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Balancing Services Sub-group

Enhanced Frequency Containment Requirement Development 1st May 2014

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Enhanced Frequency Containment Capability

Outline

- Context
- What it is and what is isn't
- Next Steps
- NIC

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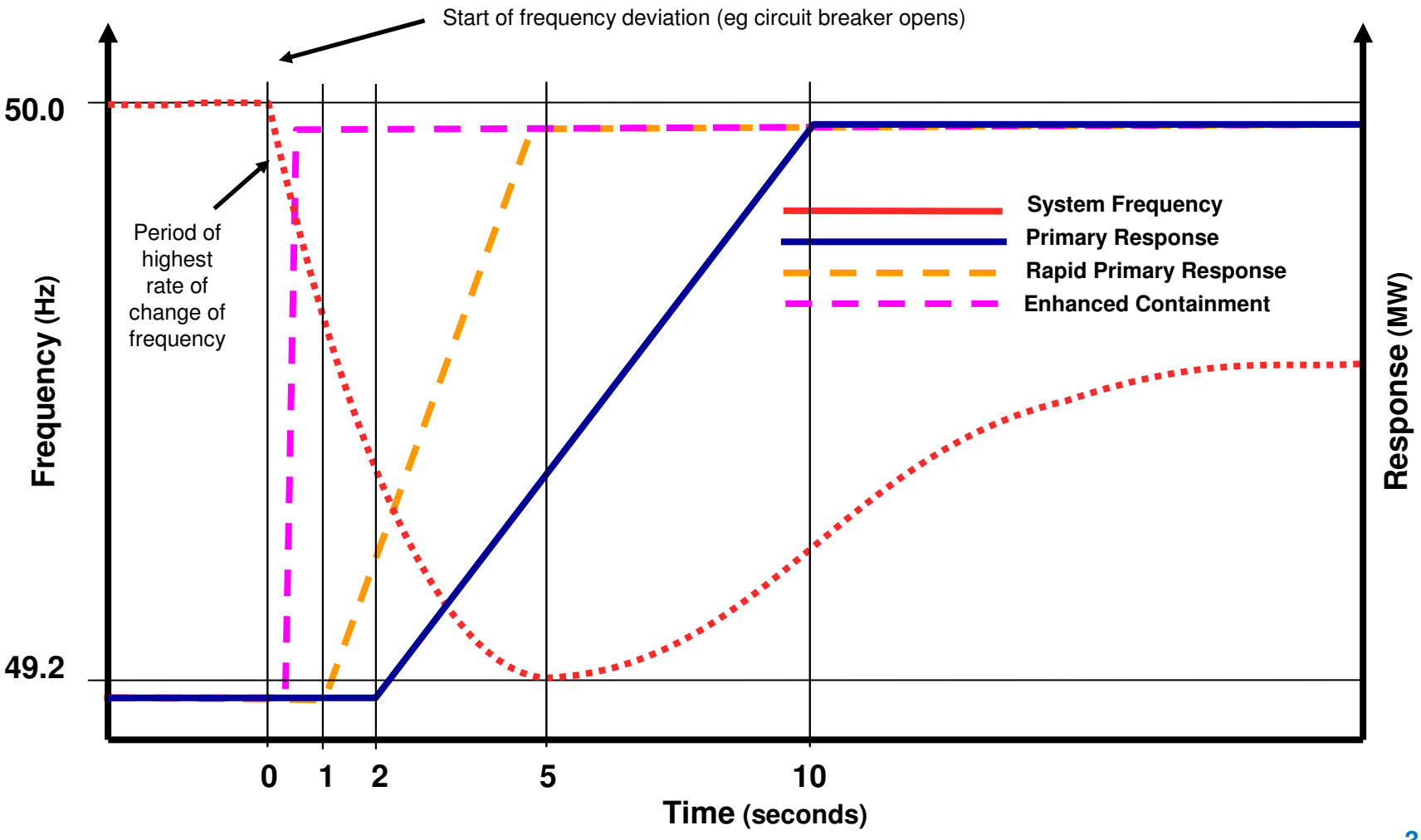
Enhanced Frequency Containment Capability



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Enhanced Frequency Containment Capability

What is it?

