Introduction

DS3 Industry Forum

4th June 2015

Louis Fisher

Agenda

Time	Agenda Item	Speaker
10:00-10:05	**Introduction**	Chair: Louis Fisher
10:05- 11:05	**DS3 Programme Status Update**	Presentation: Robbie Aherne
	Regulatory Authorities Update	Presentation: Andrew McCorriston
	Questions and Answers	Chair: Louis Fisher
11:05-12:15	**Rate of Change of Frequency (RoCoF)**	Presentation: David Cashman Presentation: Tony Hearne
	System Services	Presentation: Eoin Kennedy
	Questions and Answers	Chair: Louis Fisher
12:15-12:55	**Operational Policies** • VDIFD • Frequency Regulation	Presentation: Lisa McMullan Presentation: Norman Watson
	Control Centre Tools	Presentation: Michael Burke
	Questions & Answers	Chair: Louis Fisher
12:55-13:00	**Closing Remarks**	Chair: Louis Fisher

DS3 Programme Status Update

DS3 Industry Forum
4th June 2015

Robbie Aherne

Recent Operational Experience

High Wind Levels in Early 2015

Chart 1: SNSP %

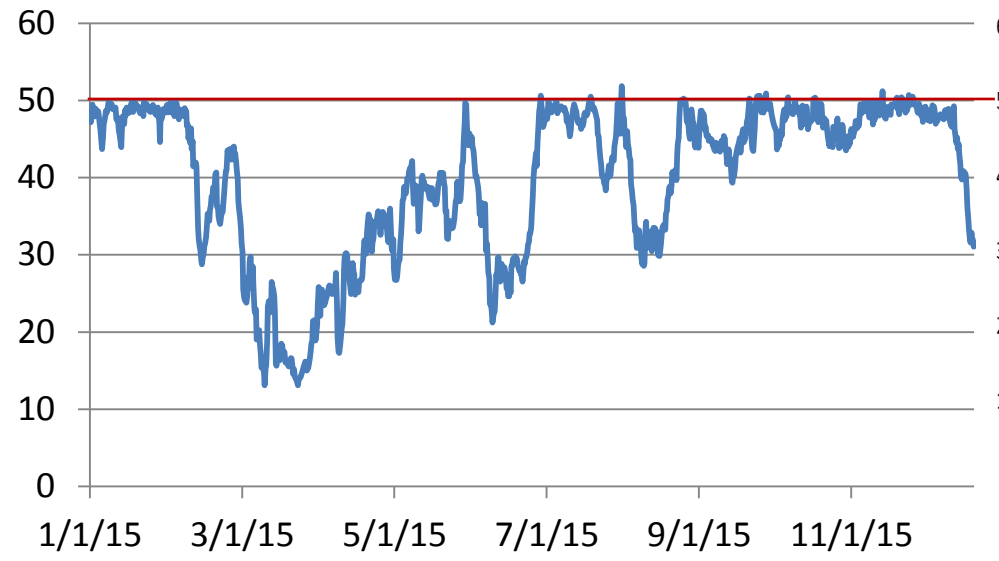
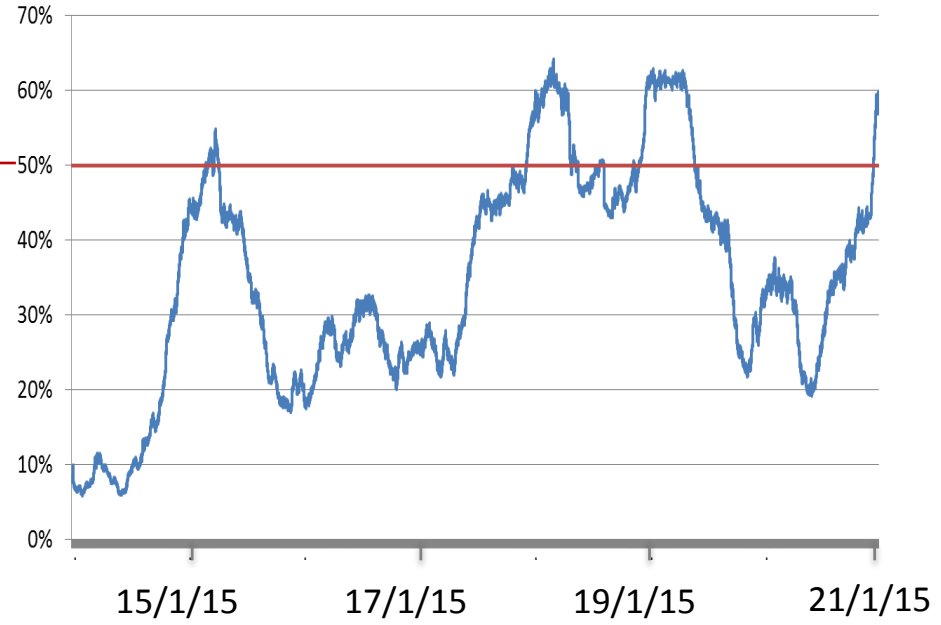


Chart 2: Wind as % of Demand



System Non-Synchronous Penetration (SNSP) was regularly hitting the 50% limit

… at times exports allow wind levels greater than 50% of demand

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$$\text{SNSP} = \frac{\text{Wind + Imports}}{\text{Demand + Exports}}$$

DS3 Programme

DS3 – Shaping the System of the Future

Grid Code

Performance Monitoring

DSM

System Services

ROCOF

Frequency

Voltage

Renewable Data

WSAT

Control Centre Tools

Model Dev. & Studies

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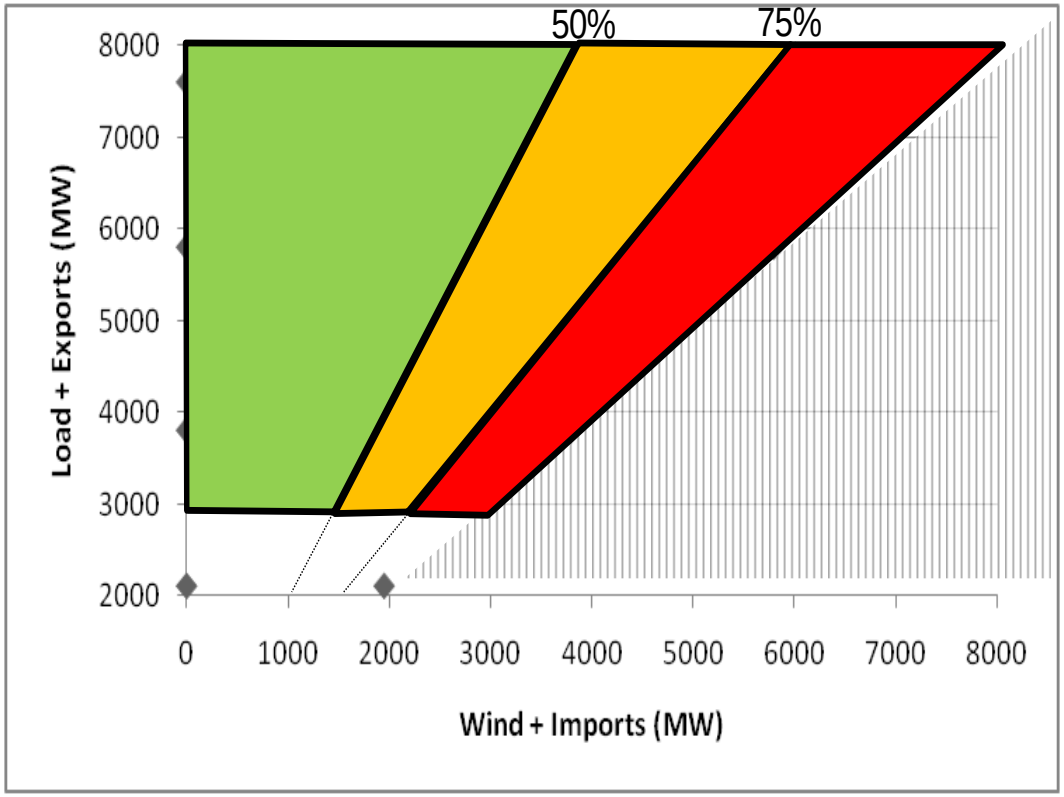
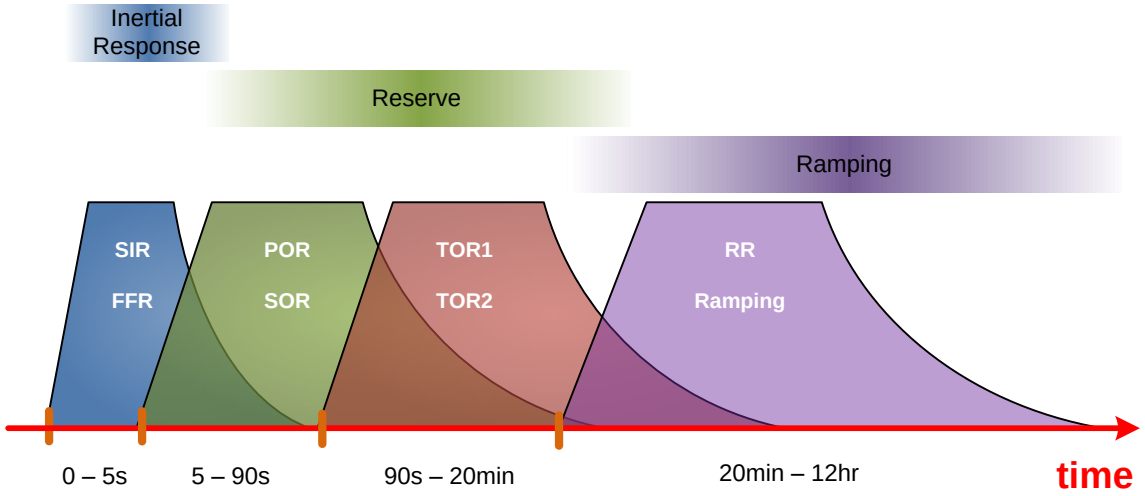
System Non-Synchronous Penetration



$$\text{SNSP} = \frac{\text{Wind + Imports}}{\text{Demand + Exports}}$$

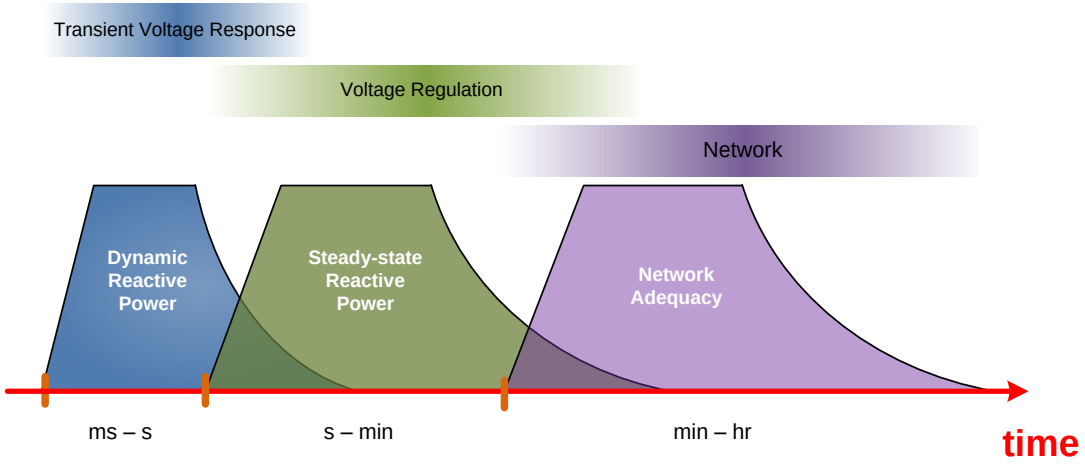
DS3 System Services Products

NEW
- Synchronous Inertial Response
- Fast Frequency Response
- Fast Post-Fault Active Power Recovery
- Ramping Margin 1,3,8 hrs



Frequency Related Products

NEW
- Dynamic Reactive Power

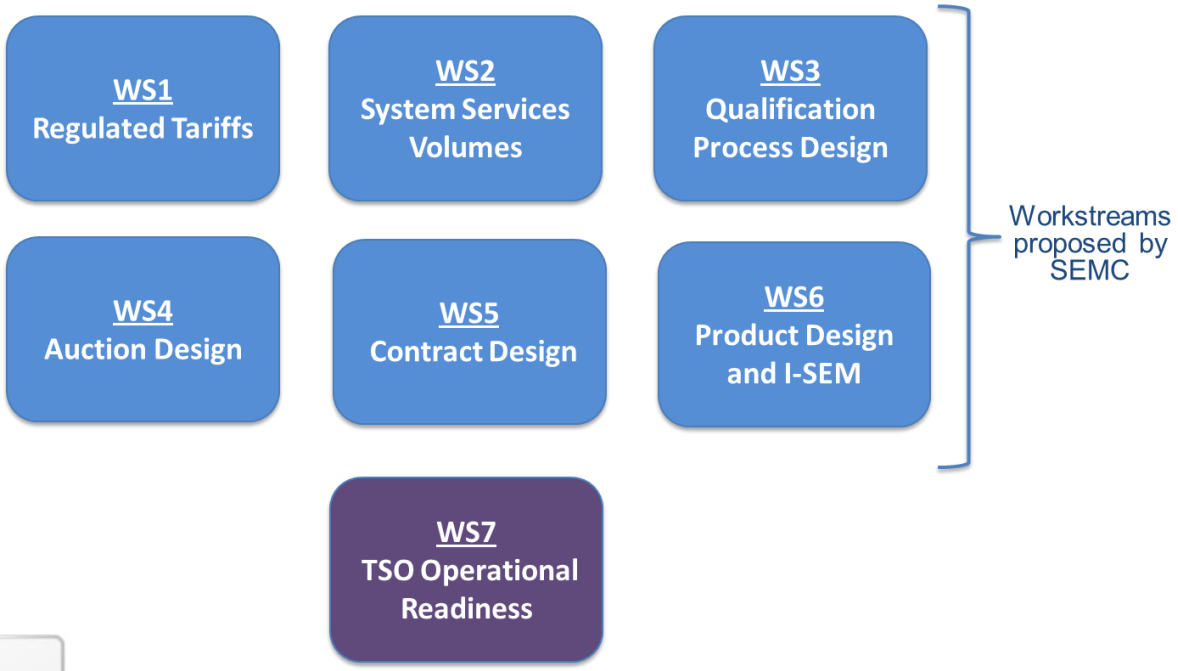


Voltage Related Products

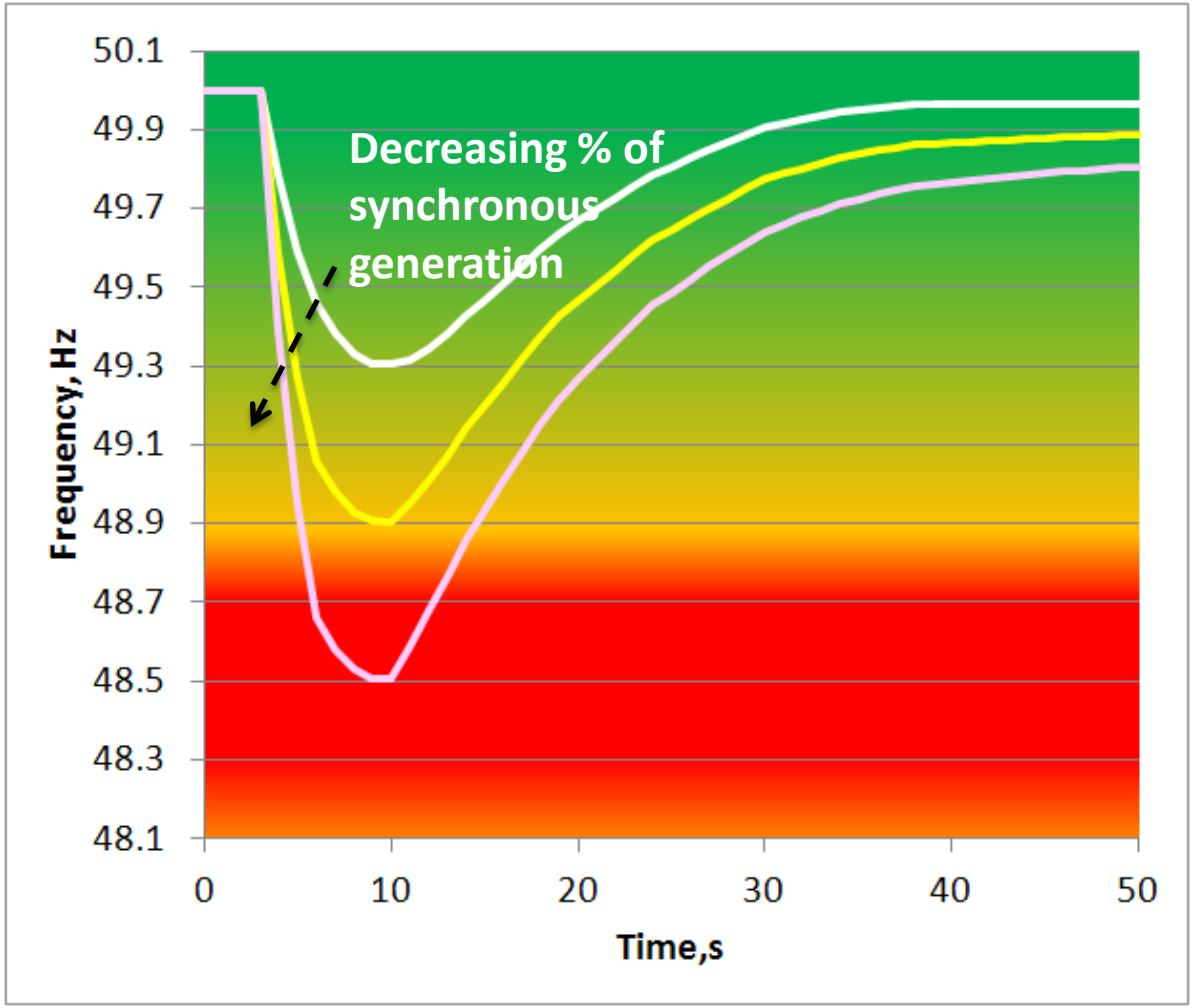
System Services

- System Services Project Plan published on 20/05/2015 – published as a three-entity branded document

- TSO Procurement Strategy document published on 03/06/2015 – "living document"



Rate of Change of Frequency (RoCoF) Concept



RoCoF Implementation Project

Plan A: Move to 1 Hz/s over 500ms

Plan B: Stay at 0.5 Hz/s

Generator Studies Project

TSO-DSO Implementation Project

Alternative / Complementary Solutions Project

Can synchronous generators ride through a high RoCoF event?

