TSO-DSO Coordination for Future System Services Provision

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Outline

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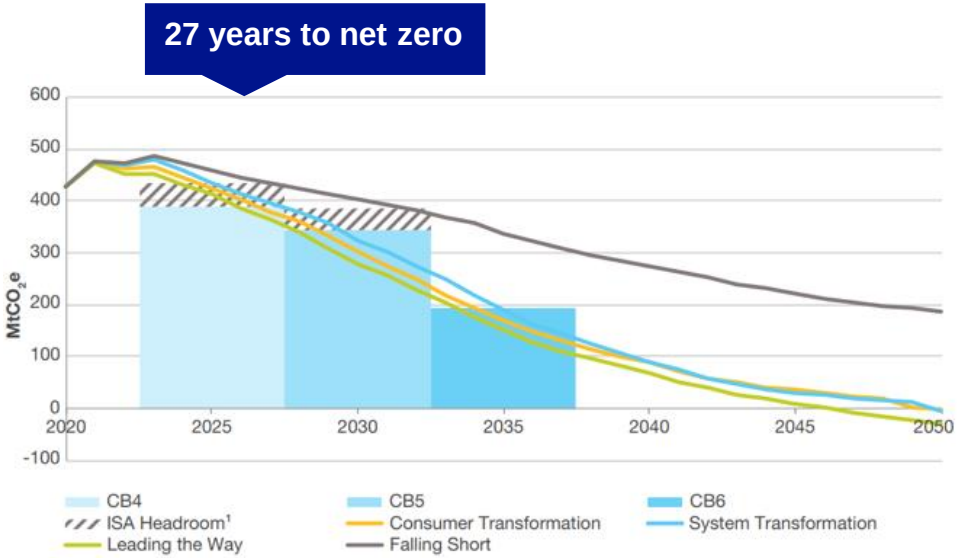
01	Transformation of GB Power System
02	Conflict in Future System Operation - Balancing Mechanism Coordination
03	Proposed Solution – ANM Coordinating Balancing Mechanism Delivery
04	Trial Demonstration Outcomes
05	Conclusions

Transformation of GB Power System

Net Zero Target 2050

- Operation and control increasingly challenging
- Novel services continuously explored and developed
- Extensively harnessing capabilities of Distributed Energy Resources (DER) and flexibility within Distribution networks



Source: FES in Five July 2022

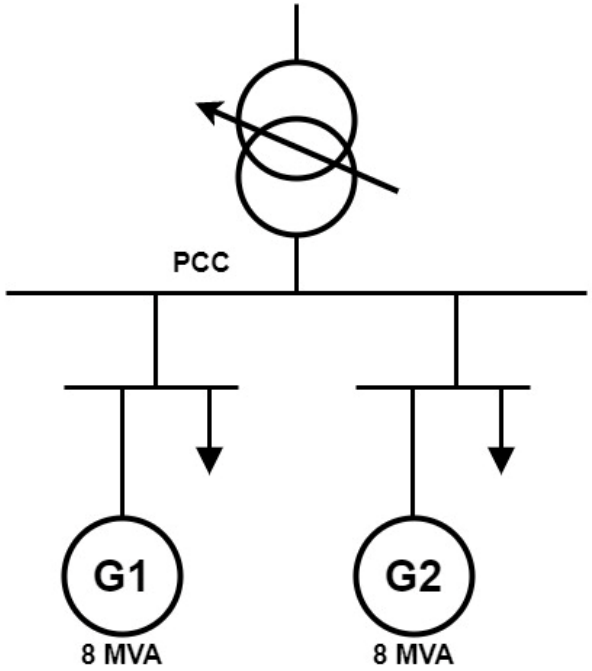
Problem Statement

ANM schemes which are not coordinated with wider Balancing Services markets will increase costs to consumers and may pose a risk to security of supply

Potential Conflict between BM and ANM

Sample Distribution Network

- Two Generators rated at 8MVA
- ANM implemented with objective to controlling power export at PCC* (9MW)
- Generator G1 non-curtailable
- Generator G2 curtailable – ANM
- 1 MW Load, no load variations