- Fast acting, but needs to be stable and predictable
- Delivery of Active Power in less than two seconds of a frequency deviation commencing
  - Less than 500ms preferred, final specification subject to feedback received
- Variety of trigger mechanisms plausible
  - RoCoF
  - Direction actuation (eg intertrip)
  - Static relay unlikely to be quick enough

How much?

- At any one time, the total system requirement is less than the largest loss risk
- Proportionality to frequency deviation preferred

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Enhanced Frequency Containment Capability

Duration?

- Long enough to allow “conventional” response to take over
- Subject to maximum volume of energy available
  - potential trade off between power delivered and duration

What would it be used for?

- Containment of frequency after large losses

How often?

- On the occasion of a large loss (ie 10 to 20 times per year)

When?

- At times of low load, post 2017/18
- Potential value earlier

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What does it do for the system?

- Additional option to manage frequency containment
- Fit for purpose for future operating scenarios

What does it do for potential providers?

- New opportunity to deliver value
- Potential value from innovation
- Opportunity to manage energy volumes

Isn't this "Synthetic Inertia"?

- The system requirement is similar and it's possible that "Synthetic Inertia" could meet an Enhanced Frequency Containment requirement
  - "Synthetic Inertia" is currently incompletely defined and likely needs to be system specific
- No absolute requirement to exceed active power rating or "power available" at this stage

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Enhanced Frequency Containment Capability

Next steps in development

- Gauge interest and development requirements from potential providers
  - Summer 2014
- Identify gaps in capability which might benefit from development
  - Autumn 2014
- Develop timeline for prospective capability requirement
  - Winter 2014
- Progress Enhanced Frequency Control Network Innovation Competition project
  - Full Submission deadline is Friday 25 July 2014
  - https://www.ofgem.gov.uk/network-regulation-–-riio-model/network-innovation/electricity-network-innovation-competition

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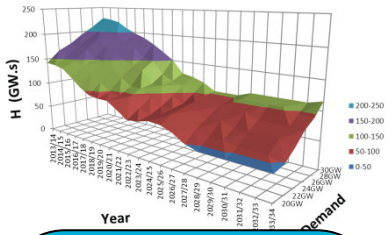
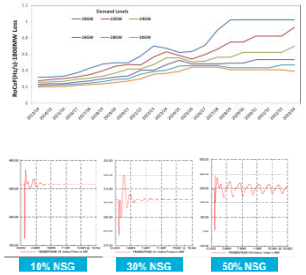
Addendum
Network Innovation EFCC Project

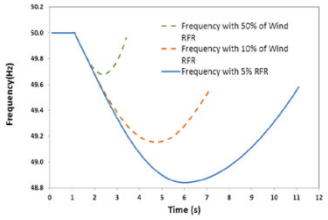
Managing Low System Inertia, still providing frequency response across the recovery timeframe



Expected Reduction in System Inertia; faster frequency movement- risk of short term under/ overshoots



Challenges:
- Trade offs between Frequency Containment & Deficits during Recovery phase
- System Stability



Solutions:
- Rapid Frequency Response
- Storage
- Demand Side Response
- Portfolio of services and technologies
- New commercial frameworks

NIC Project Investigates (trial) the provision of rapid power modulation to address frequency containment, whist still maintaining system stability