Great Island GI4 ✓

Can DSOs protect against islanding using different settings or measures to RoCoF?

Can embedded synchronous generators ride through a high RoCoF event?

Investigate and, if appropriate, propose alternatives

Complements requirements for System Services

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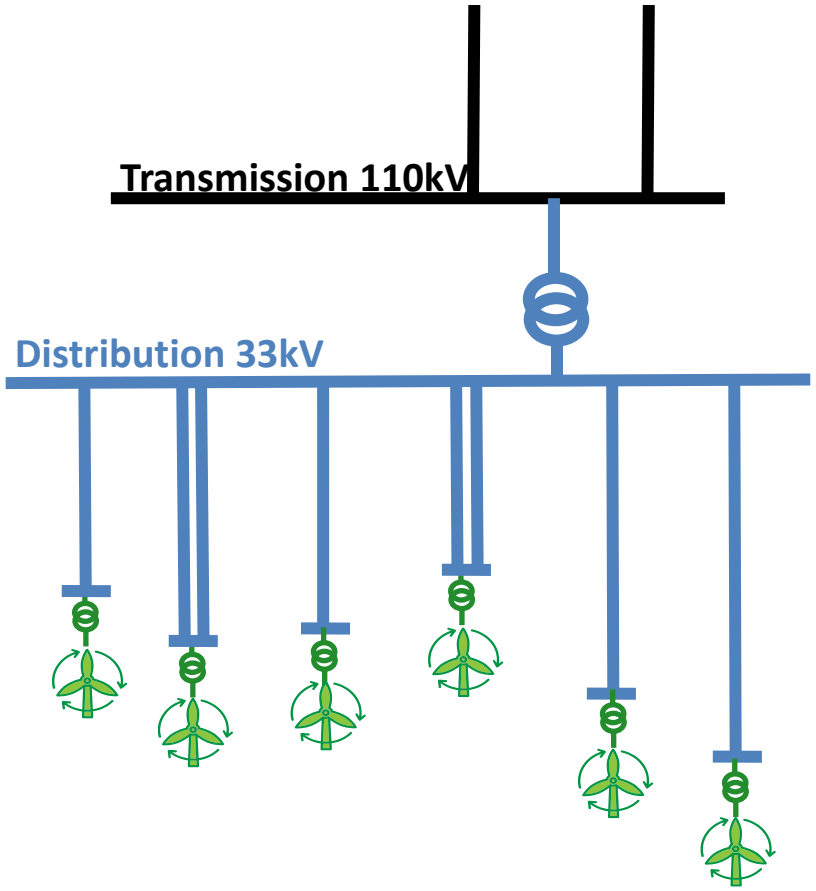
Realising Potential of Embedded Generation

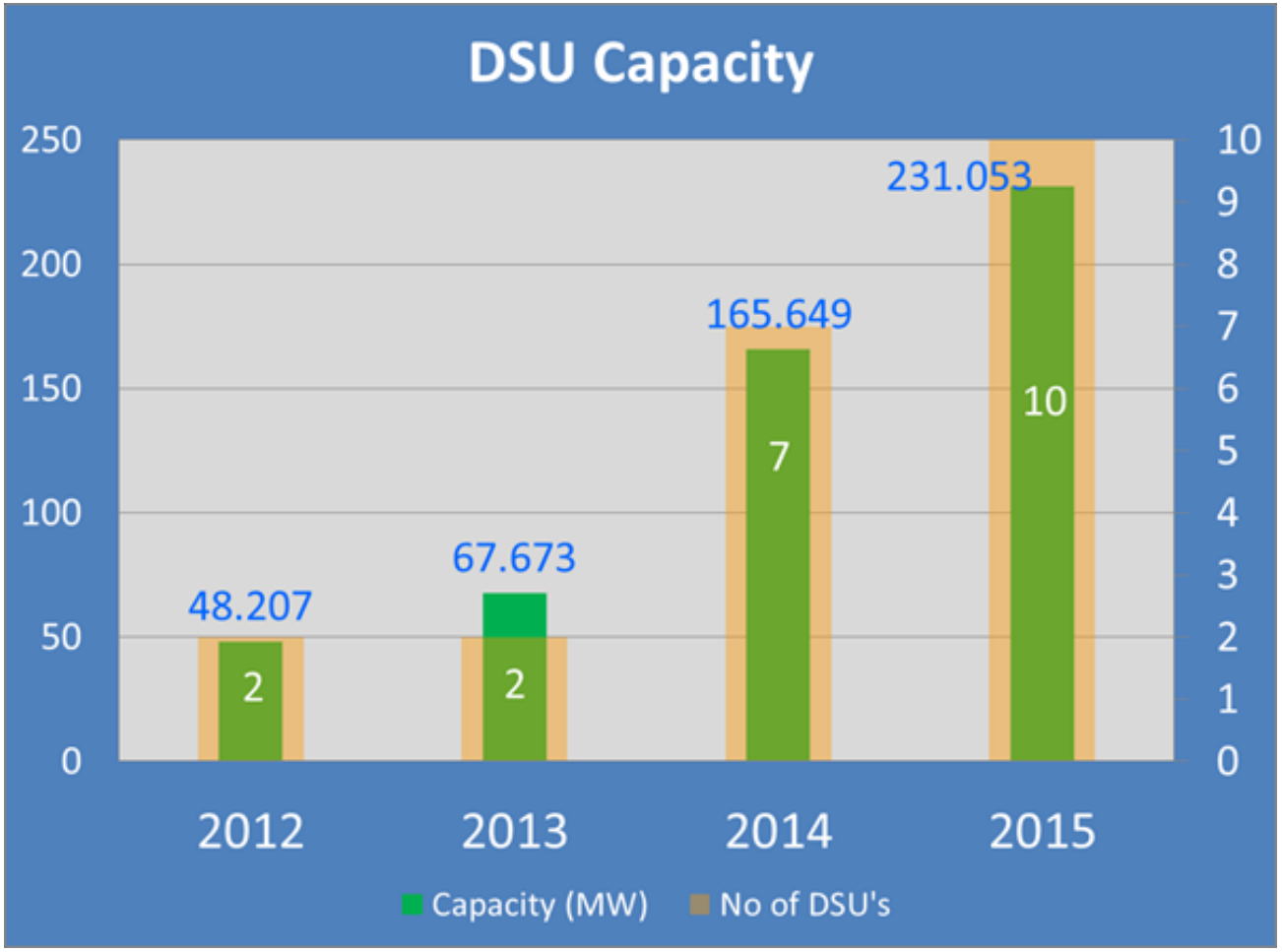


Established TSO-DSO Governance Arrangements for DS3

Key Issues:

- RoCoF protection setting for island detection – critical to moving standard
- Use of embedded generation for voltage and frequency control
- Impact of active generation / demand on DSO operations and network security

DSM Rapidly Evolving and Growing….



DSM Growth….A Balancing Challenge

Consumer & DSM

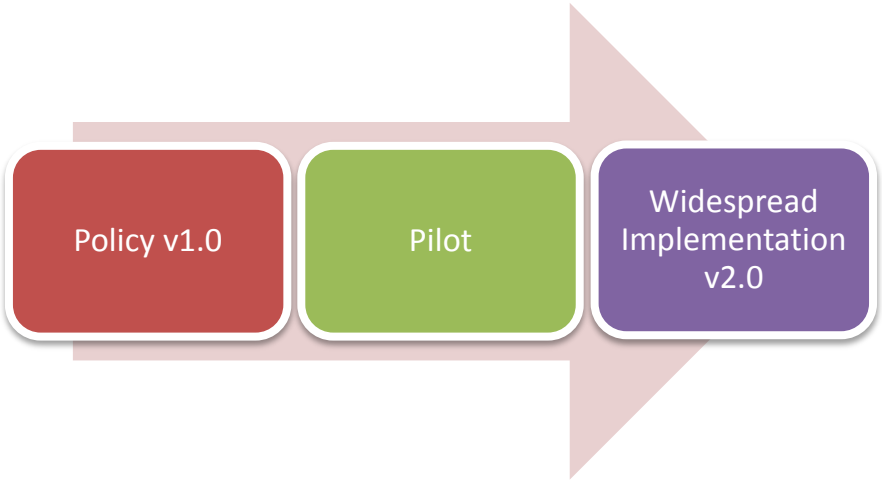
Trust, data privacy, cyber security, solid commercial foundation

Power System

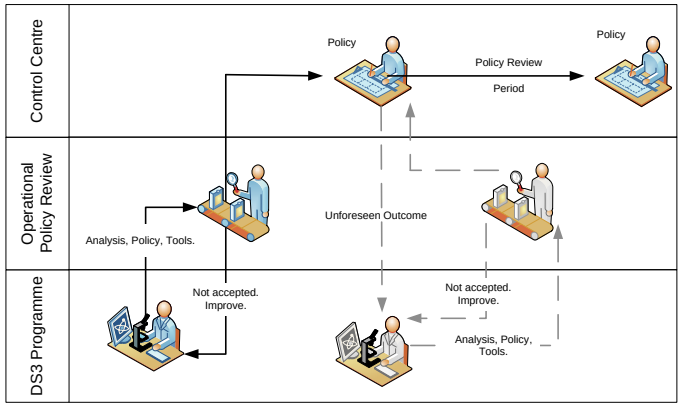
Flexibility requirements, TSO and DSO secure operation, performance monitoring

Operational Policies & Related Studies

- Automated Dynamic Studies Tool (operational)
- Frequency regulation (complete)
- Voltage dip induced frequency dip (on-going)
- Quantitative frequency oscillation analysis (on-going)
- Provision of static frequency response (on-going)
- High frequency mitigation analysis (on-going)
- Cauteen Nodal Voltage Control Pilot Project (on-going)
- Northern Ireland Nodal Voltage Control Pilot Project (on hold)



Operational Policy Review Committee

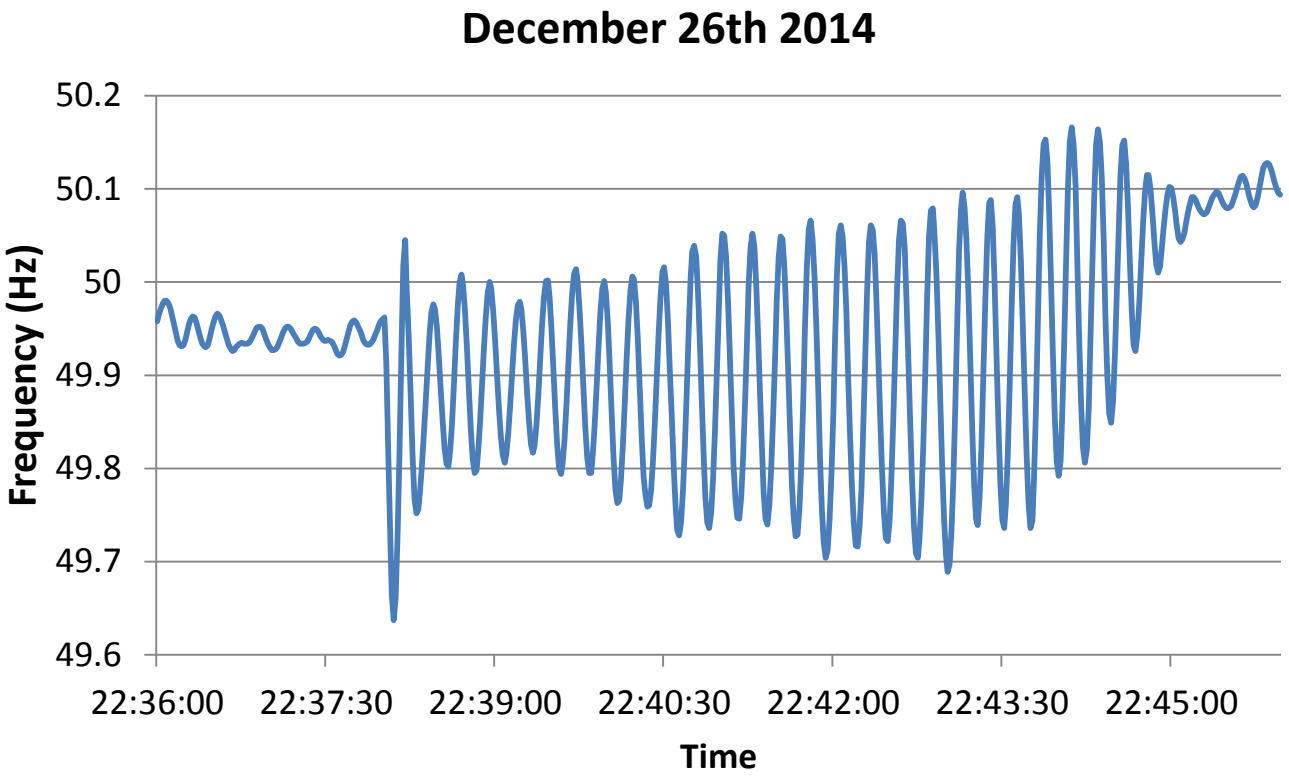


EWIC Export Limit

EWIC Interconnector	MW	B	-526 <MW< 504 Current restriction is -300<MW <504	EWIC Interconnector	This applies to all units registered as EWIC Interconnector units. It ensures that all flows do not exceed an import of 504MW to Ireland and an export of 526MW to UK (values taken from Portan). This is required to ensure that the limits are respected. Current restriction is due to a high frequency limit on the island.

- Largest single out-feed – mitigate potential for high frequency event
- Market flows are unaffected
- High frequency mitigation studies underway (summer)
- Long term: Over Frequency Generation Setting Schedule (studies underway to define)

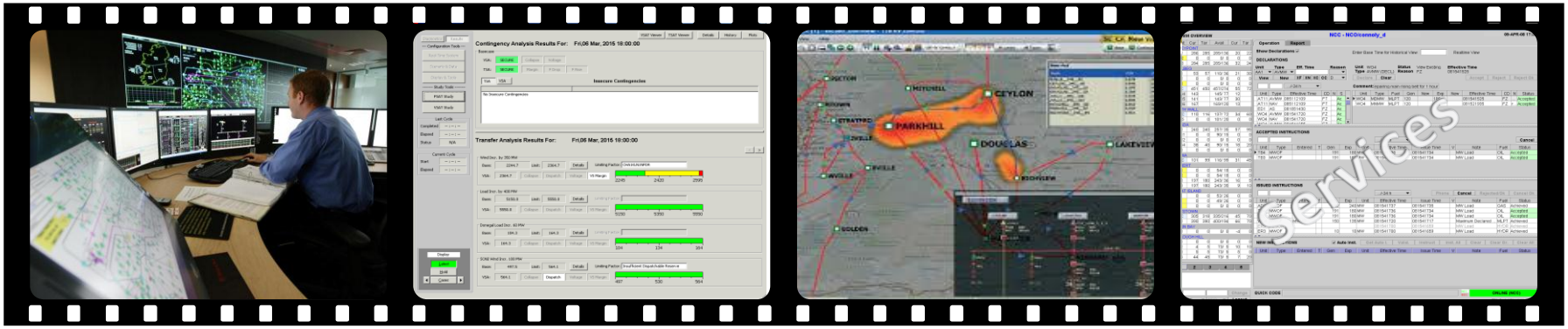
System Oscillation



1. TSOs frequency oscillation quantitative analysis
2. Alstom(a) frequency oscillation quantitative analysis and (b) “diagnosis and recommendation” report

Control Centre Tools

- WSAT voltage stability transfers (complete)
- Ramping tool and policy (trialling)
- Short circuit tool (trialling)
- EMS integration project (on-going)



Existing Control Centre Tools

2011

Tools Delivered

WSAT, Short Circuit, Wind Dispatch, Synchrophasor….

2012 - 2015

New Tools

Regulation, Ramping, Voltage Trajectory, WSAT Look ahead, System Services….