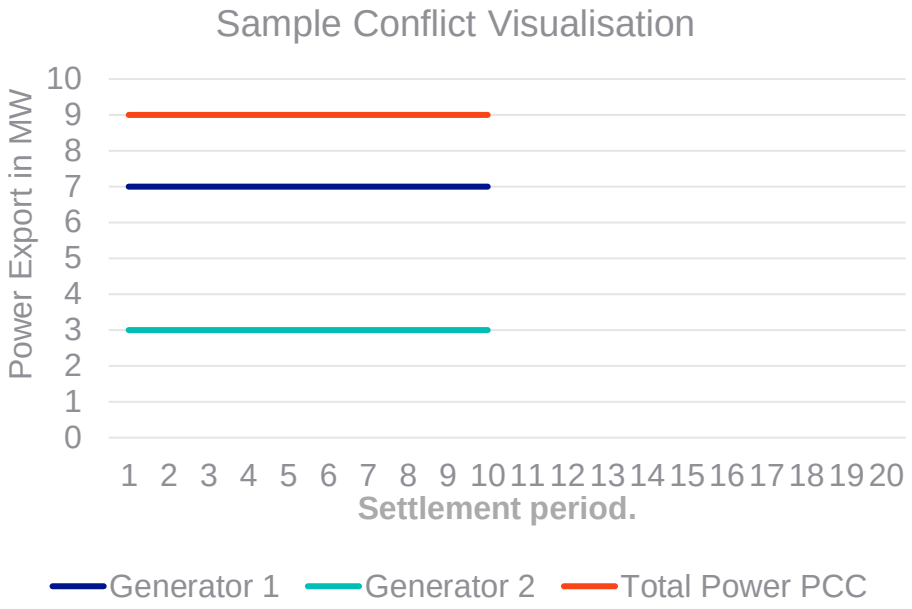
*PCC = point of common coupling

Potential Conflict between BM and ANM

Sequence Leading to Conflict:

1. Normal operating conditions

   ANM controlling power at PCC



Potential Conflict between BM and ANM

Sequence Leading to Conflict:

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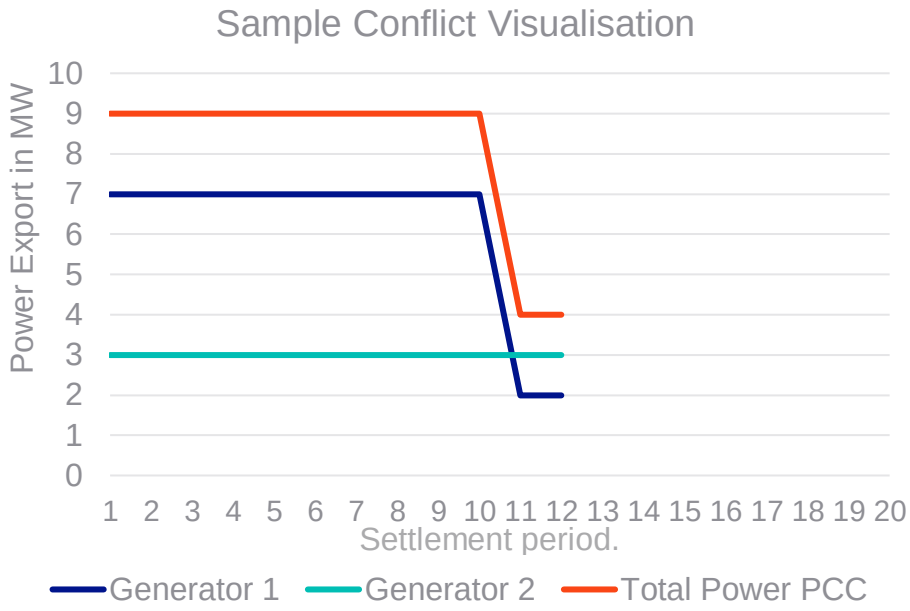
2. NGESO issues command to Generator 1 to reduce power by 5MW

   Generator 1 responds by reducing power output from 7MW to 2MW



Potential Conflict between BM and ANM

Sequence Leading to Conflict:

1. Normal operating conditions

   ANM controlling power at PCC

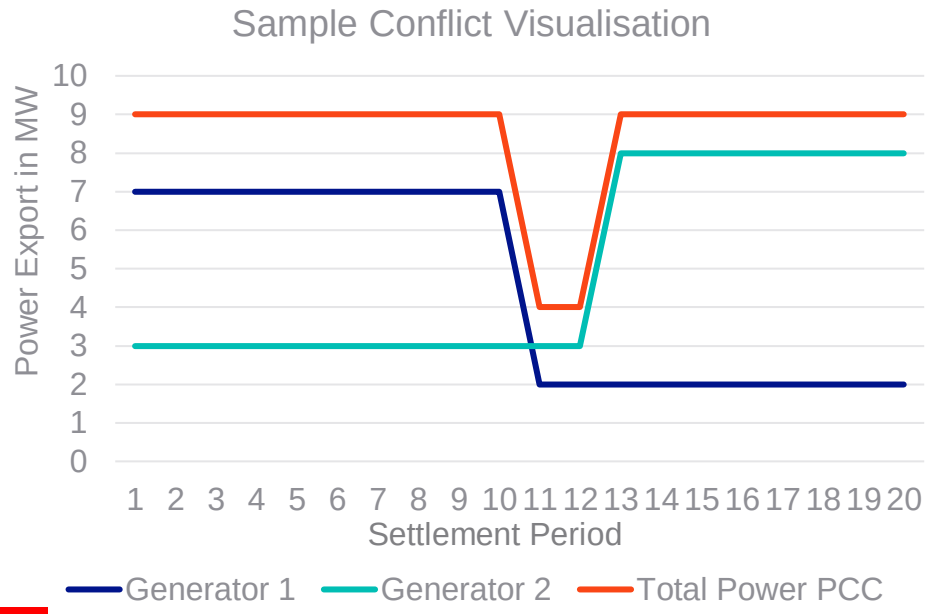
2. NGESO issues command to Generator 1 to reduce power by 5MW

   Generator 1 responds by reducing power output from 7MW to 2MW

3. ANM observes the reduction in uncontrolled Generator 1 and releases headroom for Generator 2

   Generator 2 ramps up power to 8MW

Impact of BM nullified



Potential Solutions

- Nine solutions proposed under four categories for conflicts identified.
- Solutions evaluated based on cost benefit analysis and their technical feasibility.
- Solution W1 (technical) taken forward for proof of concept implementation and demonstration.

