generation/increase demand in exporting group or increase generation/reduce demand in the importing group
  - What are the forecast costs
  - What is the duration
  - BM vs BS

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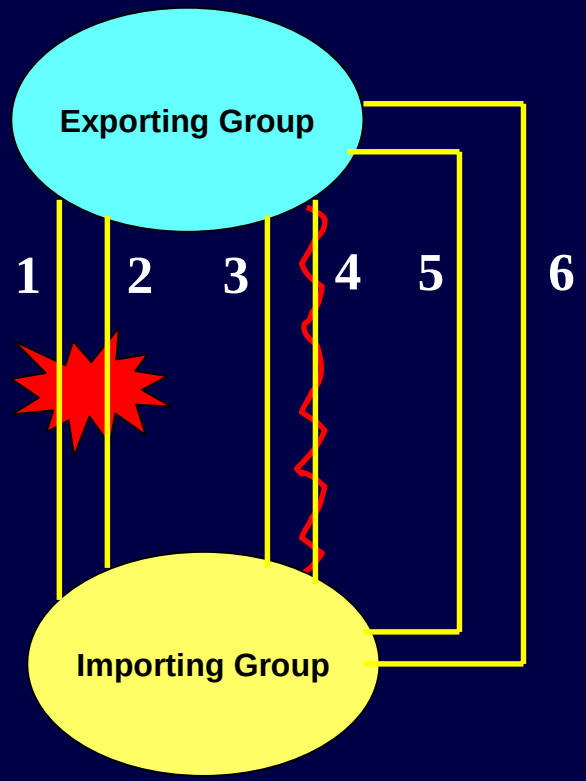
Example Continued

MORE installed on
Circuit 3 - 10 minute and
continuous ratings
increase by 100 MW

Circuit	Pre Fault Flow/MVA	Post Fault Flow/MVA	10 Minute Rating/MVA	Continuous Rating/MVA
1	900	0	2800	2600
2	900	0	2800	2600
3	700	2000	2000	1800
4	0	0	0	0
5	350	600	1500	1200
6	350	600	1500	1200



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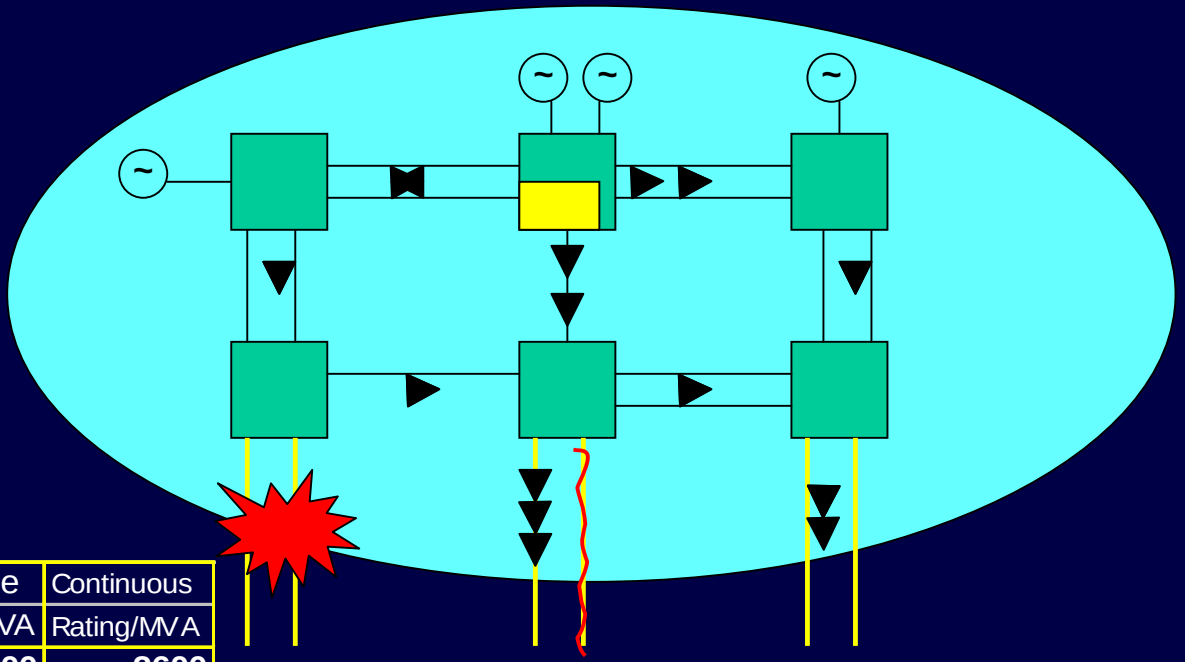
Example Continued