2015 - 2017

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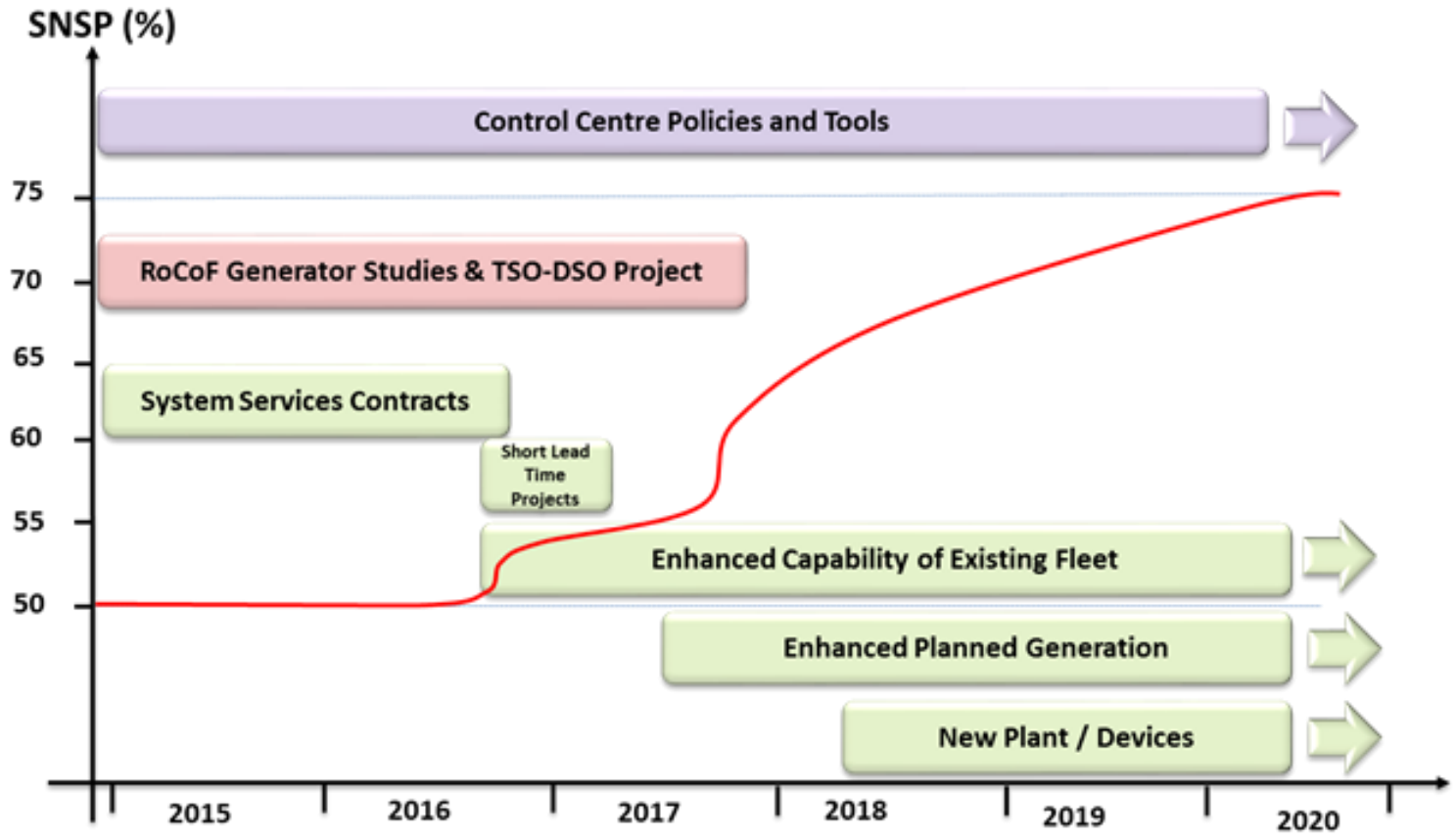
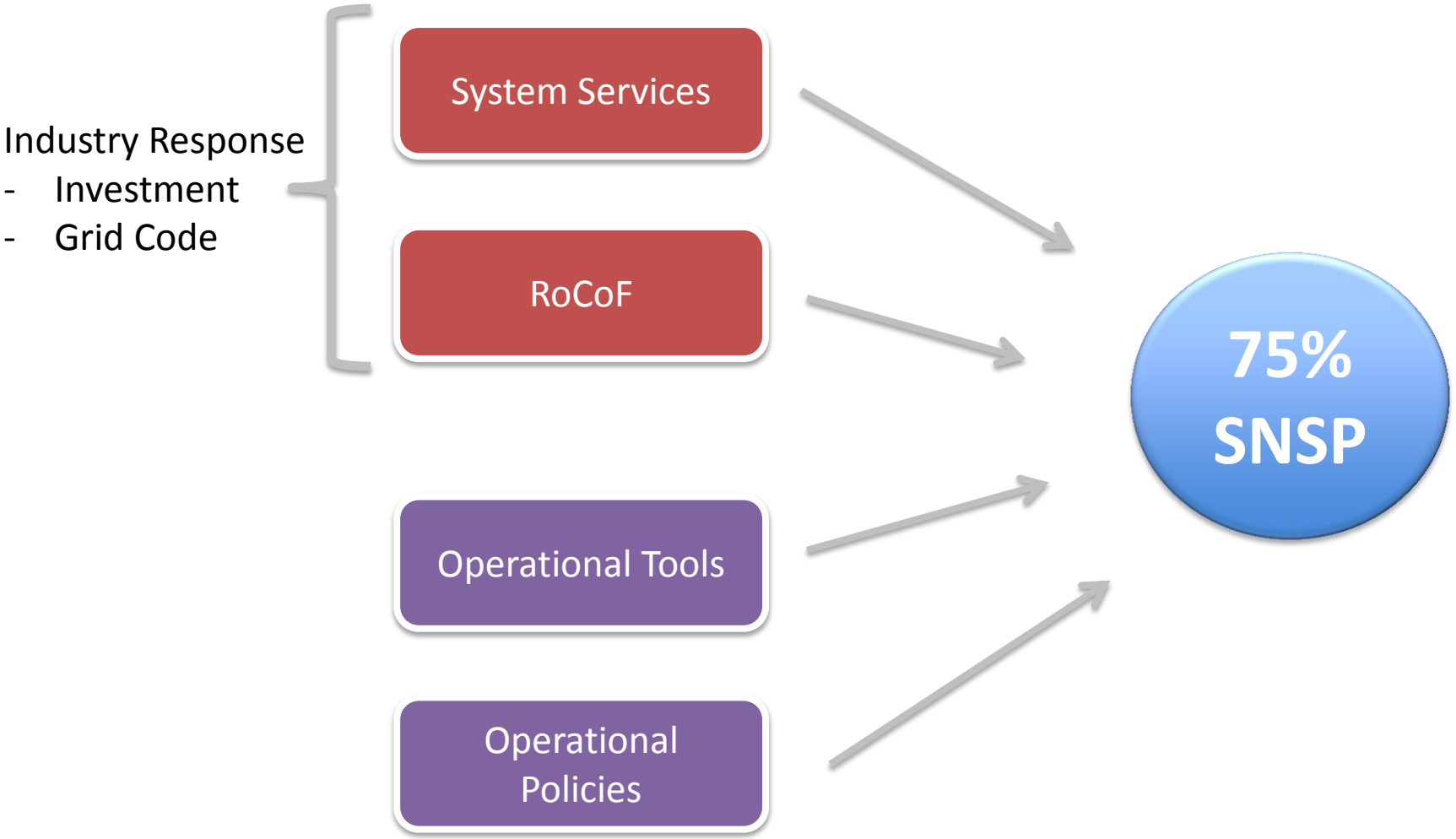
Summary

Operational Capability Outlook



Complements 2015 workstream plans

Complementary Progress Essential



DS3 Programme Summary

- RoCoF workstreams progressing
- System Services underway but significant design and implementation issues need to be worked through
- Need to maximise contribution from embedded generation and demand side response – DSO/DNO collaboration key
- Operational policies and tools need to develop in parallel in a considered manner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Regulatory Authorities Update

DS3 Industry Forum

4th June 2015

DS3:

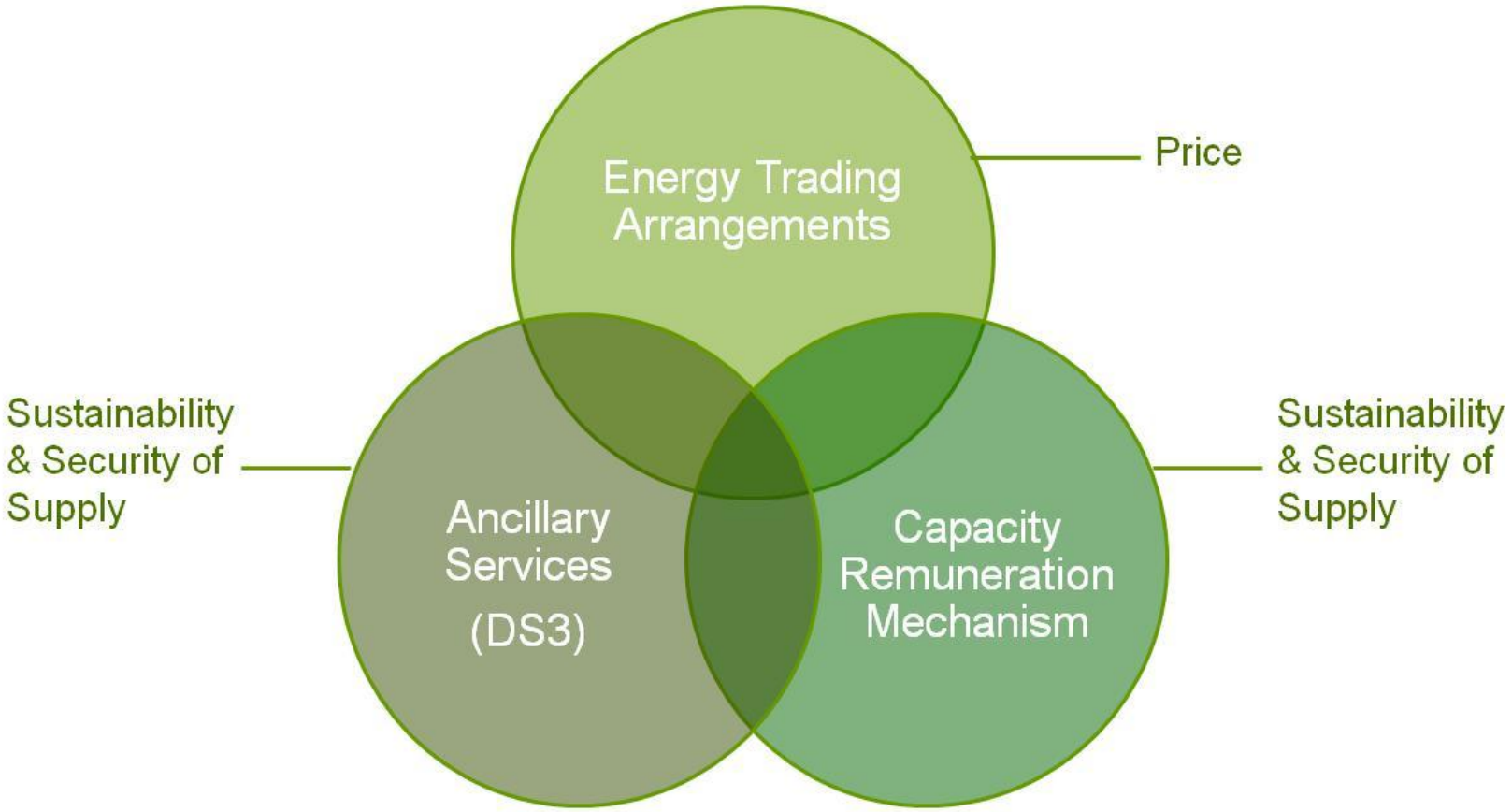
Delivering a Secure, Sustainable Electricity System

RA Update – DS3 Industry Forum

4th June 2015

SEM committee

New Arrangements - 2017



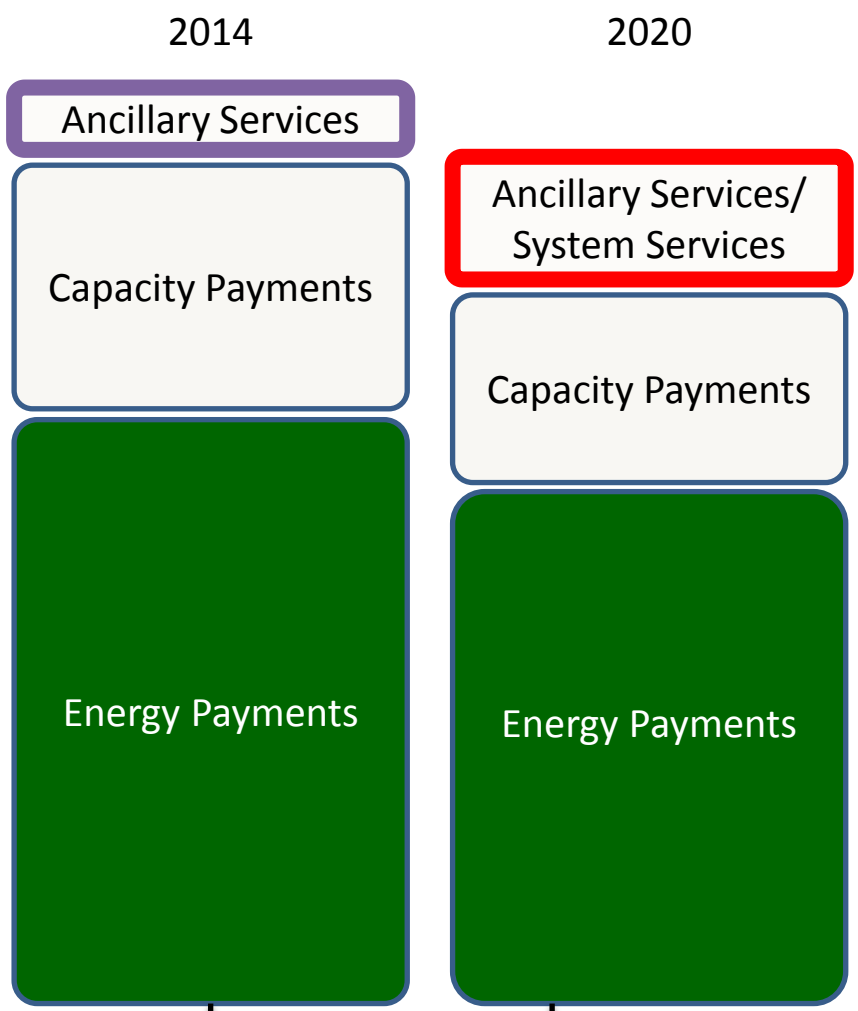
SEM committee

Our Focus: Consumer's Interests

Reliable, secure electricity at sustainably low prices

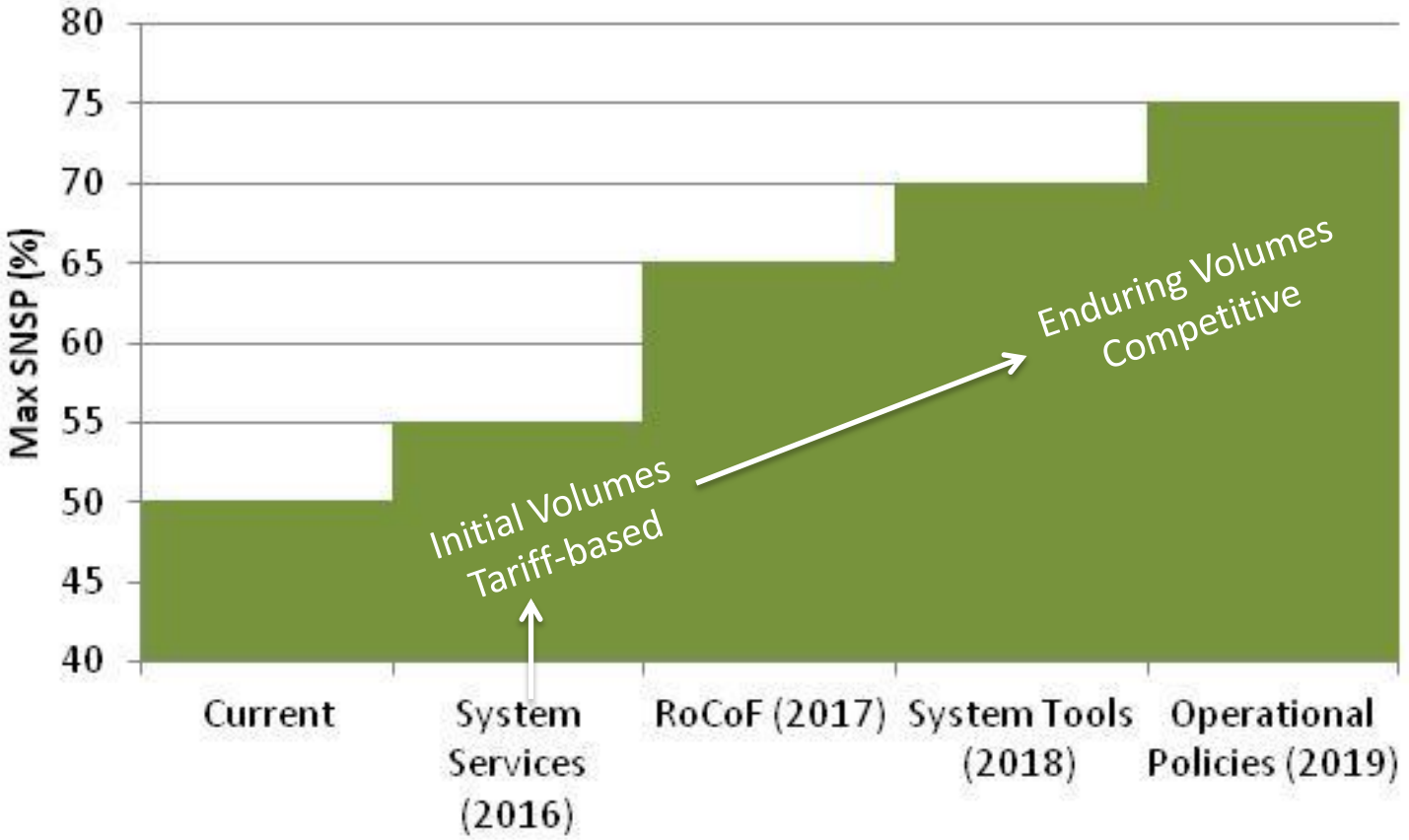
- ETA structurally aligns energy trading with GB / EU
- CRM replaces CPM and focuses generator incentives
- System Services introduced to provide incentives for flexible performance

Pay-off : ***higher renewable utilisation, driving lower Energy Prices and lower total cost***



SEM committee

Ramping Renewable Utilisation



SEM committee

Evolving Policy

- DETINI Consultation on CfD Implementation in Northern Ireland may remove 40% NI renewable target
  - Utility Regulator's early view:
    - DS3 programme would likely remain a positive value proposition for NI consumers
    - SNSP is 'clipping' at 50% today; benefits of increasing it are measurable now, at only 20% penetration (Cal 2014)
    - Pragmatic, contextual management of procured System Service Volumes, particularly during ramp (2017 – 2019) can ensure value for money

SEM committee

Evolving Policy

- Workstream Interaction with ETA, CRM:
  - Consumer's interests are promoted when market arrangements are clear and bolt together smoothly in both design and implementation
  - The SEM Committee have instructed all three projects to co-ordinate their activities: total consumer impact takes precedence over outcomes in any one area
  - Opportunities to leverage and combine project milestones are currently being explored
  - Some depth to this area; further liaison will be required with TSOs and stakeholders where specific combining of work or deliverables is identified

SEM committee

Rate of Change of Frequency Update

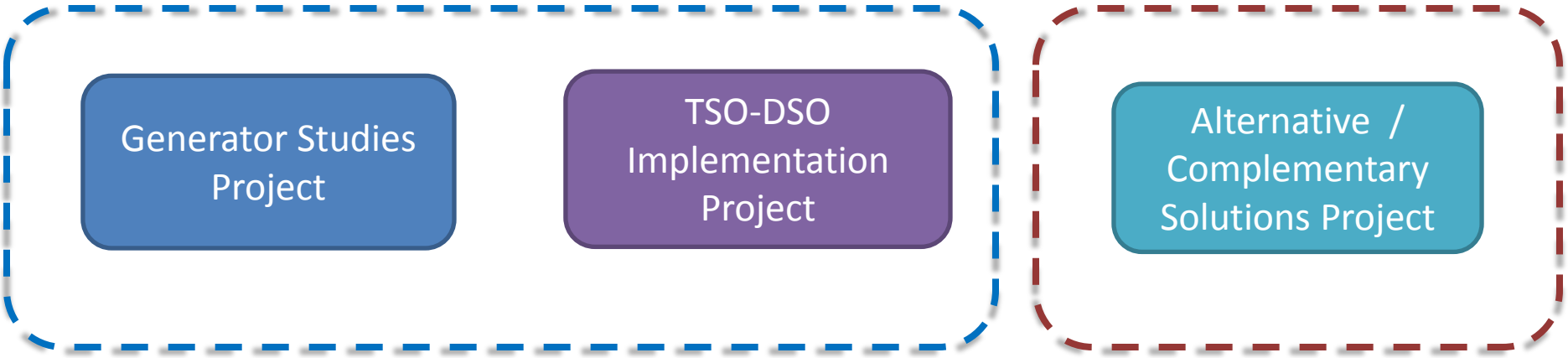
DS3 Industry Forum
4th June 2015

David Cashman

Presentation Overview

- Updates on status of three key workstreams
- Generator Studies Project
- TSO-DSO Implementation Project
- Alternative / Complementary Solutions Project