“W” solutions
Reconfiguration of ANM schemes

“X” solutions
Improved information exchange between DNOs and generators

“Y” solutions
Changes to Balancing Services procurement

“Z” solutions
Coordinating CLASS and ANM systems

nationalgrid

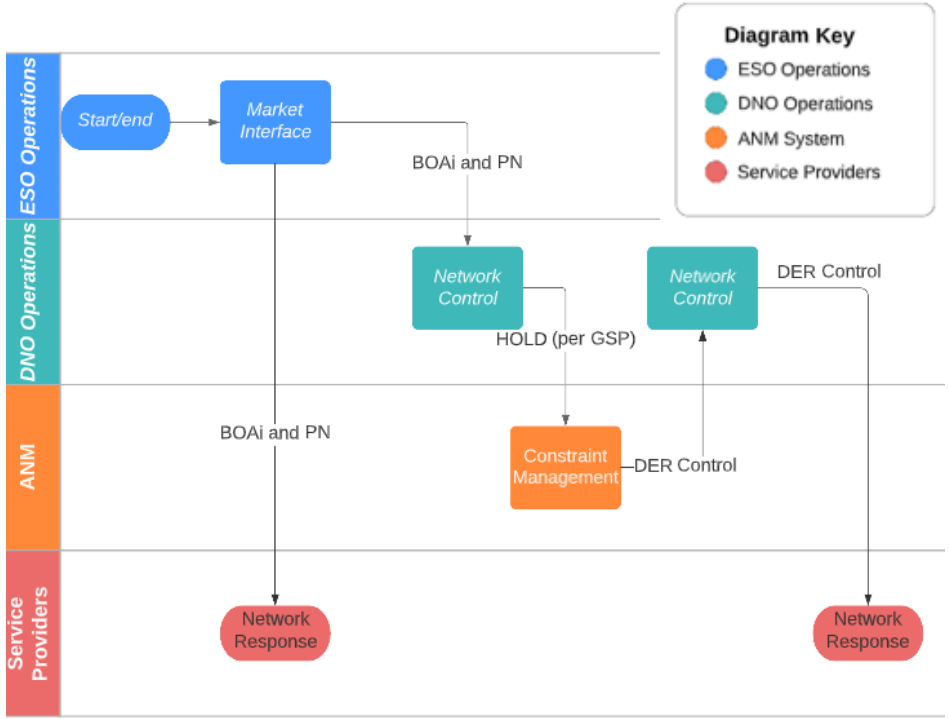
nationalgridESO

wsp

smarter grid solutions

The Solution