Consequences of reduction of system inertia

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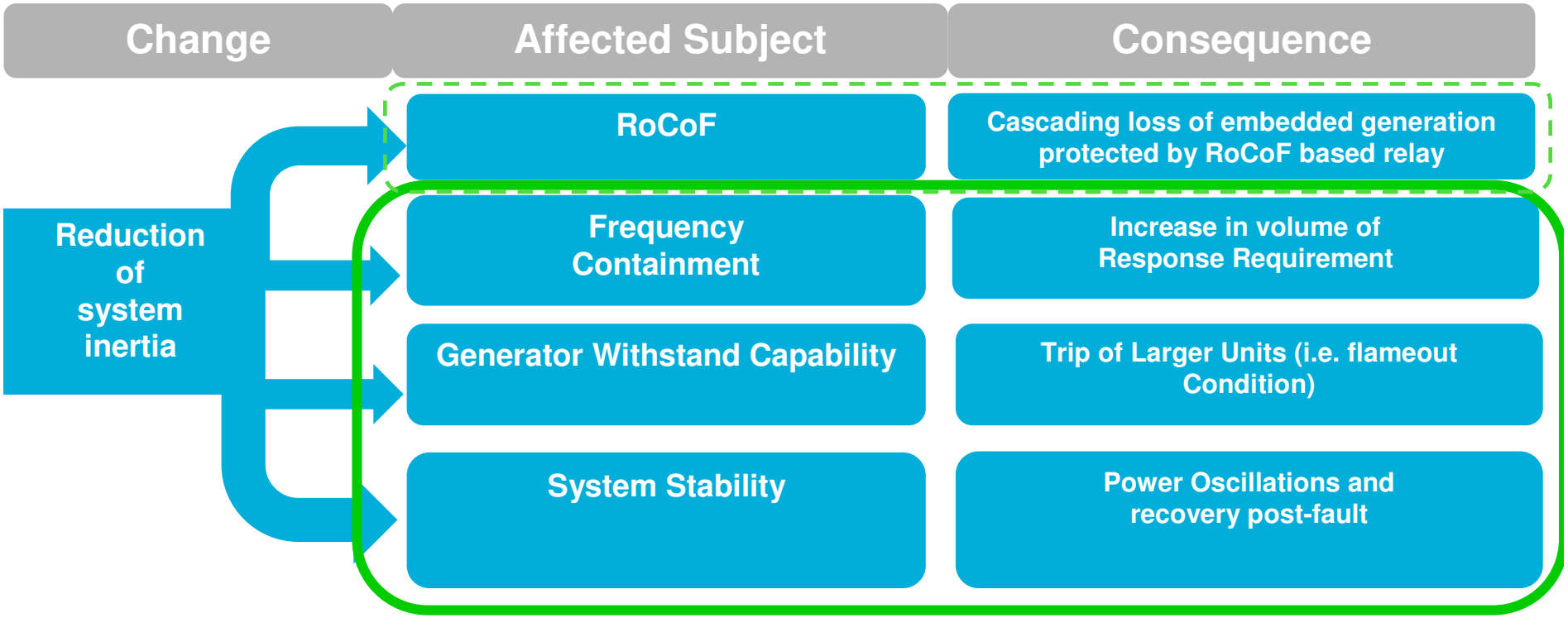
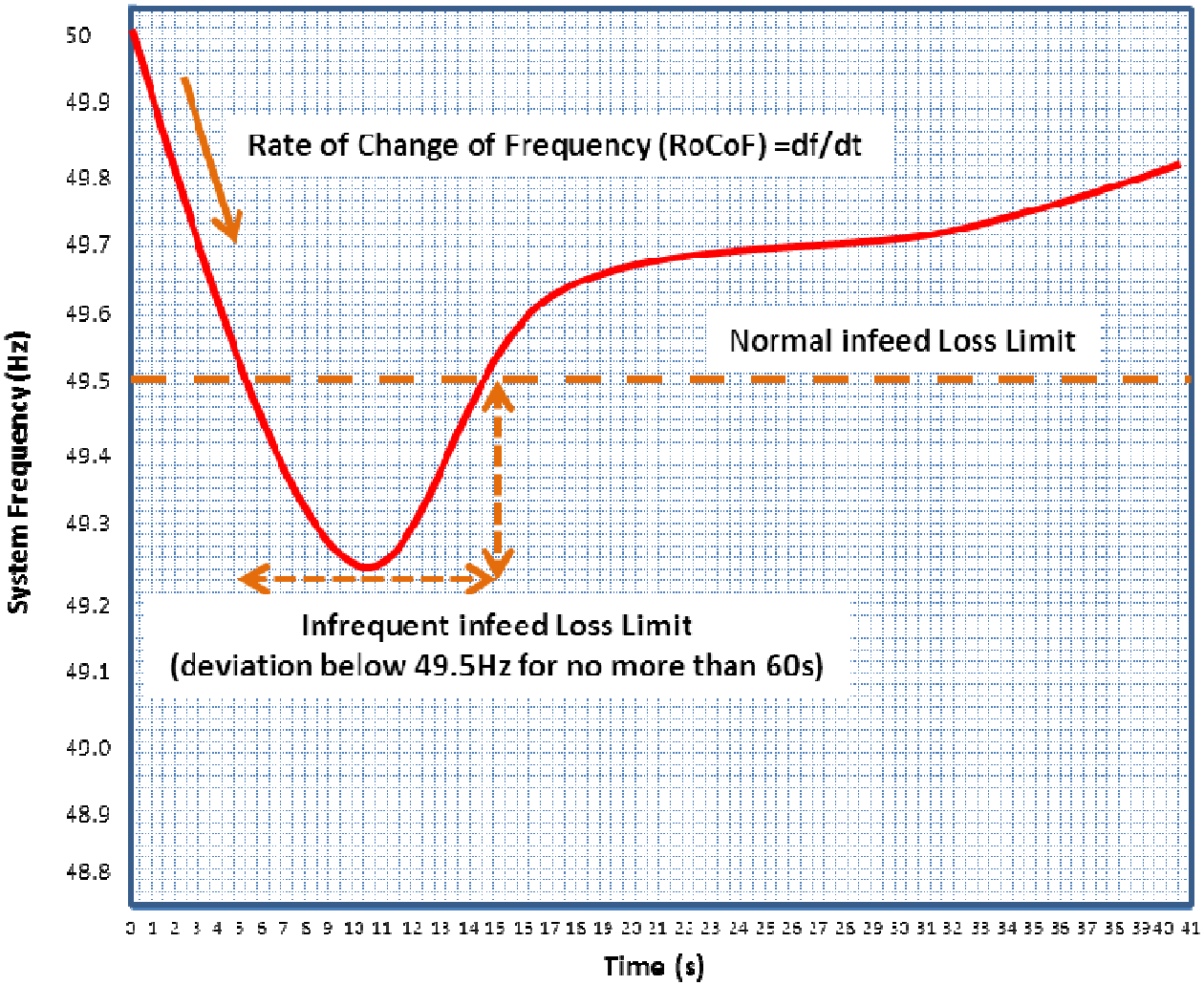