RoCoF Implementation Project



Timeline Update

- Project start date: 21st Nov 2014

- 6 months since beginning of project

Generation Studies Project

- All phase 1 Generators have commenced project
- CER and SONI quarterly updates published
  - Ireland: 24 Green status and 6 Amber
  - Northern Ireland: 4 Green status and 2 Amber
- Currently all phase 1 generators in IE and NI are on track to conclude by May 2016
- One generator (GI4) has declared compliance to the new standard
- Meetings with generators and OEMs scheduled for June

TSO-DSO Implementation Project

- Managed through existing TSO-DSO governance structure
- Ongoing bi-lateral TSO-DSO meetings taking place
- Loss of Mains (LoM) protection setting change process initiated by DSOs

TSO-DSO Implementation Project

- Ireland:
  - ESBN to finalise frequency injection bench testing of RoCoF relays imminently
  - Settings change requests issued to generators through User Questionnaire form
  - Engagement with embedded generators on RoCoF withstand capability through DCRP
  - Database of Distribution connected settings currently being compiled

- Northern Ireland
  - RoCoF project timelines for settings changes revised based on NIE projections
  - Current plan is to assess the impact of G59 rev 3 setting changes in advance of implementing 1 Hz/s settings
  - Database of settings for distribution connected wind generation has been compiled and work is ongoing to obtain embedded generation settings and volumes
  - Modification of Distribution Code for RoCoF requirements for embedded generators > 100 kW approved

Alternative / Complementary Solutions Project

- Joint project by TSOs
- Communication with industry via DS3 Advisory Council and website/email

Phase 1

- Range of theoretical options assessed at a high level
- Subset of viable options selected for Phase 2 analysis

Phase 2

- More detailed review of the selected options from Phase 1
- Analysis focused on technical and economic aspects of options

Phase 1 Assessment On-going

- DNV GL appointed end of March and due to conclude end June

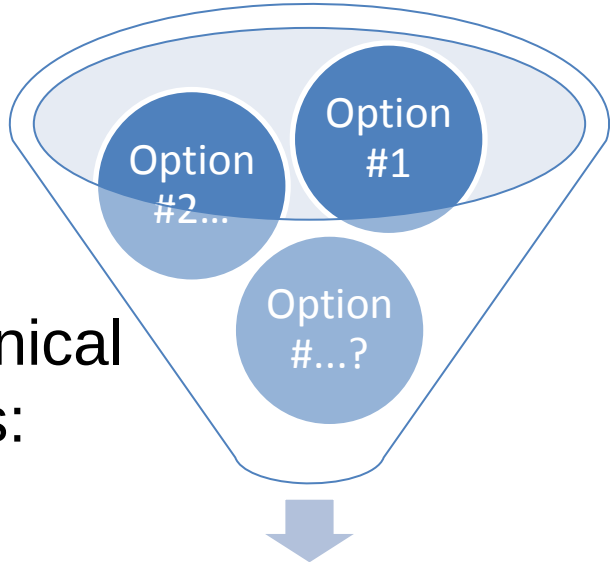
- Analysis to date:
  - Assessment of non-synchronous device capability to provide RoCoF mitigation
  - Investigation of RoCoF detection methodologies and response times of devices

- Current analysis:
  - High level appraisals of technology types using ‘Faceplate’ templates
  - Comparison of technology types

Phase 1 Next Steps

- Finalize technology assessments
- Draft final report including technology appraisal and assessment of Non-synchronous device capability
- Publish for industry comment – End June 2015
- 2 Week response time for industry comment

Phase 2 Overview



- More detailed analysis likely including technical and economic studies of shortlisted options:
  - Dynamic simulations
  - Plexos studies

- Due to commence July 2015 with publication of draft results by December 2015

- Industry comment by Q1 2016

Summary

- Generator Studies project progressing and broadly on schedule
- Loss-of-Mains protection setting change process initiated with DSOs
- NI timelines for LoM changes revised based on NIE advice
- Alternative / Complementary Solutions project Phase 1 report due in June
- Alternative / Complementary Solutions project Phase 2 to commence in July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DS3 Industry Forum
ESBN Update

Tony Hearne

4th June 2015

Overview

Reactive Power / Voltage Control update

- Distribution Code DS3 (Reactive Power) Modifications
- Analogue Output capability integration with DCC SCADA
- WFPS Reactive Power Capability & Control Test Procedure – Type B ≥ 5MW
- Reactive Power / Voltage Control Nodal Controller Pilot – Cauteen Cluster

ROCOF update

- Interface Relay Tests
- Questionnaire and Settings Change
- Alternative LoM Protection

Conclusion

Reactive Power / Voltage Control Update

Distribution Code DS3 Modifications

The following DS3 modifications were approved by the CER with an effective date of 08 October 2013:

MP 22 – DS3 Fault Ride Through

MP 23 – DS3 Reactive Power Voltage Control

More recently the following related clarification modifications were approved by the CER with an effective date of 23 February 2015:

MP 31 – Fault Ride Through

MP 32 – Voltage Regulation

MP 33 – Voltage Step Change

AO capability integration with DCC SCADA

Historically DCC SCADA did not require AO capability. However, the recently mandated new DS3 reactive power control modes have necessitated the integration of AO capability with DCC SCADA.

ESBN has recently successfully performed a FAT and a SAT (at Leopardstown Road).

ESBN is currently organising a site test at Cauteen after which this new capability will be rolled out to all Type B ≥ 5MW WFPSs.

WFPS Test Procedure – Type B ≥ 5MW

ESBN is working with EirGrid on the above-mentioned test procedure which is now near completion and ready for trial.

It is planned to trail this new test procedure at the Cauteen Cluster.

In addition to the test procedure ESBN is also working with EirGrid on the associated business processes which will be required to coordinate the testing between the DSO, TSO and IPP.

Furthermore ESBN has developed the necessary in-house business processes and training material required for this testing.

Nodal Controller Pilot – Cauteen Cluster

A formal project has been initiated within ESBN.

The high-level functionality has been agreed between ESBN and EirGrid and we are currently working through the lower-level details.

A software simulator with load-flow has been developed which is being used to inform these design decisions.

The hardware design of the Nodal Controller has been concluded.

The pre-requisite communications infrastructure has progressed to the detailed design phase and will be installed at Cauteen imminently.

The participating IPPs have been engaged.

ROCOF Update

Interface Relays Tests

	Legacy Voltage & Frequency Settings								New Voltage & Frequency Settings							
	A	B	C	D	E	F	G	H	A	B	C	D	E	F	G	H
RoCoF 0.4 Hz/s	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip	Trip	NO TRIP	1.746	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
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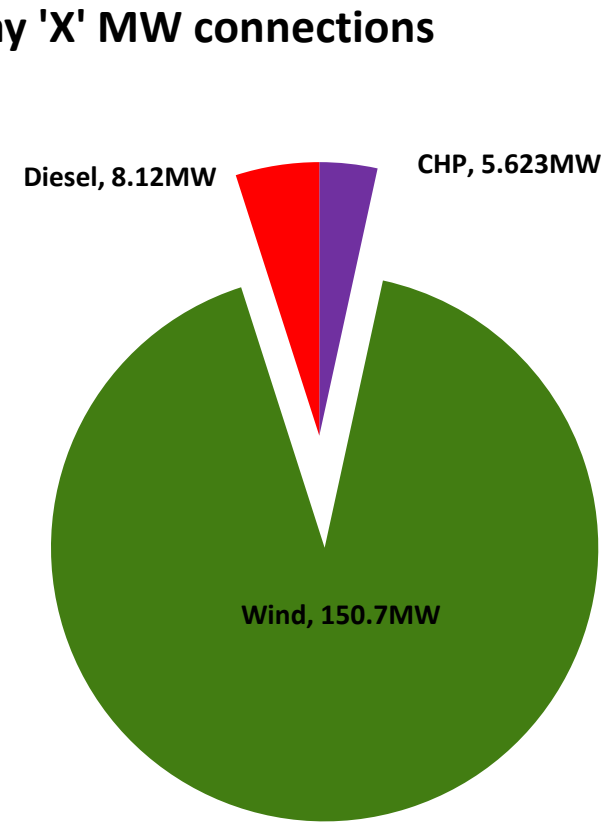
	Trip	Trip	Trip	Trip	Trip by OF	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by OF	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by VS	NO TRIP	NO TRIP	NO TRIP
	Trip	Trip	Trip	Trip	Trip by OF	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	Trip	NO TRIP	NO TRIP	NO TRIP	NO TRIP
	Trip	Trip	Trip	Trip	Trip by OF	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP
	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP
	NO TRIP	1.153	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP
	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP

Interface Relays Tests

- Difficulty testing relay
- This relay represents a significant percentage of MW connections
- Issues a trip signal for all traces provided by EirGrid
- Working with manufactures to resolve problem



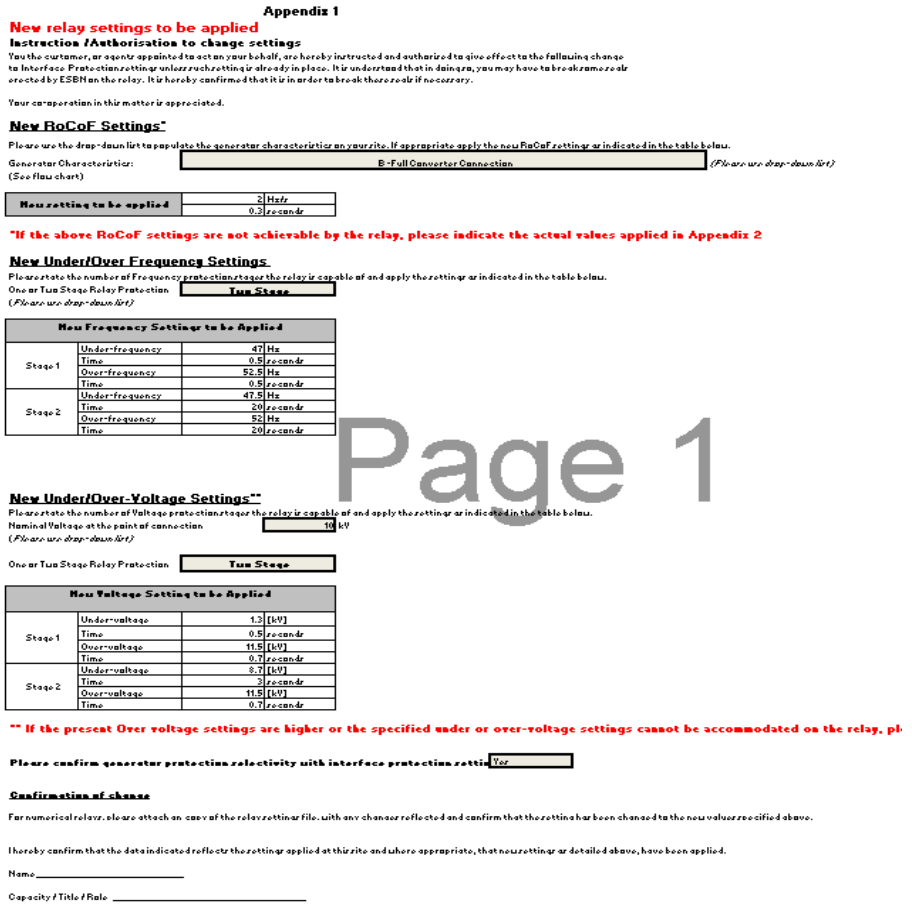
Questionnaire and Settings Change

Wind Generators

- Instruction to change settings resent to all Wind Farm contacts
- Discussions held with larger developers
- Most will change setting over the coming months

Non-Wind 0 MEC Generators

- Meeting held with stakeholders of non-wind embedded generators
- Instruction to change interface settings sent
- Issues with new voltage settings and FRT capability



Appendix 1

New relay settings to be applied

Instruction /Authorisation to change settings

You the customer, or agent appointed to act on your behalf, are hereby instructed and authorised to give effect to the following change to Interface Protection settings unless such setting is already in place. It is understood that in doing so, you may have to break seals erected by ESBN on the relay. It is hereby confirmed that it is in order to break these seals if necessary.

Your co-operation in this matter is appreciated.

New RoCoF Settings*

Please use the drop-down list to populate the generator characteristics on your site. If appropriate apply the new RoCoF settings as indicated in the table below.

Generator Characteristics: (See flow chart) — E-Full Converter Connection (Please use drop-down list)

New setting to be applied		
	2	Hz/s
	0.3	seconds

*If the above RoCoF settings are not achievable by the relay, please indicate the actual values applied in Appendix 2

New Under/Over Frequency Settings

Please state the number of Frequency protection stages the relay is capable of and apply the settings as indicated in the table below.

One or Two Stage Relay Protection — Two Stage (Please use drop-down list)

New Frequency Settings to be Applied			
Stage 1	Under-frequency	47	Hz
	Time	0.5	seconds
	Over-frequency	52.5	Hz
	Time	0.5	seconds
Stage 2	Under-frequency	47.5	Hz
	Time	20	seconds
	Over-frequency	52	Hz
	Time	20	seconds

Page 1

New Under/Over-Voltage Settings**

Please state the number of Voltage protection stages the relay is capable of and apply the settings as indicated in the table below.

Nominal Voltage at the point of connection — 10 kV (Please use drop-down list)

One or Two Stage Relay Protection — Two Stage

New Voltage Setting to be Applied			
Stage 1	Under-voltage	1.3	[kV]
	Time	0.5	seconds
	Over-voltage	11.5	[kV]
	Time	0.7	seconds
Stage 2	Under-voltage	8.7	[kV]
	Time	3	seconds
	Over-voltage	11.5	[kV]
	Time	0.7	seconds

** If the present Over voltage settings are higher or the specified under or over-voltage settings cannot be accommodated on the relay, pl

Please confirm generator protection selectivity with interface protection setti — Yes

Confirmation of change

For numerical relays, please attach an copy of the relay setting file, with any changes reflected and confirm that the setting has been changed to the new values specified above.

I hereby confirm that the data indicated reflects the settings applied at this site and where appropriate, that new settings as detailed above, have been applied.

Name _____

Capacity / Title / Role _____

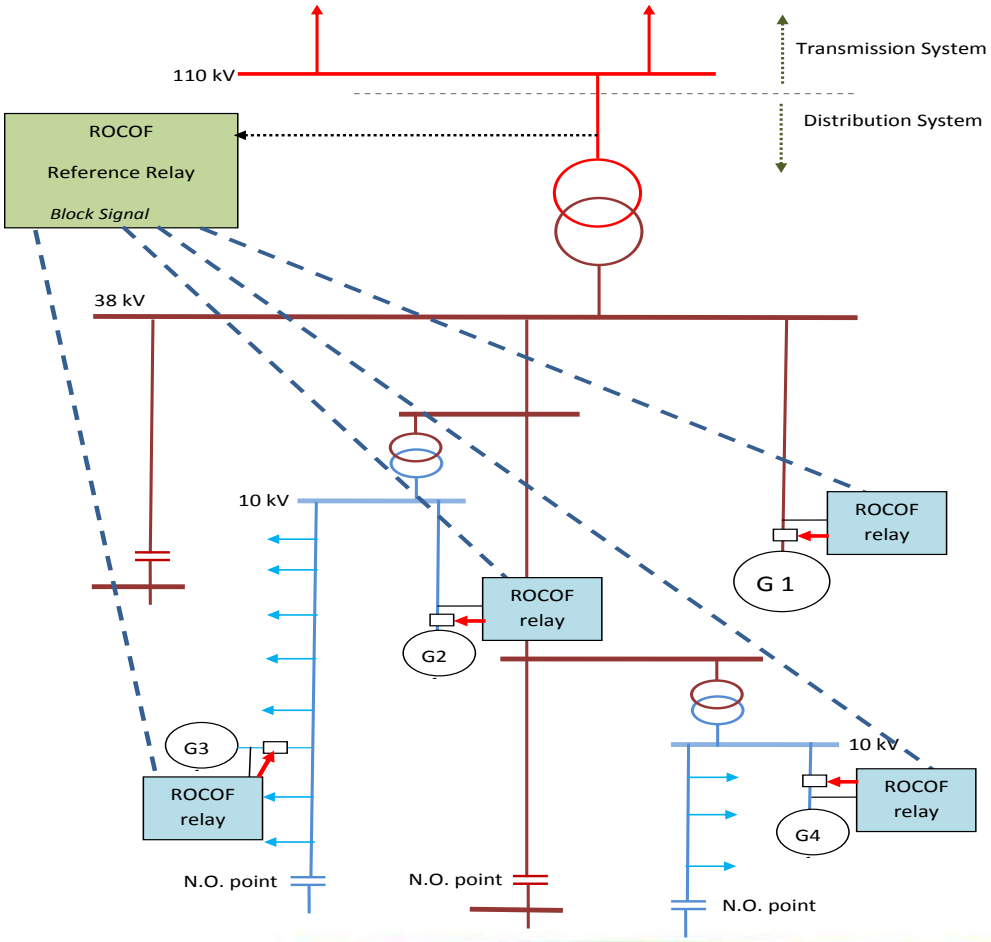
Alternative LoM Protection

- **Where a RoCoF setting of 1Hz/s cannot be applied, alternative LoM protection maybe required**
- **Selection of Alternative LoM Solutions being explored are:**

1. ***Supervised RoCoF***: G10 type relay monitors the Transmission system voltage, in the event of a disturbance a blocking signal is sent to a local network G10 relay inhibiting operation. **Trial Project due to begin in coming weeks**.

2. ***And RoCoF & Vector Shift***: The relay needs to see both a RoCoF and Vector Shift to initiate a trip signal. This may reduce the sensitivity of relays to grid disturbances. Studies required.

3. ***Exchange Relay:*** This option will be informed by analysing of the installed fleet of G10 relays. Early indications show that some relays maybe not operate for the sample traces provided by EirGrid using a RoCoF setting of 0.6Hz/s.



Thanks for Listening

Questions?