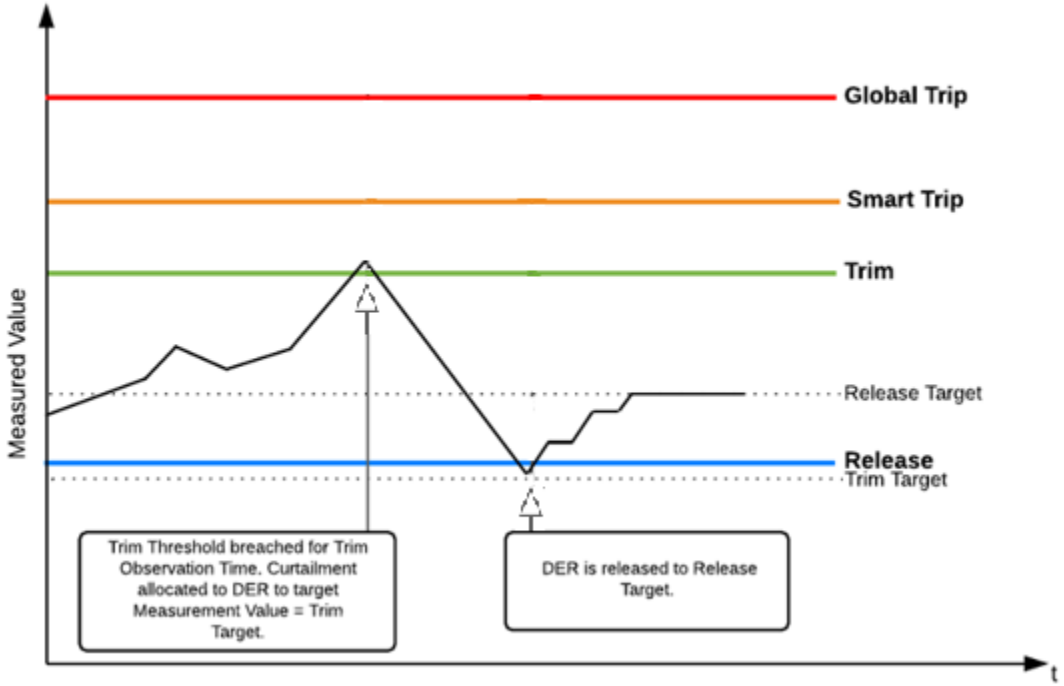
1. ESO notifies DNO about service requests
2. DNO calculates whether conflict is possible
3. If conflict is possible DNO puts ANM into “Hold Mode”
4. ANM actively manages Flexible DER Contribution



Normal ANM Operation

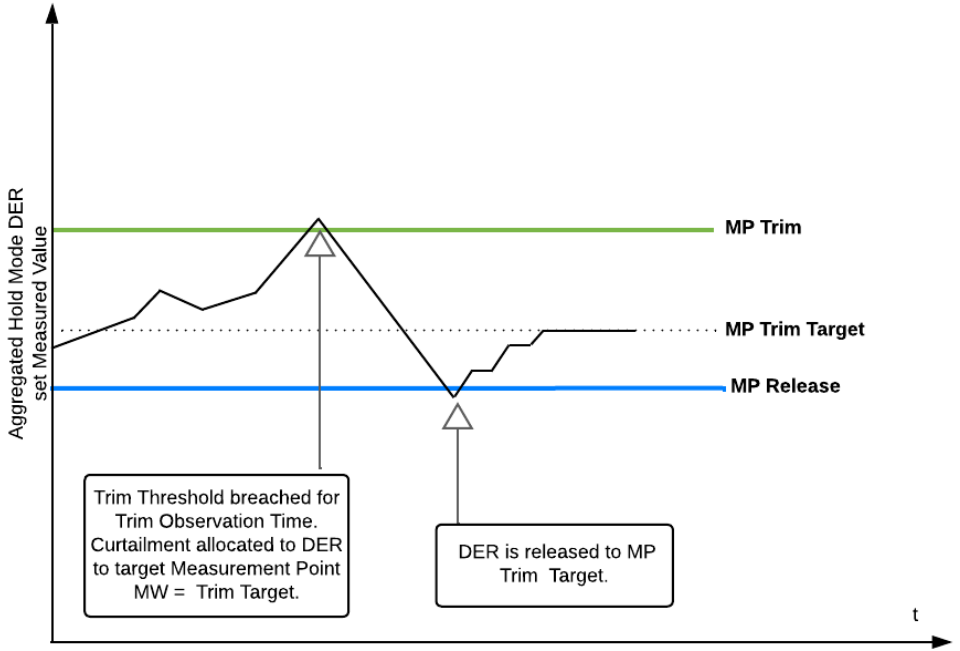
Constraint locations are managed in real time by *Measurement Points (MP)*