- Both the effect of the rapid change on the range of generator protections and controllers needs consideration
- The effects of new rapid response services upon nearby plant similarly require consideration

System Frequency Containment & recovery



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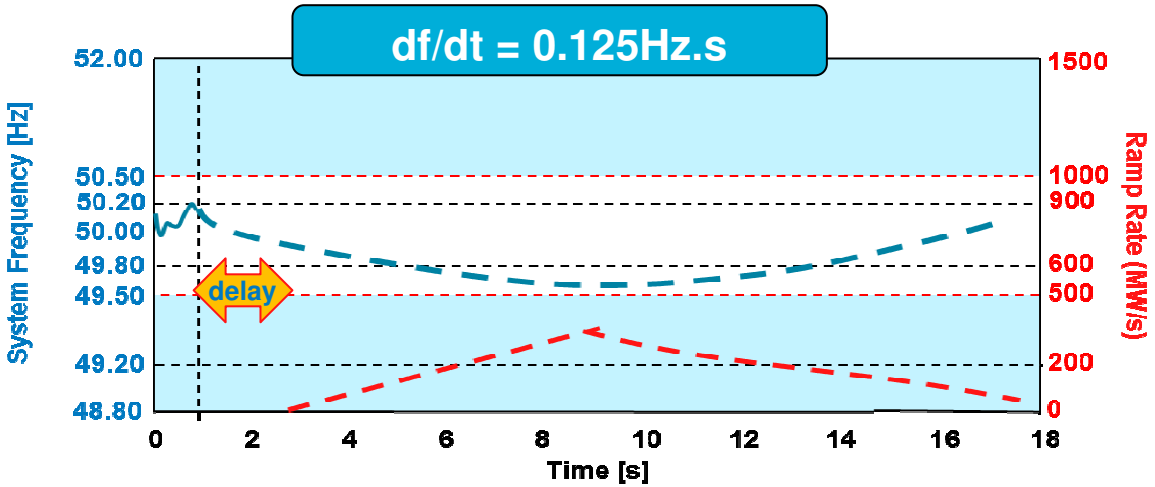
Frequency Response (1)

- When the system inertia is ***high***, there will be more time for the primary response to react and contain the frequency within statutory limits.
- On average, on thermal plant, 2s after the event the primary response starts to become effective. Within this 2s, this plant is also additionally providing an inertia response to frequency decline.
- Service currently defined around aligning NSG performance to that of thermal plant. For fast response different specification may be required.