DS3 System Services

DS3 Industry Forum
4th June 2015

Eoin Kennedy

Presentation Overview

- TSO Procurement Strategy
- Project Plan
- I-SEM Interaction
- Stakeholder Engagement
- Next Steps
- Key Messages

System Services Decision

235 €M Cap in 2020/21

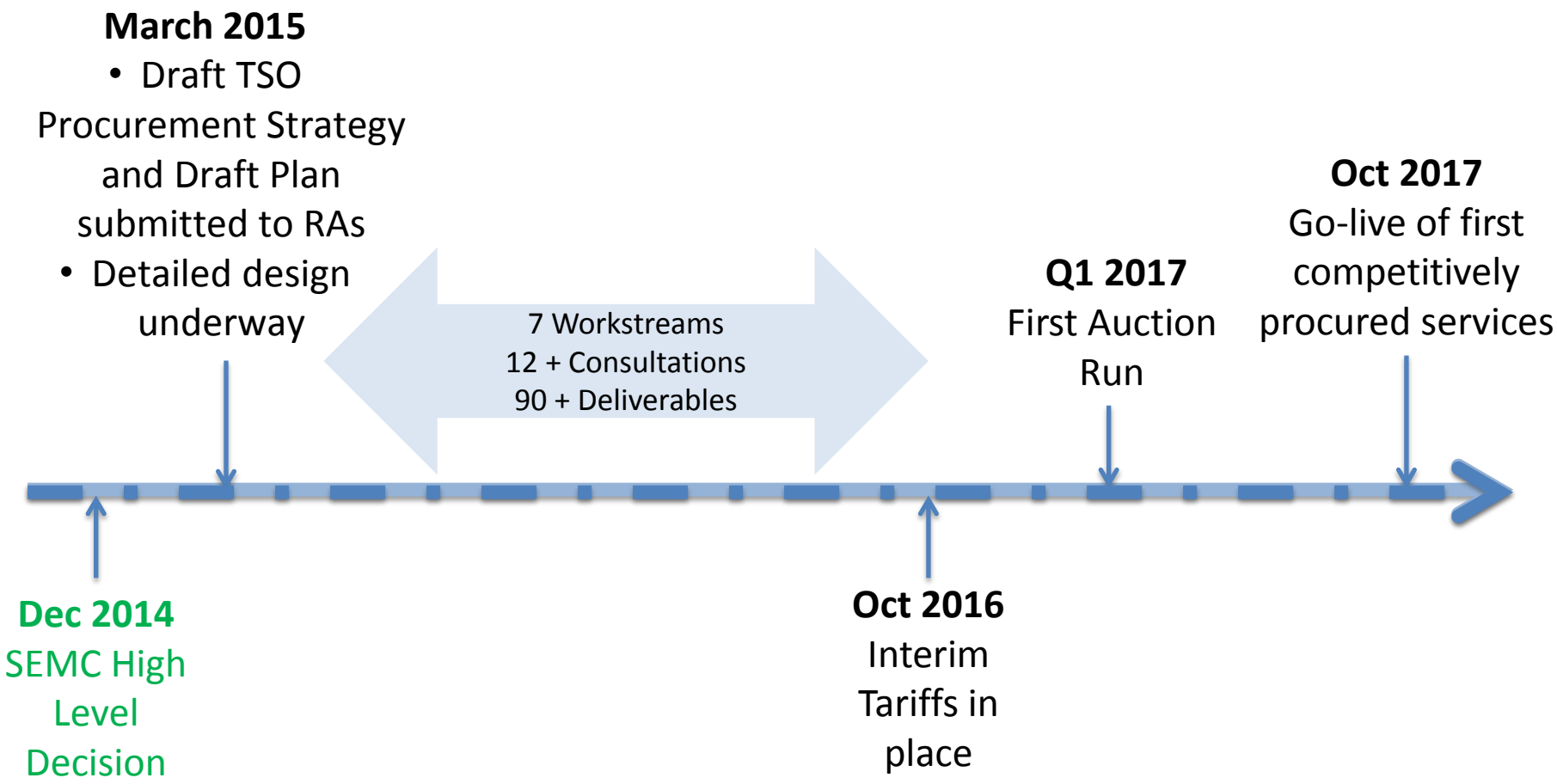
Prepared for all 14 services and in place by Oct 2016

– "Cost-plus" based on a Best New Entrant (BNE) model or similar
– TSO consultations on tariff methodology and resulting tariffs

Allows for

- Early implementation of System Services
- Capability of current fleet to be revealed

Timeline


March 2015
• Draft TSO Procurement Strategy and Draft Plan submitted to RAs
• Detailed design underway
7 Workstreams
12 + Consultations
90 + Deliverables
Q1 2017
First Auction Run
Oct 2017
Go-live of first competitively procured services
Dec 2014
SEMC High Level Decision
Oct 2016
Interim Tariffs in place

TSO Procurement Strategy

TSO Procurement Strategy

- "Living" document
- Draft version published on 3rd June provides a good indication of the likely structure and content of the enduring document
- Will be updated periodically during the course of the Implementation Project as decisions are made and key design aspects become clearer

Table of Contents


EIRGRID SONI

DS3 System Services

Draft TSO Procurement Strategy

Dated: 2/6/2015

Project Plan

Workstreams

WS1
Regulated Tariffs

WS2
System Services Volumes

WS3
Qualification Process Design

WS4
Auction Design

WS5
Contract Design

WS6
Product Design and I-SEM

Workstreams proposed by SEMC

WS7
TSO Operational Readiness

- Settlement
- Codes
- Control Centre Tools
- Financial
- System Services Performance Monitoring Infrastructure
- Training and Industry Communications
- Project Management
- Other Operational Readiness Activities

WS1 – Regulated Tariffs

SEMC Decision on Methodology for Calculation of Tariffs
Q1 2016

→

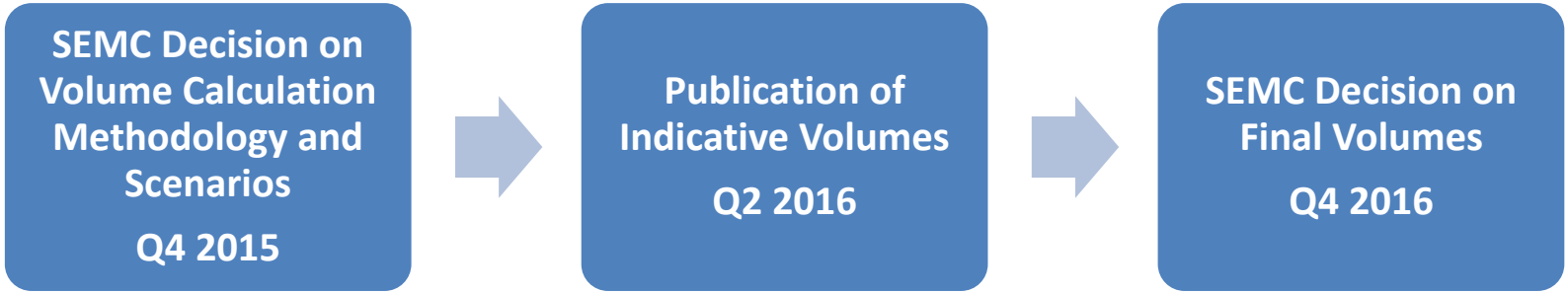
SEMC Decision on BNE Model and Interim Tariffs
Q3 2016

→

Go-live of Interim Regulated Tariff
Oct 2016

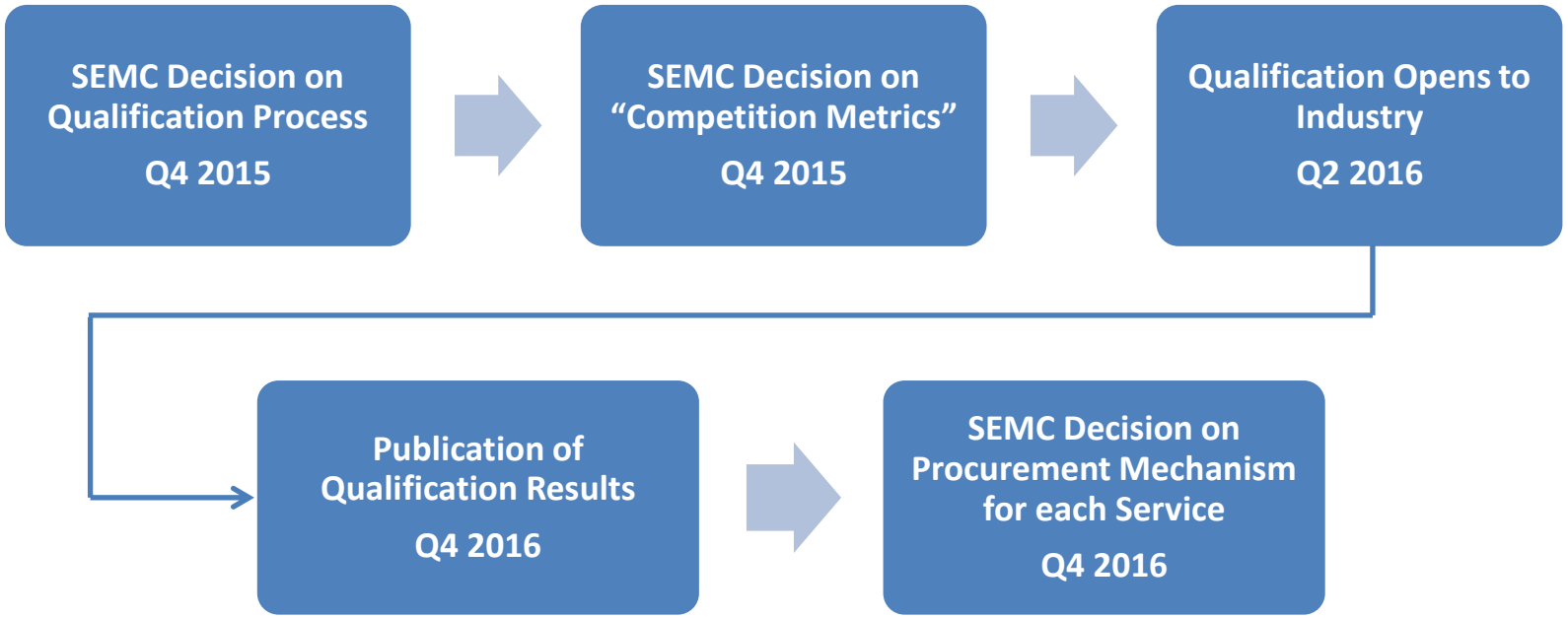
No.	Consultation	Responsible Party	Date
C.3	Methodology for Regulated Tariffs	TSOs	Sept/Oct 2015
C.11	BNE Model and Interim Regulated Tariffs	TSOs	Mar/Apr 2016
C.12	BNE Model, Volumes and Regulated Tariffs	TSOs	Apr/May 2017

WS2 – System Services Volumes



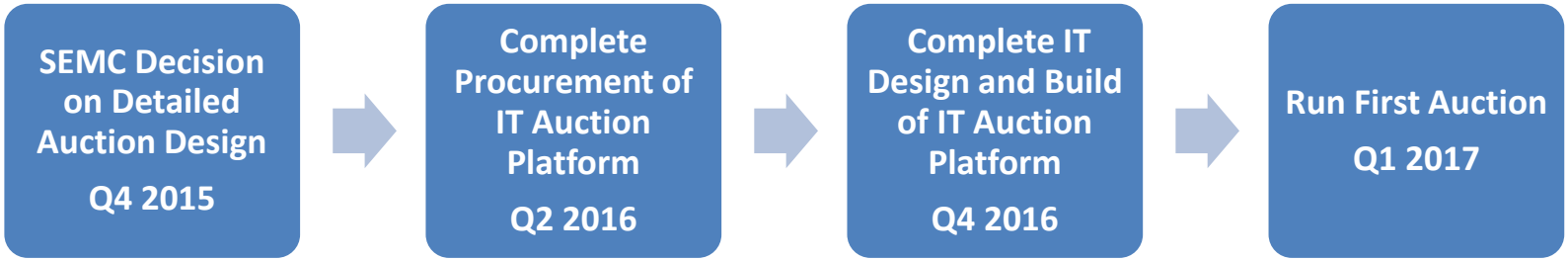
No.	Consultation	Responsible Party	Date
C.1	Scenarios for Volume Calculation	TSOs	Jul/Aug 2015
C.2	Volume Calculation Methodology	TSOs	Jul/Aug 2015
C.9	Volume Analysis Results	TSOs	Feb/Mar 2016

WS3 – Qualification Process Design



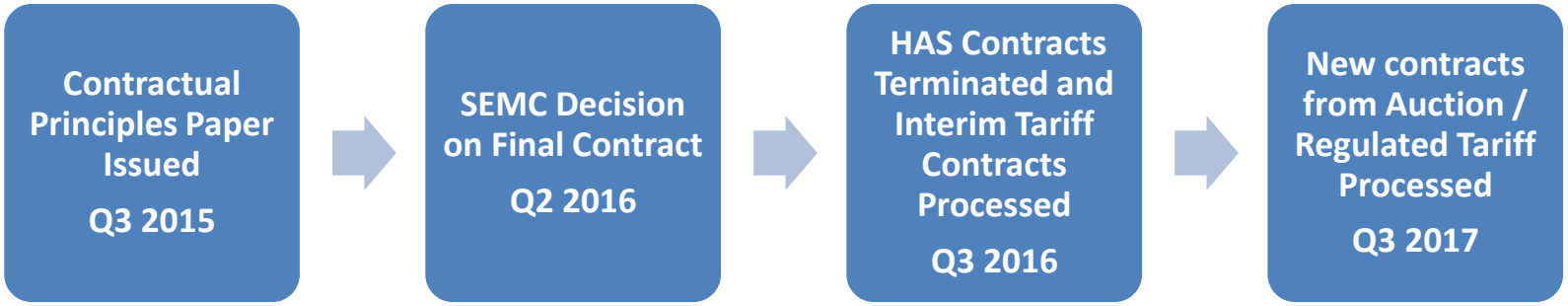
No.	Consultation	Responsible Party	Date
C.4	Qualification Criteria and Other Requirements	SEMC	Sept/Oct 2015
C.5	"Competition Metrics"	SEMC	Sept/Oct 2015

WS4 – Auction Design



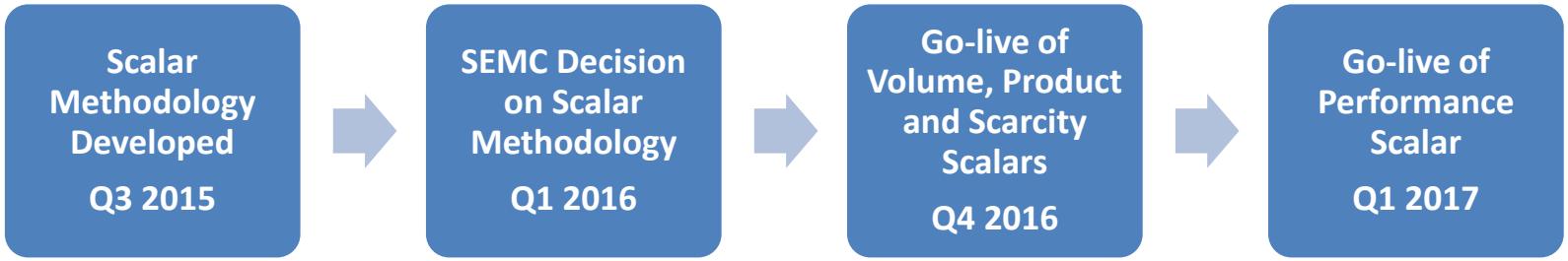
No.	Consultation	Responsible Party	Date
C.6	Detailed Design of Auction	SEMC	Sept/Oct 2015

WS5 – Contract Design



No.	Consultation	Responsible Party	Date
C.7	Contractual Principles	SEMC	Sept/Oct 2015
C.10	Proposed Template Contract	TSOs	Jan/Feb 2016

WS6 – Product Design and I-SEM



No.	Consultation	Responsible Party	Date
C.8	Scalar / Performance Monitoring Methodology and Enduring Process	TSOs	Sept/Oct 2015

WS7 – TSO Operational Readiness

Codes	Control Centre Tools	Settlement	System Services Performance Monitoring Infrastructure
Training and Industry Communications	Project Management	Financial	Other Operational Readiness Activities

Summary of Consultations

No.	Consultation	Responsible Party	Date
C.1	Scenarios for Volume Calculation	TSOs	Jul/Aug 2015
C.2	Volume Calculation Methodology	TSOs	Jul/Aug 2015
C.3	Methodology for Regulated Tariffs	TSOs	Sept/Oct 2015
C.4	Qualification Criteria and Other Requirements	SEMC	Sept/Oct 2015
C.5	"Competition Metrics"	SEMC	Sept/Oct 2015
C.6	Detailed Design of Auction	SEMC	Sept/Oct 2015
C.7	Contractual Principles	SEMC	Sept/Oct 2015
C.8	Scalar / Performance Monitoring Methodology and Enduring Process	TSOs	Sept/Oct 2015
C.9	Volume Analysis Results	TSOs	Feb/Mar 2016
C.10	Proposed Template Contract	TSOs	Jan/Feb 2016
C.11	BNE Model and Interim Regulated Tariffs	TSOs	Mar/Apr 2016
C.12	BNE Model, Volumes and Regulated Tariffs	TSOs	Apr/May 2017

Note: Further consultations will be required as part of TSOs' operational readiness activities

Design and Implementation

- Decision introduces complex design issues
- Key design challenges are the Auction and BNE tariff methodology
- Techno-economic consultancy support and expertise being engaged to assist with the principles and methodologies of these particular design aspects
- After that work, we will be in a better position to validate those aspects of the implementation plan

IS Aspects

- Significant level of IS development required to enable successful delivery and enduring operation of the DS3 System Services arrangements
- TSOs are working to develop greater certainty on the timelines and costs

Settlement System

Auction Platform

Performance Monitoring and Testing

Scarcity Scalar

Operational Tools

Implementation

- Implementation work is underway with first consultations planned for summer 2015

Example: Volume Calculation

- Development of the following is progressing well:
  - Principles for creating service provider portfolios
  - Principles/methodology for how to calculate volumes
  - Assumptions used to calculate volumes

I-SEM Interaction

I-SEM Interaction

Design

- E.g. Balancing arrangements

Delivery

- E.g. Timing of consultations
- E.g. Timing of DS3 and CRM auctions

- Quarterly working level meetings between TSOs-RAs DS3 and I-SEM teams to ensure alignment

Stakeholder Engagement

Approach to Consultations

- Aim is to engage and consult with stakeholders to greatest extent practicable
- Consultations will need to be overlapped – may be issued in batches
- Need to balance duration of consultation periods with overall delivery timelines
- 6 week periods allowed for in project plan but may decide to lengthen/shorten depending on importance/complexity of issues

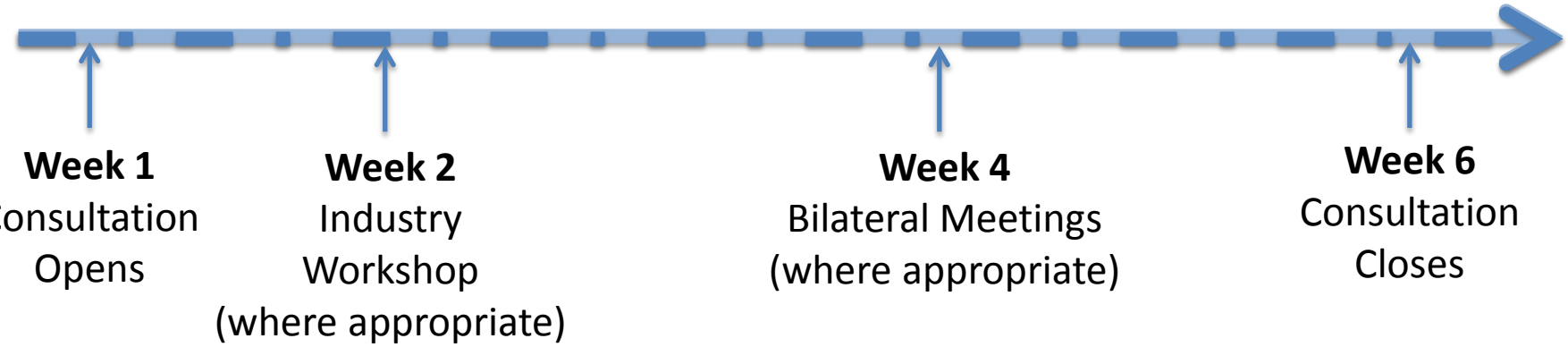
TSO-led Consultations

1. Consultation paper published on the TSO and SEM Committee websites.
2. Stakeholders submit a response to the TSOs.
3. TSOs and RAs review the submissions and the TSOs prepare a recommendations paper that takes due consideration of the views expressed.
4. The TSOs submit the recommendations paper to the RAs' Project Board for feedback or approval, depending on the context.
5. The SEM Committee will approve or provide feedback (where appropriate) on TSOs' recommendations papers. All recommendation papers will be published on the EirGrid, SONI, and SEM Committee websites.
6. When making a formal decision, the SEM Committee considers the TSOs' recommendations paper, as well as all responses received from stakeholders, and issues a decision paper.