1. Measured Value exceeds trim threshold.
2. Flexible DER are curtailed
3. Measured Value reaches Release threshold
4. Some Flexible DER are released & safe margin is maintained.



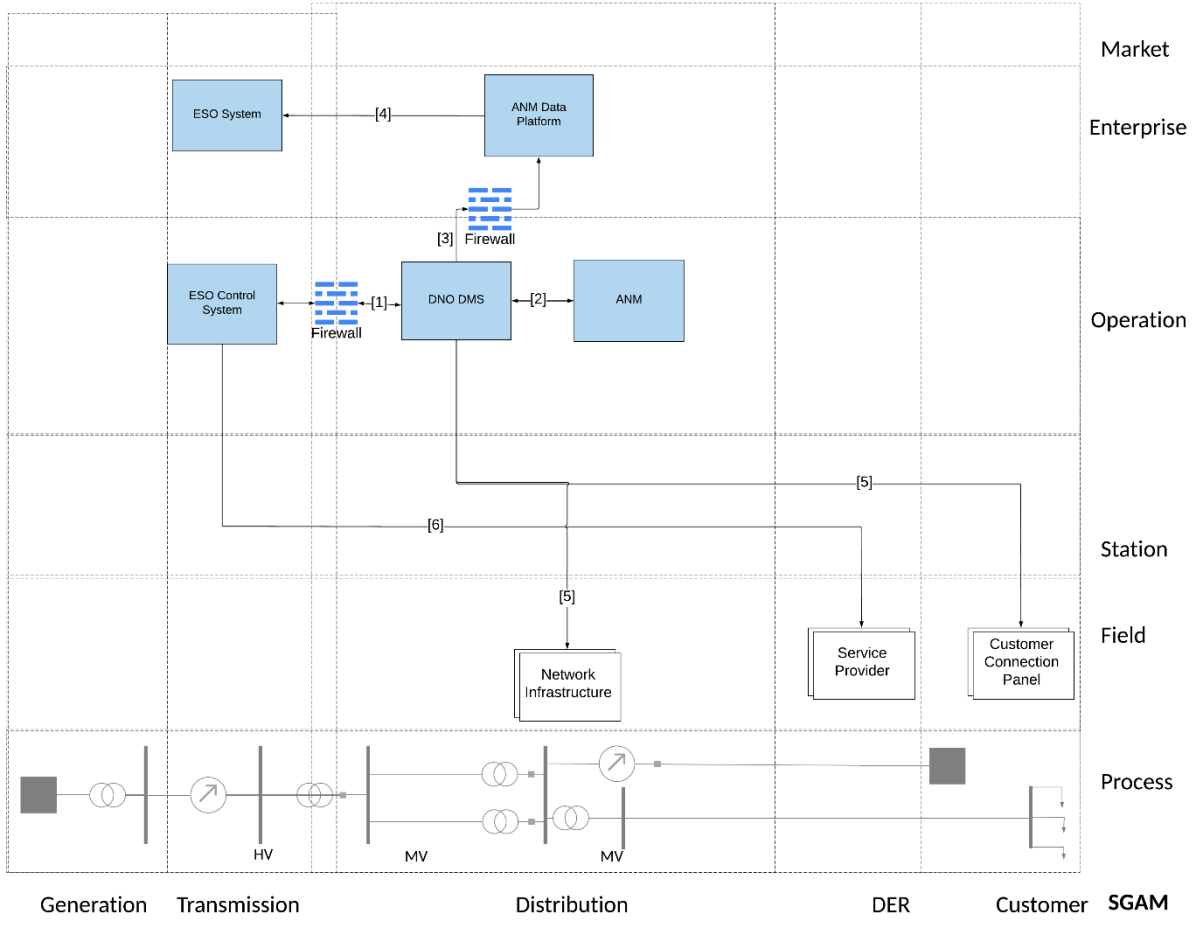
Hold Operation

- Extension to Normal ANM Operation
- Virtual Measurement point enabled
  - Measured Value = Aggregated Generator Contribution
  - Trim = AGC when Hold enabled
- Principles of Access Maintained
- Other network constraints can be managed



Architecture

ID	Communication Type	Medium
1	ICCP over Dedicated Operational Telecom Network (Phase 1)	Dedicated Operational Telecom Network
2	ICCP	LAN
3	ICCP	LAN
4	Web service API (Phase 2)	Dedicated MPLS
5	Existing SCADA infrastructure	Depending on DNO
6	Existing Balancing Mechanism communications	Depending on provider