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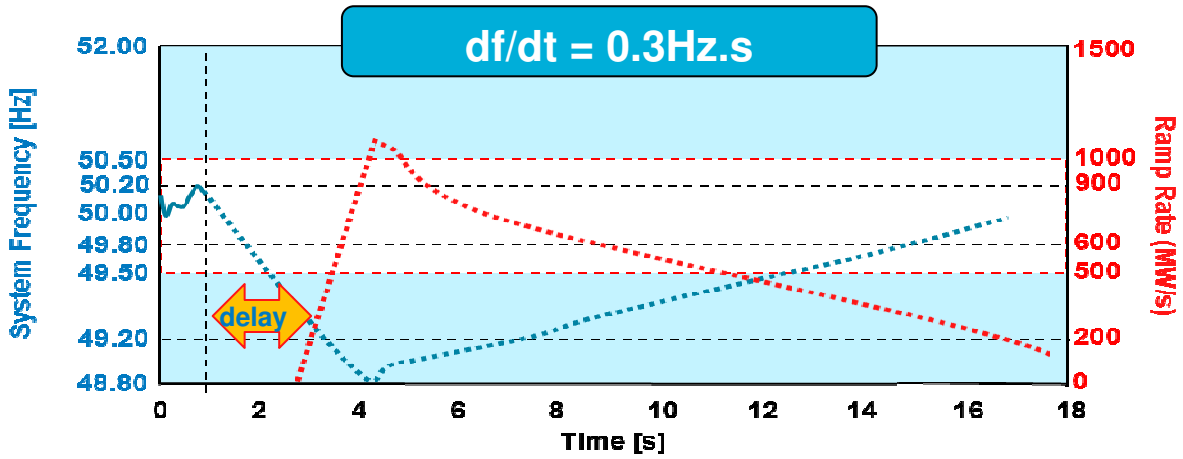
Frequency Response (2)

- When the system inertia is ***low***, the frequency deviates with a higher rate of change, hence it will require either larger volume of response, or a faster response to become available.
- The delay between the event and the beginning of the response is also more critical- the catching and arresting of the frequency decline
- Innovation therefore in service definition, specification and the technology of control and delivery of response from users is needed



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Opportunity for Innovation

- To avoid significant increase cost in frequency response, provision of rapid frequency response is desirable
- To achieve such rapid response, different approaches to “prediction/instruction/detection/activation” of response is desirable
- Diversifying the frequency response market (obtaining rapid response from solar PV, DSR, storage, and Wind) will also enable a more economic and efficient way of delivering system requirement.

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Stage 1

- Demonstrate a new Prediction/ instruction /detection/ activation method for primary response
  - Based on either df/dt, or a pre-loss calculation of it, or another metric (defined by user & technology) equally effective; rather than a reliance on absolute frequency
  - In proportion or delivered at a higher rate than the df/dt occurring
  - Faster than, 2sec from the initiation of the event
  - Regional specific- df/dt as seen regionally will be different. The effectiveness of the overall service provided will therefore to be evaluated from the range of services provided over the range of locations provided, for the range of system conditions considered.

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Stage 2

- Demonstrate the effectiveness of providing the response via the new method from
  - DSR
  - Storage
  - Solar PV
  - Wind
- New technology focused solutions may need investigating
  - Speed/ slip modulation control on asynchronous generation
  - Frequency dependant loss state within PV semiconductor

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Stage 3

- Demonstrate the optimisation of response in order to provide the most economic and efficient rapid frequency response
  - At different system conditions
    - Generation/Demand level
    - For different df/dt
- Validation of control approaches across small and low disturbances, and inter area oscillation and periods of extensive voltage dip associated with the loss.
- Trial period of at least 3-6months to observe effects of service, coupled with simulation and tested service assessment, where appropriate.