Note: Where the TSOs have limited involvement in the development of the proposals being consulted on, the consultation will follow the established regulatory process

Interaction with Stakeholders

- Transparent structured approach to engagement necessary
- Communication with stakeholders via consultations and industry forums/workshops (e.g. workshop shortly after opening a consultation)
- May provide opportunity for bilateral meetings during consultation (or batch of consultations) e.g. time set aside for meetings with slots allocated on a first come basis
- Communication on implementation progress and other matters via the DS3 website and email



Example timeline assuming 6 week consultation period

Next Steps

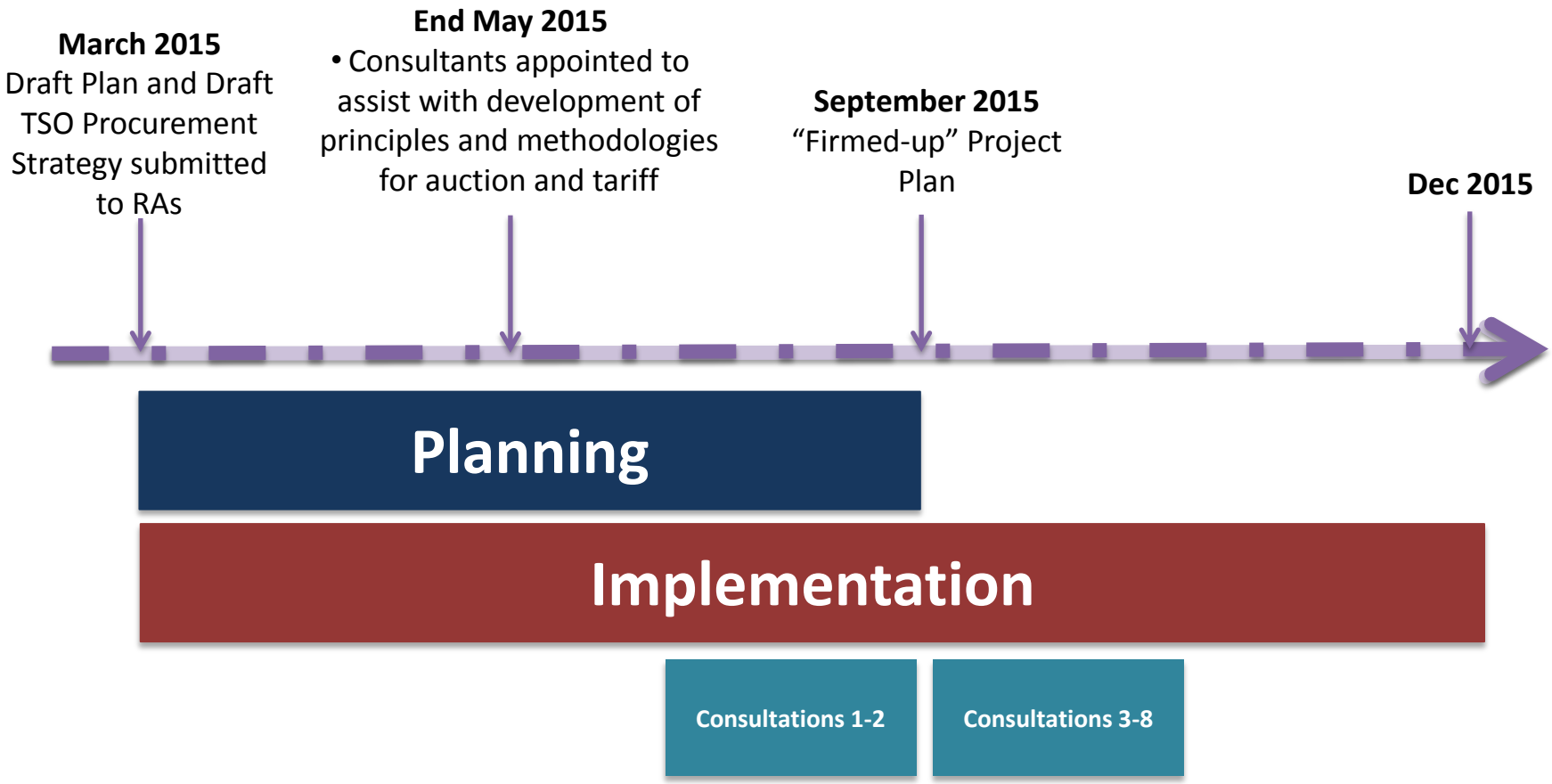
Next Steps

- Techno-economic consultancy support and expertise due to be appointed the week beginning 8th June

- Develop greater certainty on the timelines for IT systems

- Continue to undertake implementation work

Summary of Approach in 2015



Key Messages

- Draft TSO Procurement Strategy and Draft Project Plan published
- Techno-economic consultancy support and expertise being engaged to assist with principles and methodologies of challenging design aspects
- Project Plan will be “firmed up” in September 2015
- Implementation work is underway with first consultations planned for summer 2015


EIRGRID
semo
Single Electricity
Market Operator
SONI
System Operator for Northern Ireland

Voltage Dip-Induced Frequency Dip Analysis

DS3 Industry Forum
4th June 2015

Lisa McMullan

Presentation Overview

- Explanation of a VDIFD event
- Validation against real system records
- Simulation results
- Conclusions
- Next Steps