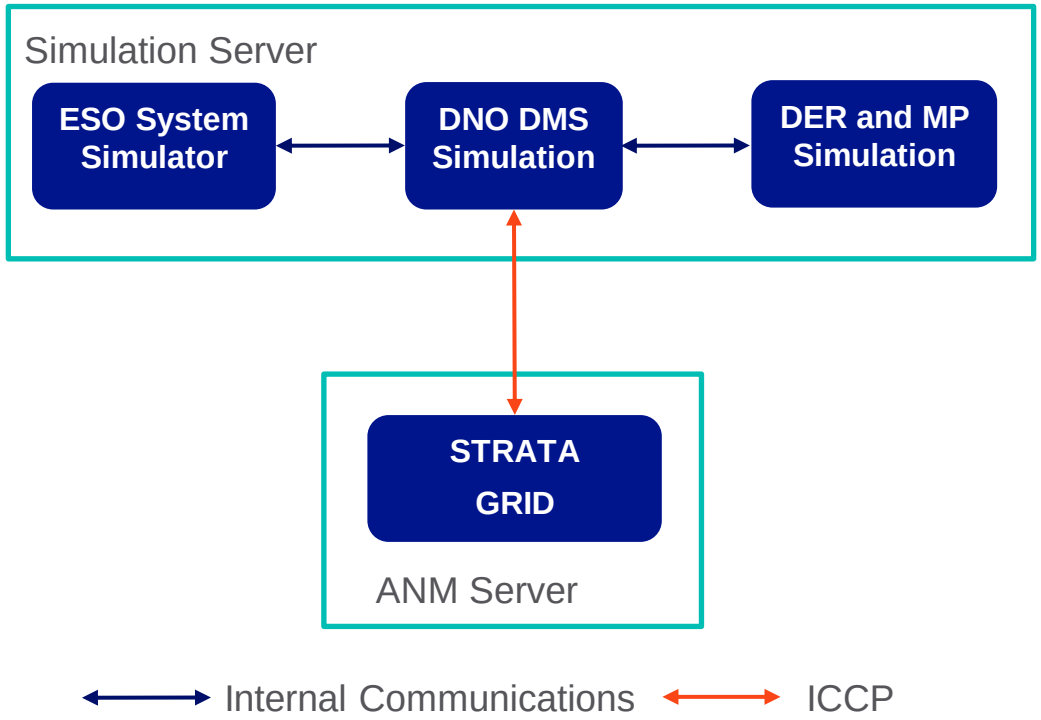


Trial Architecture

Instance of Strata Grid deployed with Hold Mode functionality

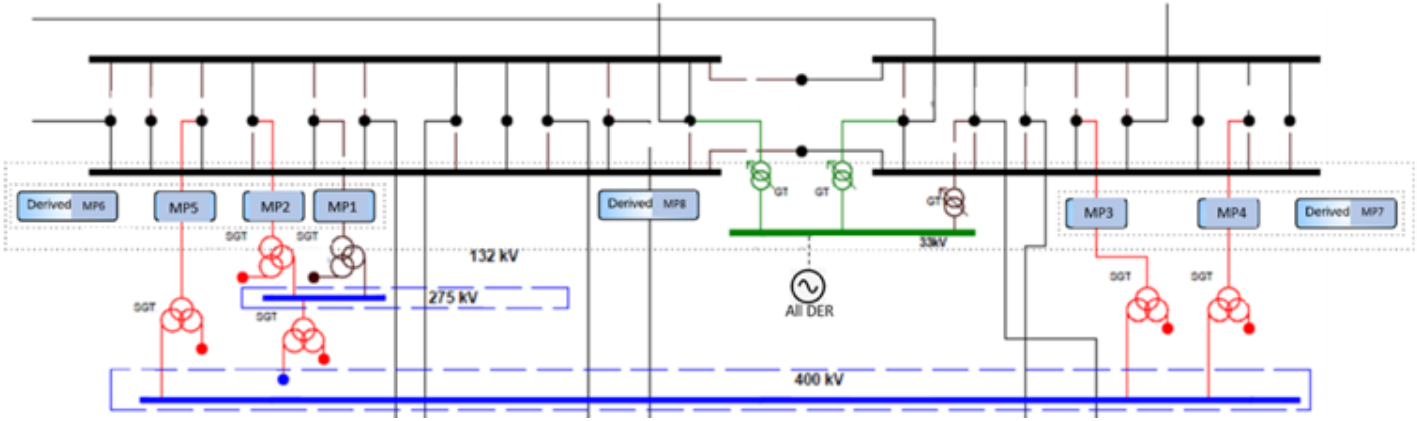
Simulation server providing following functions

- ESO System:
  - Issuing data about BM requests.
- DNO System:
  - Receiving and parsing BM requests
  - Pass through of DER & Network Data to ANM System
- Network Simulation
  - Simulating DER response
  - Simulating network response



Test Network Overview

Generator Name	Max. MW	Type	ANM Y/N
Generator 1	8	Wind	Y
Generator 2	3.68	PV	Y
Generator 3	7.84	PV	Y
Generator 4	1.9	Hydro	Y
Generator 5	4.12	PV	Y
Generator 18	10	Battery	N
Generator 19	10	Battery	N