Circuit	Pre Fault Flow/MVA	Post Fault Flow/MVA	10 Minute Rating/MVA	Continuous Rating/MVA
1	900	0	2800	2600
2	900	0	2800	2600
3	700	1400	2000	1800
4	0	0	0	0
5	350	900	1500	1200
6	350	900	1500	1200

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Example Continued

Qu. What if no transmission options and BM costs expensive?

An. Find an Alternative (e.g. Contract with demand/generation non)

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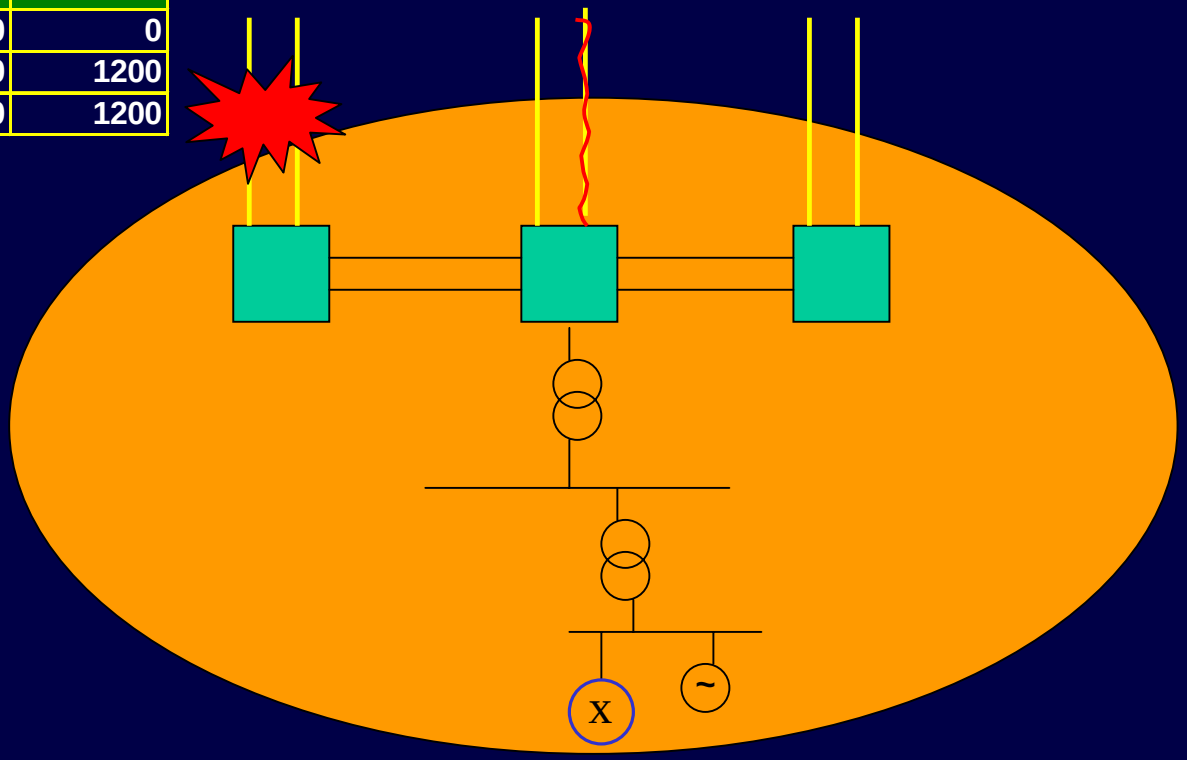
Example Continued

Circuit	Pre Fault Flow/MVA	Post Fault Flow/MVA	10 Minute Rating/MVA	Continuous Rating/MVA
1	900	0	2800	2600
2	900	0	2800	2600
3	700	1800	2000	1800
4	0	0	0	0
5	350	600	1500	1200
6	350	600	1500	1200



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Summary

- **Transmission constraints can be complex**
- **We have many options available to manage them**
- **Alternatives to BM Units are available and have been successfully used**
- **We will investigate all options to minimise costs**

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