Explanation of a Voltage Dip Induced Frequency Dip Event

Voltage Dip-Induced Frequency Dip

Severe System Fault

Voltage Dip

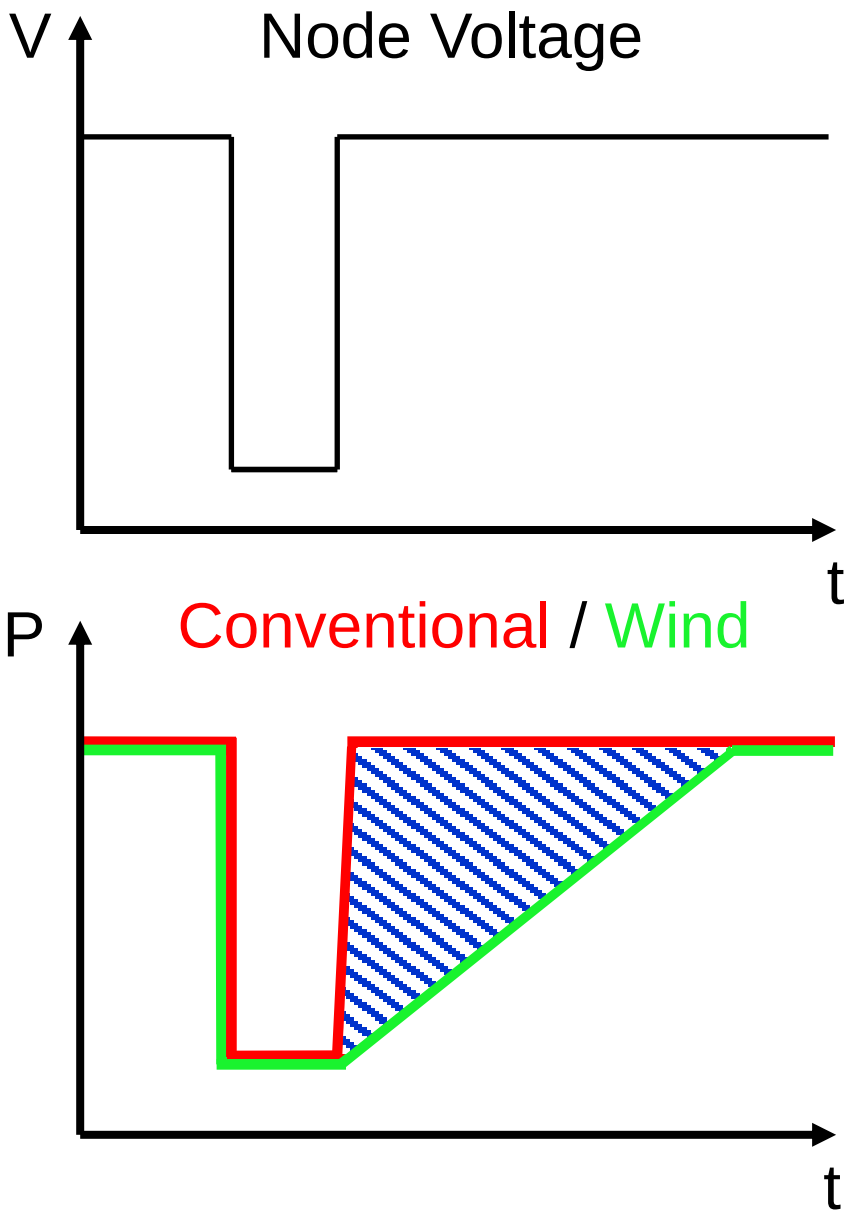
Reduction in Active Power

Fault is Cleared

Slow Active Power Recovery

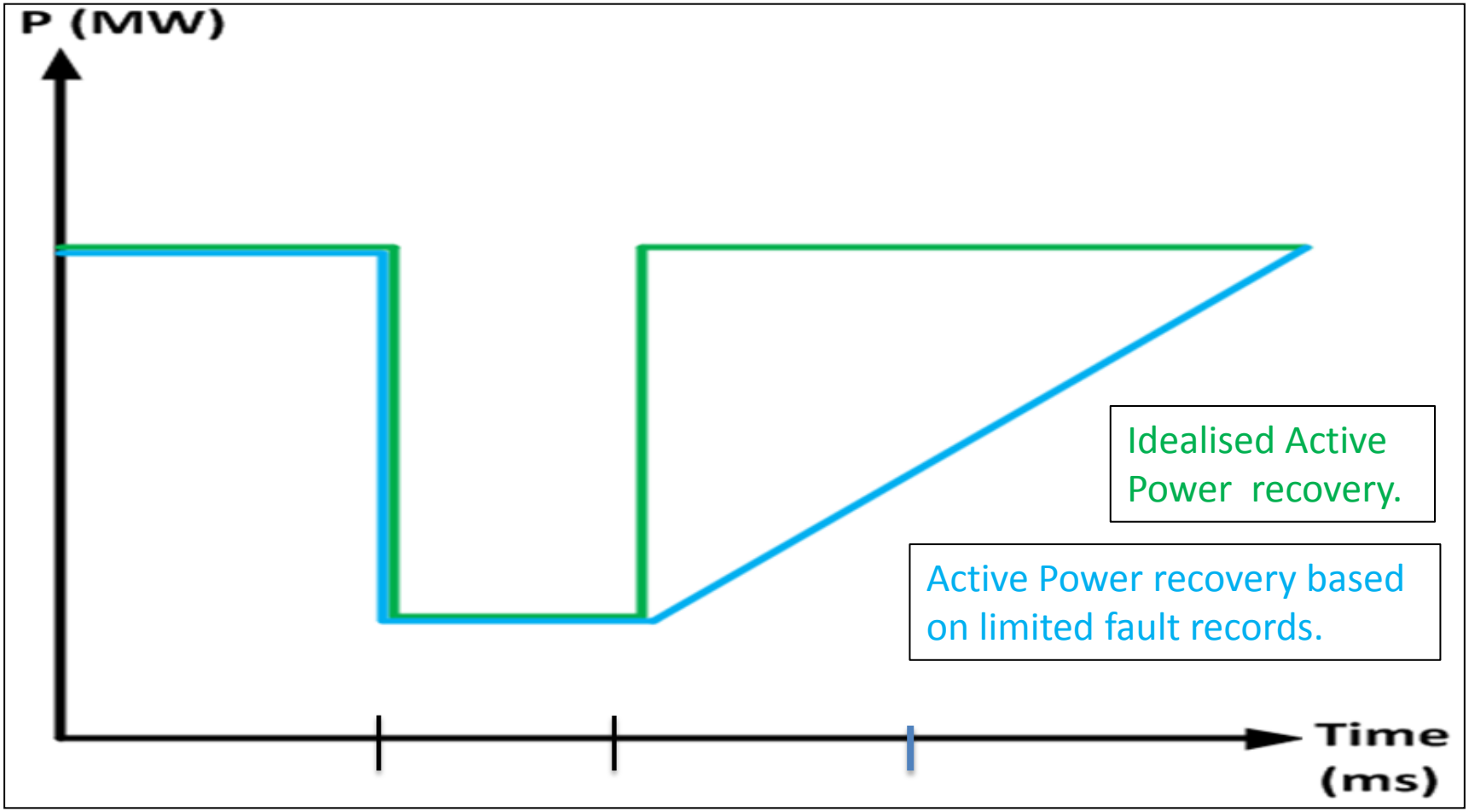
Temporary Energy Imbalance

Frequency Dip



Validation of Wind Farm Fault Ride Through Behaviour

Initial Assumptions for Wind Farm Fault Ride Through Behaviour

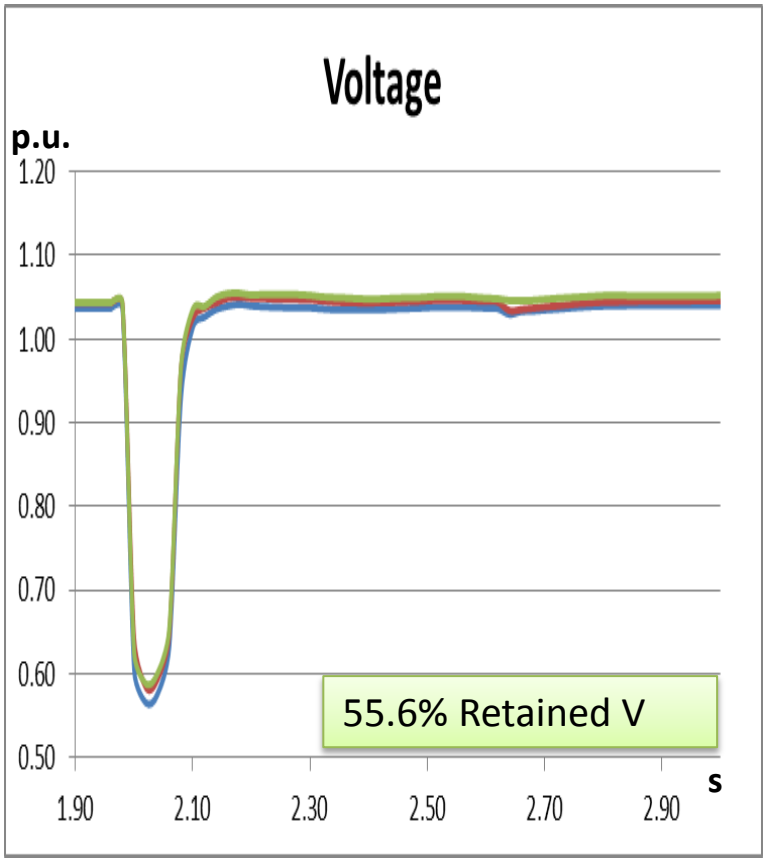


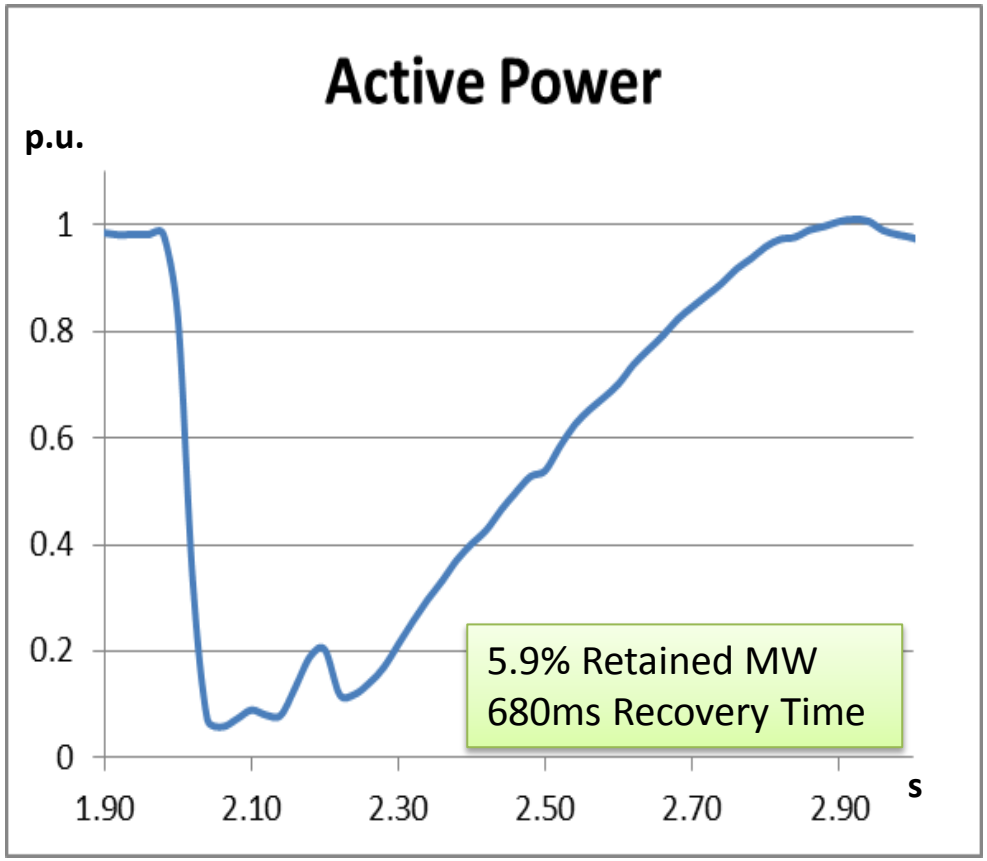
Fault applied

Fault cleared

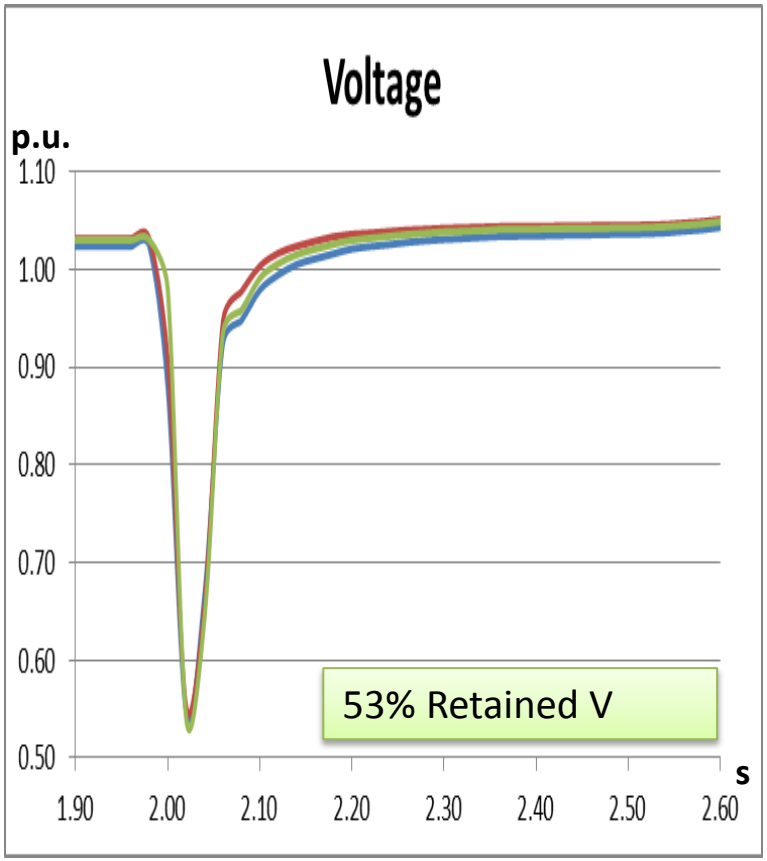
The **WFPS** shall provide at least 90 % of its maximum **AAP** as quickly as the technology allows and in any event within 500 ms of the **Transmission System Voltage** recovering to 90% of nominal **Voltage**, for **Fault Disturbances** cleared within 140 ms.