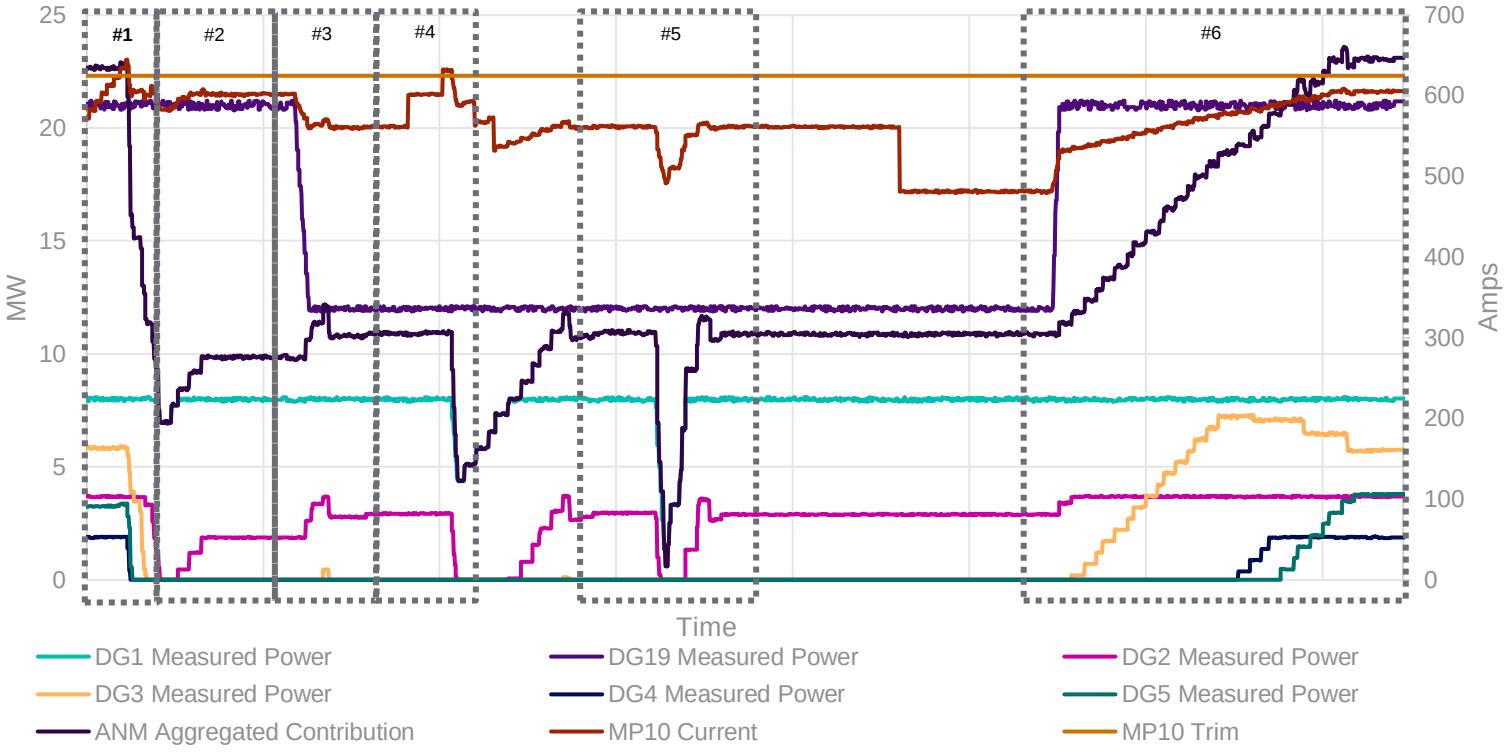


Measurement Point	Transducer Measurements	Description
MP1	Thermal (A) Directional 132 kV	Thermal constraint at transmission / distribution boundary
MP2	Thermal (A) Directional 132 kV	Thermal constraint at transmission / distribution boundary
MP3	Thermal (A) Directional 132 kV	Thermal constraint at transmission / distribution boundary
MP4	Thermal (A) Directional 132 kV	Thermal constraint at transmission / distribution boundary
MP5	Thermal (A) Directional 132 kV	Thermal constraint at transmission / distribution boundary
MP6	Thermal (A) Directional 132 kV	Virtual MP controlled overall current through MP1, MP2, and MP5.

Measurement Point	Transducer Measurements	Description
MP7	Thermal (A) Directional 132 kV	Virtual MP controlled overall current through MP4 & MP5
MP8	Thermal (A) Directional 132 kV	Virtual MP controlled overall current through MP1, MP2, MP3, MP4 & MP5
MP9	Voltage (V)	Voltage constraint in distribution network
MP10	Thermal (A) Directional 33 kV	Thermal constraint in distribution network
MP11	Thermal (A) Directional 33 kV	Thermal constraint in distribution network

Sample Results: Constraint Management in Hold Mode

1. **Thermal constraint trim & DG curtailed**
2. **BMU ramps down**
3. **Hold Mode enabled**
4. **Thermal constraint trim & DG curtailed**
5. **Voltage constraint trim & DG Curtailed**
6. **Hold Mode disabled, BMU ramps up, ANM DER ramps up.**



ABCD Learning Dissemination Webinar: https://www.nationalgrid.co.uk/innovation/projects/anm-balancing-coordination-demonstration-abcd

Commercial Evaluation and Learnings

Objectives

Financial and commercial evaluation necessary to understand the implication considering Access SCR.

Approach

- Review Access and Forward-Looking Significant Code Review (Access SCR)
- Engage with subject matter experts
- Identify data requirements for evaluation

Learnings & Challenges

Potential loss of revenue by a generator

DNO/ESO could incur costs to maintain balancing service headroom

Lack of Data

- It became apparent that the companies don't currently collect some of the information needed to carry out the assessment.
- In some cases, it would be unknown (e.g., the DNO doesn't know what a generator would export, if it was not curtailed).

Conclusions and Next Steps

- Increasing need for flexibility services from distribution network assets
- Distribution network assets may participate in one or more service provision, potential conflicts should be analysed.
- TSO-DNO coordination can mitigate conflicts
- Lack of data for analysing financial and commercial implications.
- Next Steps:
  - Data platform for facilitating information exchange between TSO and DNO
  - Analysis of additional conflicts
  - Field trial

Thank You

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