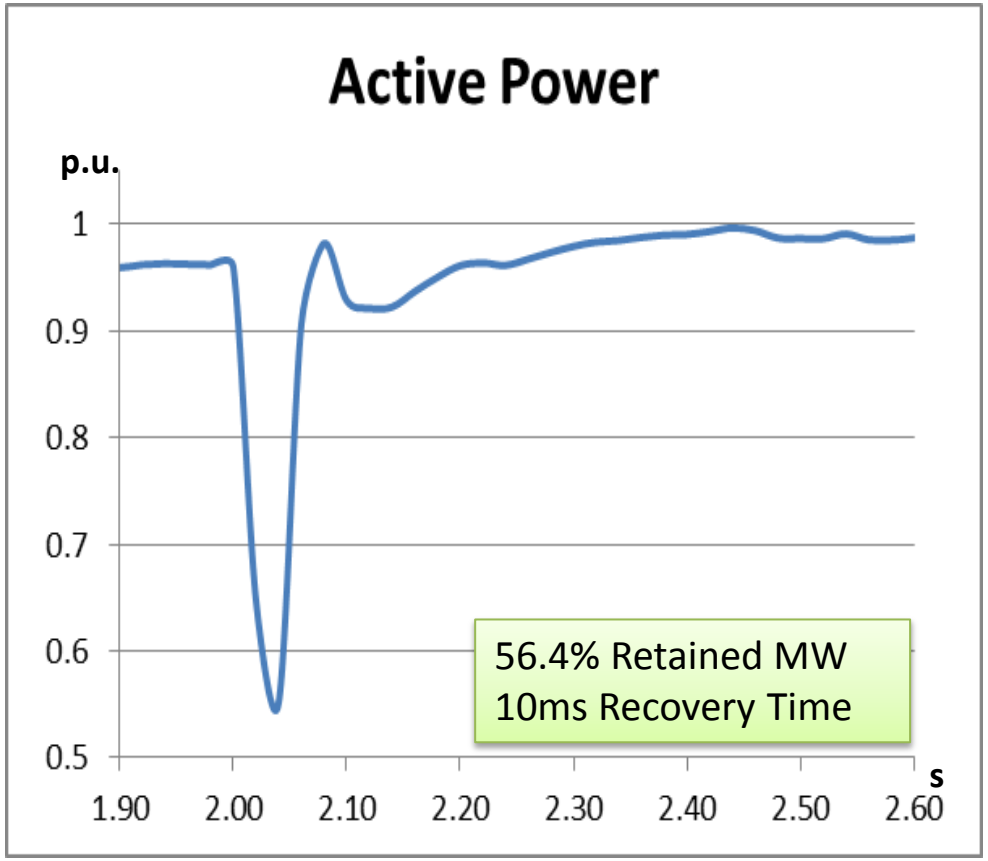
Turbine 1: Fault Duration of 60ms



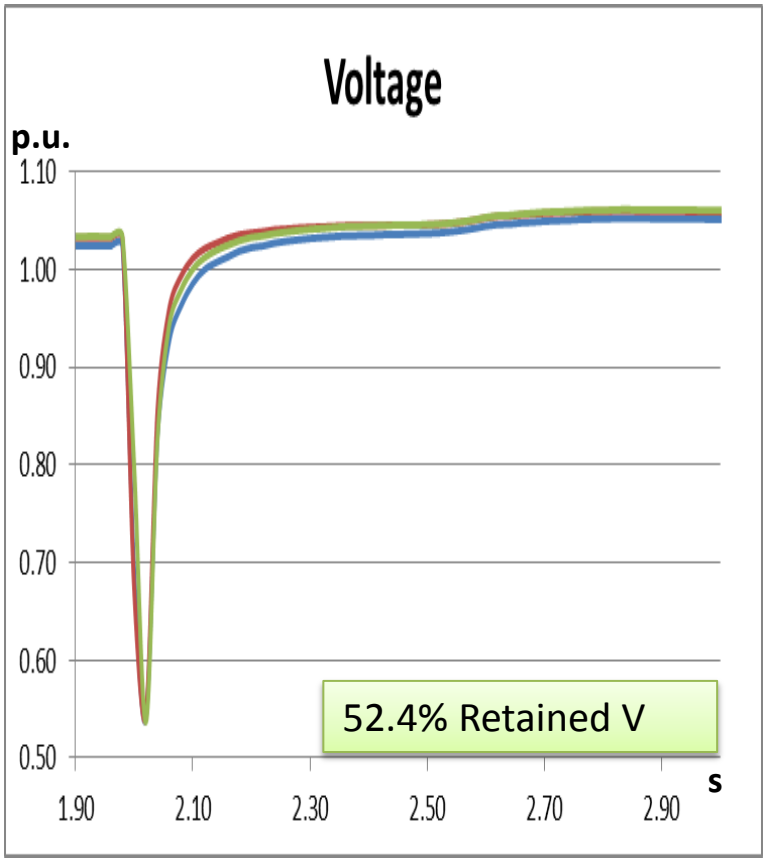


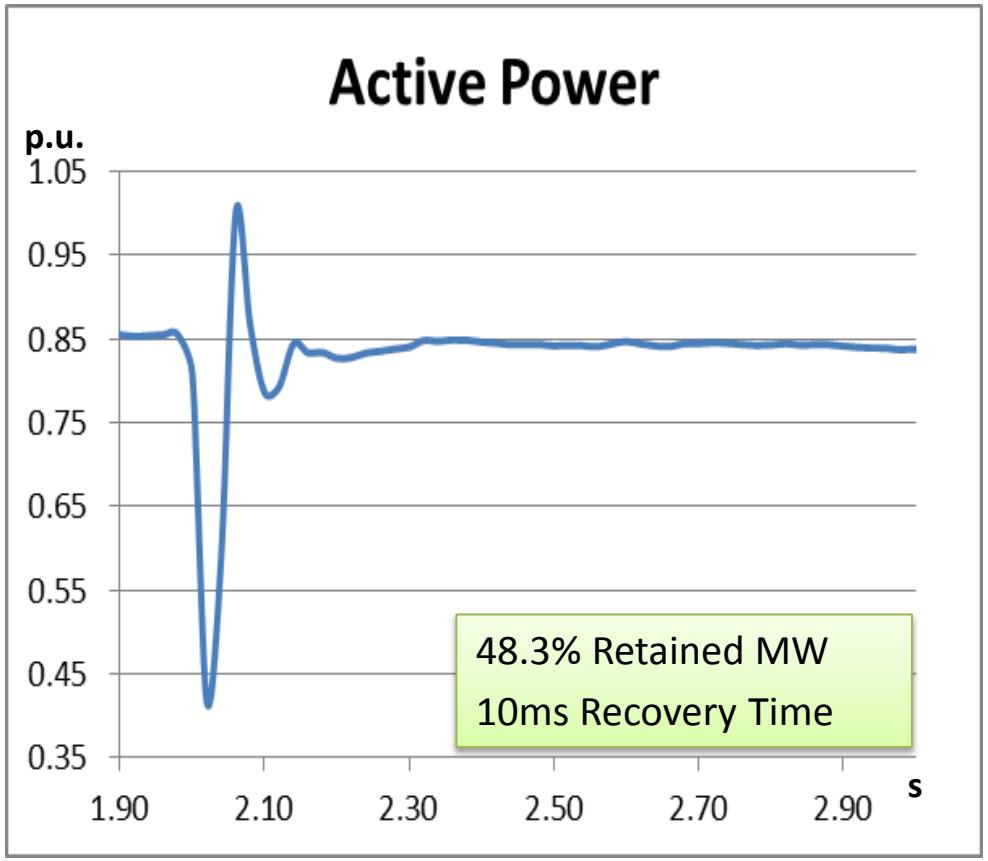
Turbine 2: Fault Duration of 67ms



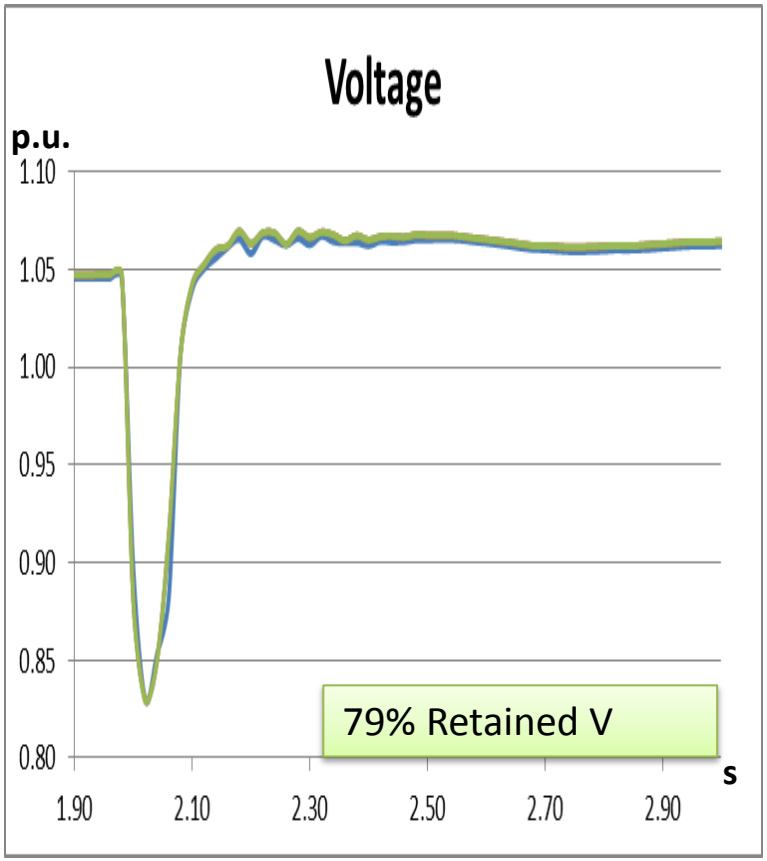


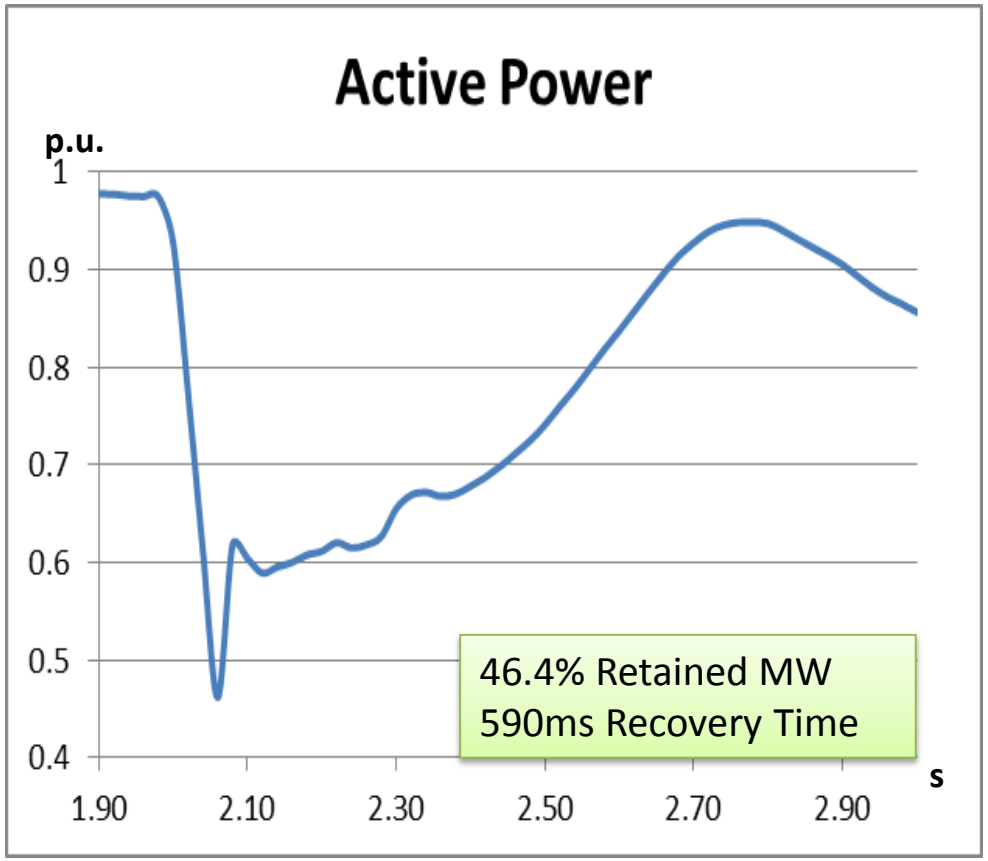
Turbine 3: Fault Duration of 67ms



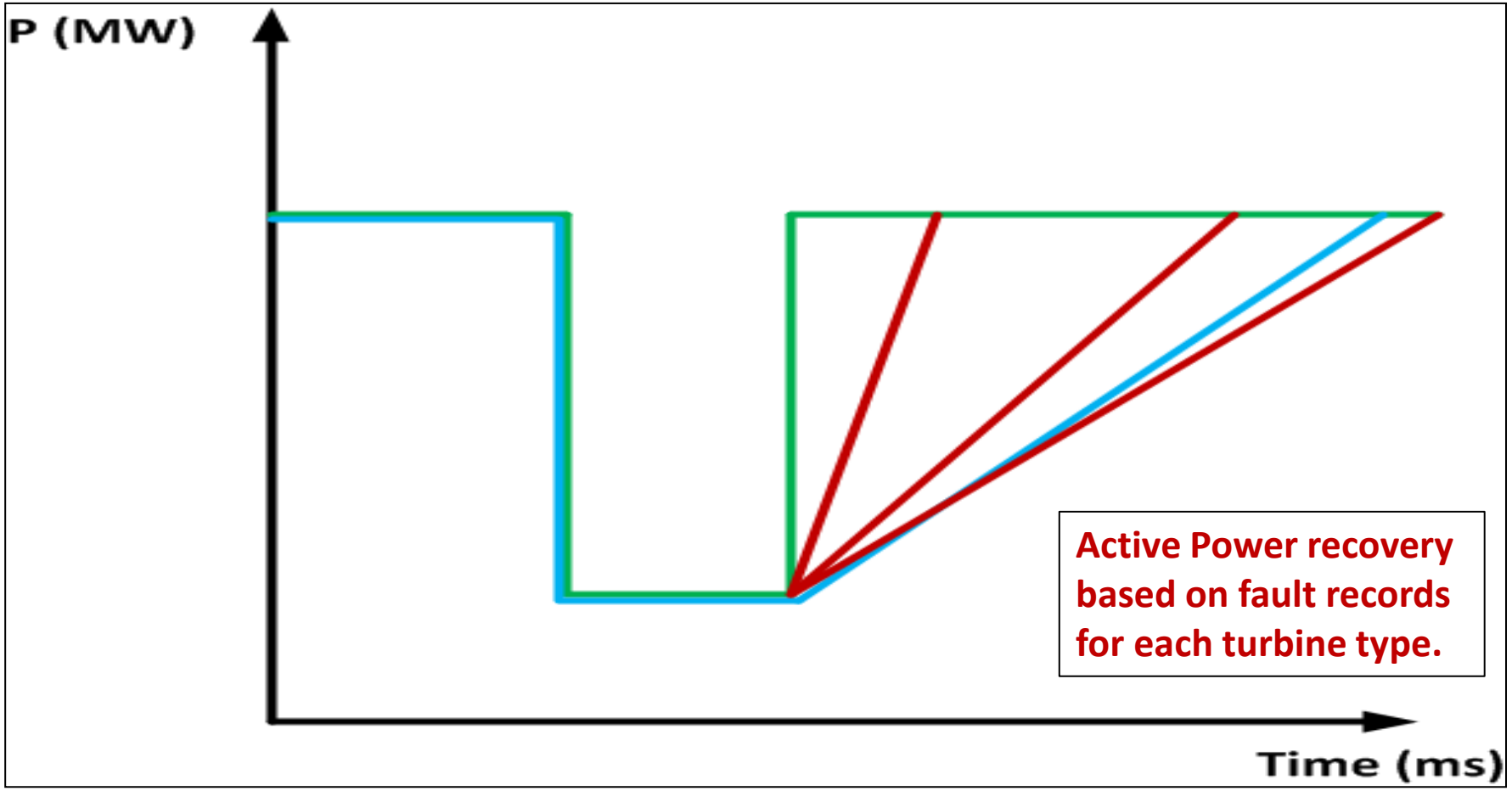


Turbine 4: Fault Duration of 70ms



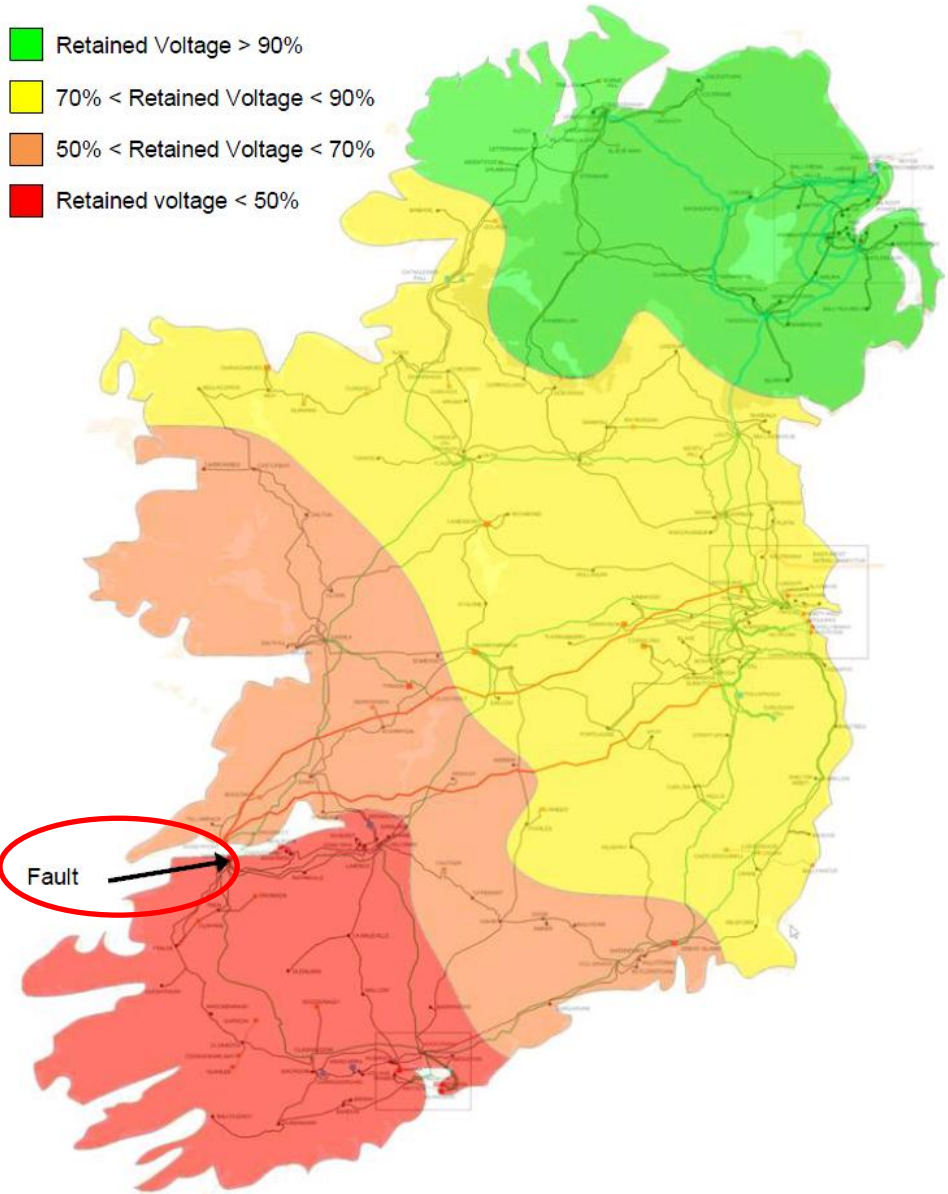


Revised Assumptions for Wind Farm Fault Ride Through Behaviour



Validation of Fault Induced Voltage Dip Propogation

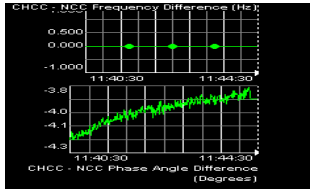
Voltage Dip Propagation



- A severe transmission fault depresses voltage at the location of the fault
- This depression propagates with varying degrees across system

Validation of Voltage Dip Propogation

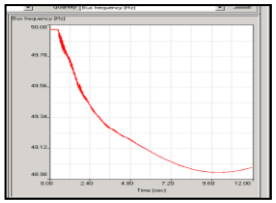
Recorded System Data



Review of fault records

Voltages at various stations recorded

Simulated Comparison in WSAT



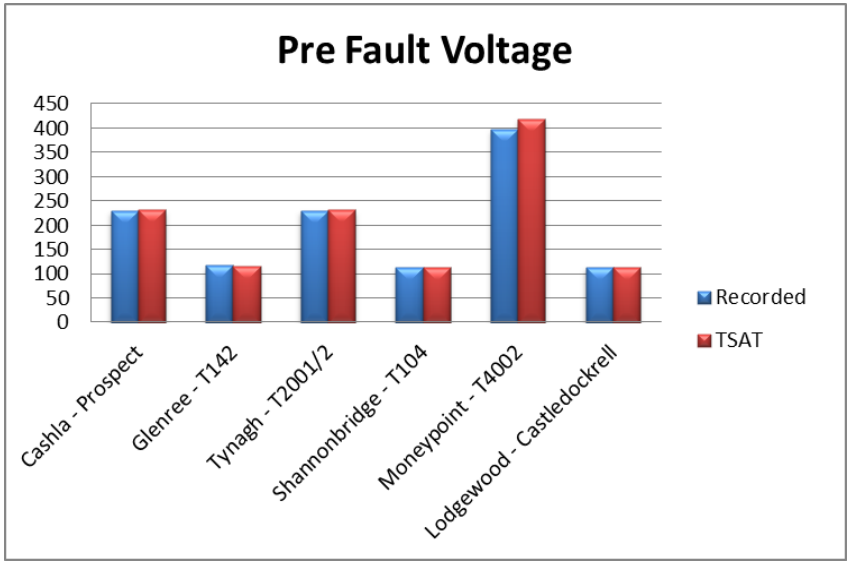
WSAT Snapshot case from event time

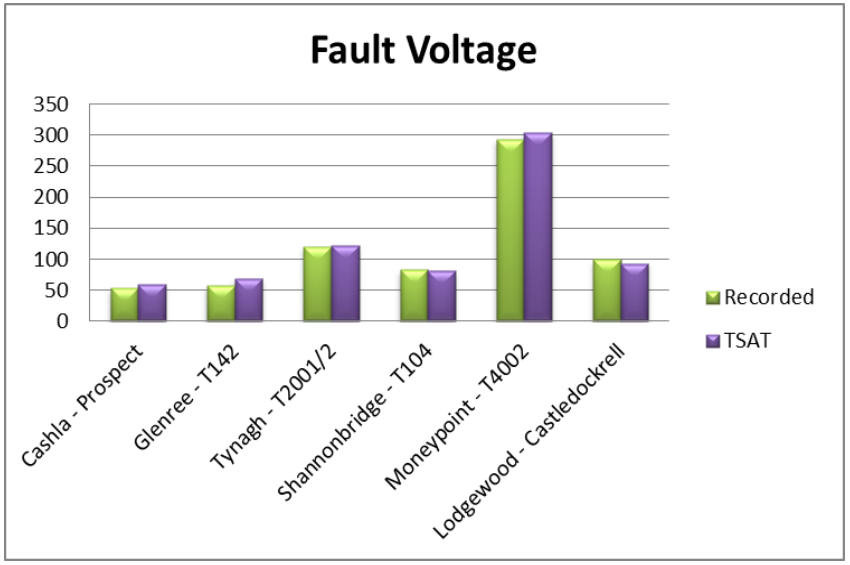
Fault emulated in the case

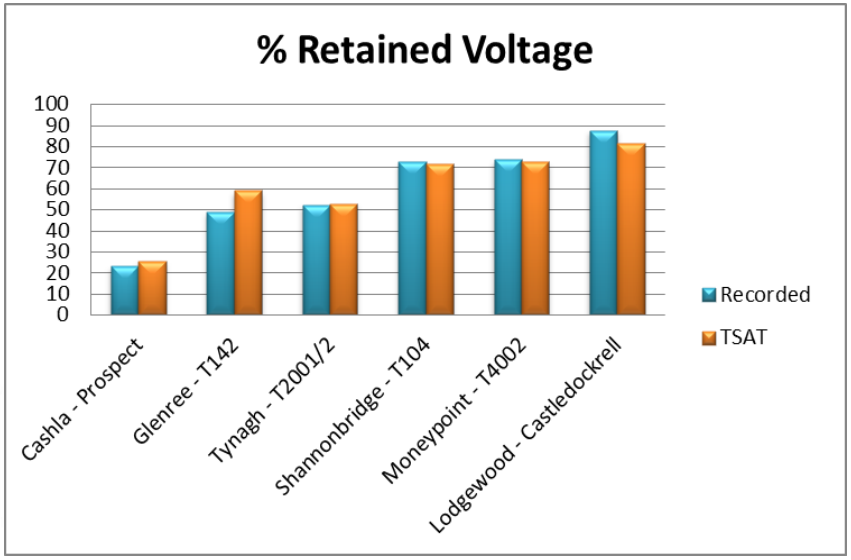
Voltages at selected stations recorded

Comparison of Voltage Propogation

Validation of Voltage Dip Propogation



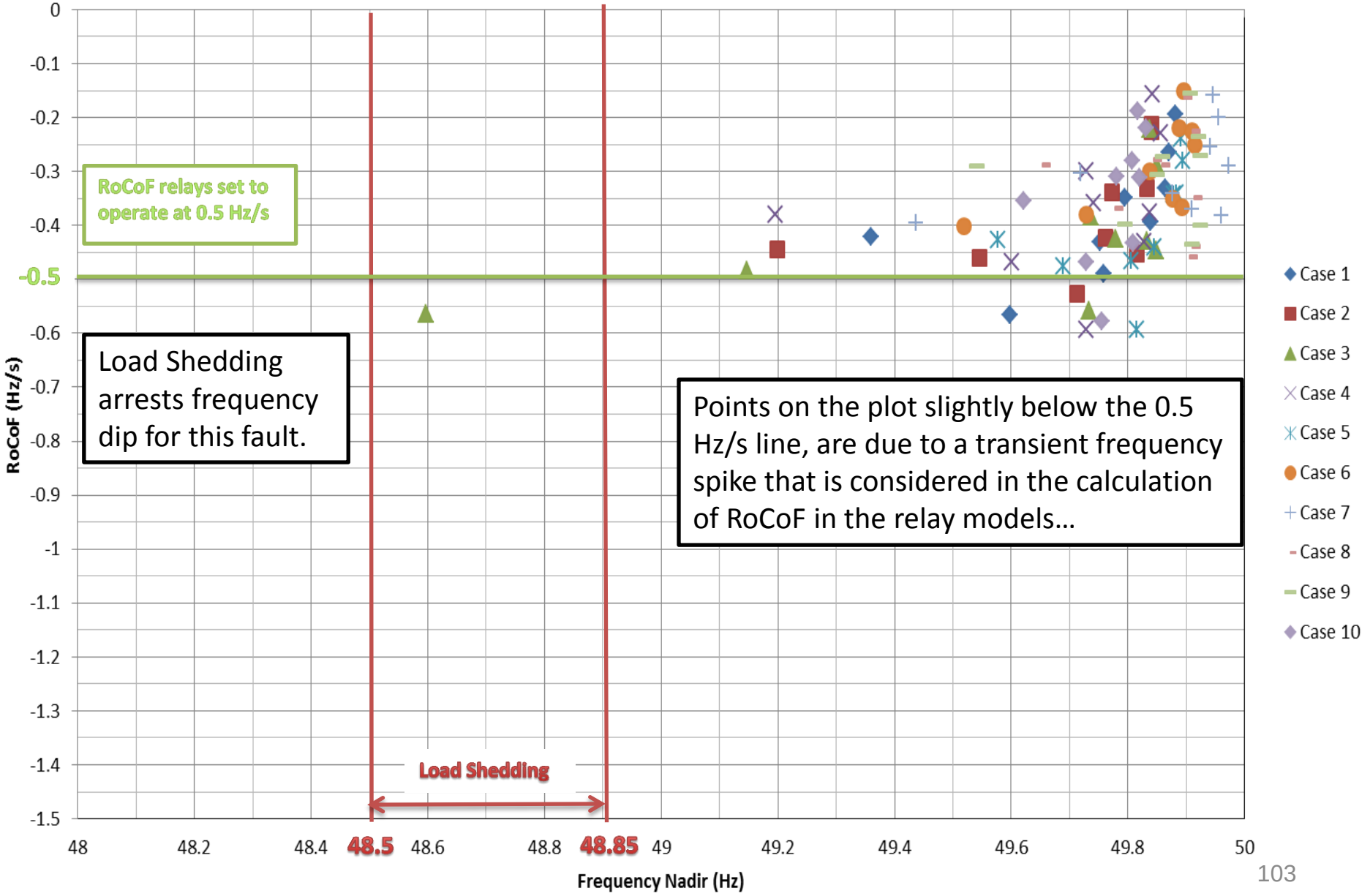




Clear Correlation of Voltage Dip Propogation

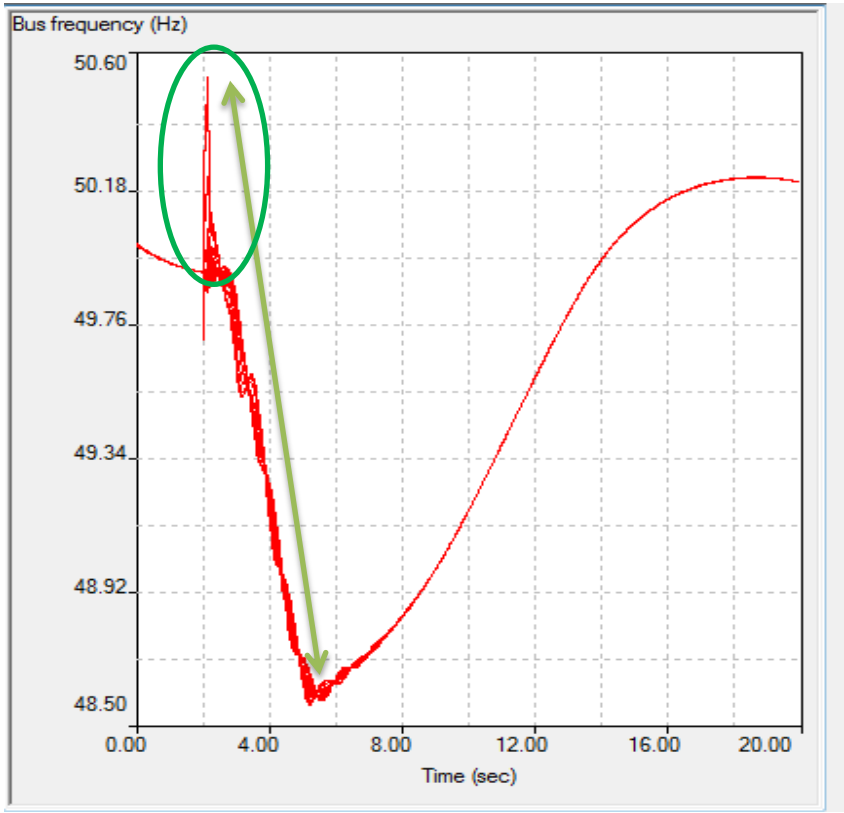
Simulation Results & Next Steps

3-Phase Busbar Fault
RoCoF Rates (Hz/s) Vs Frequency Nadir (Hz)



RoCoF Relay Operation

- Calculation of RoCoF during a transmission system fault.



Conclusions

- System is secure at current wind levels for fault events analysed thus far
- System inertia as well as levels of wind generation have an impact on VDIFD events
- Wind turbines with slower active power recovery rates contribute to VDIFD events

Next Steps

- Follow up with relevant wind farms on Fault Ride Through performance
- Examination of more severe faults
- Further validation of protection relay modelling
- Studies to inform future operational policies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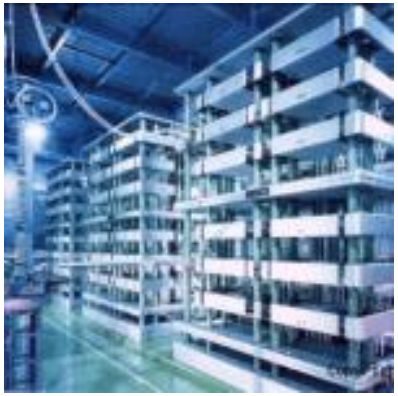
All-Island System Frequency Regulation Investigation

DS3 Industry Forum
4th June 2015

Norman Watson

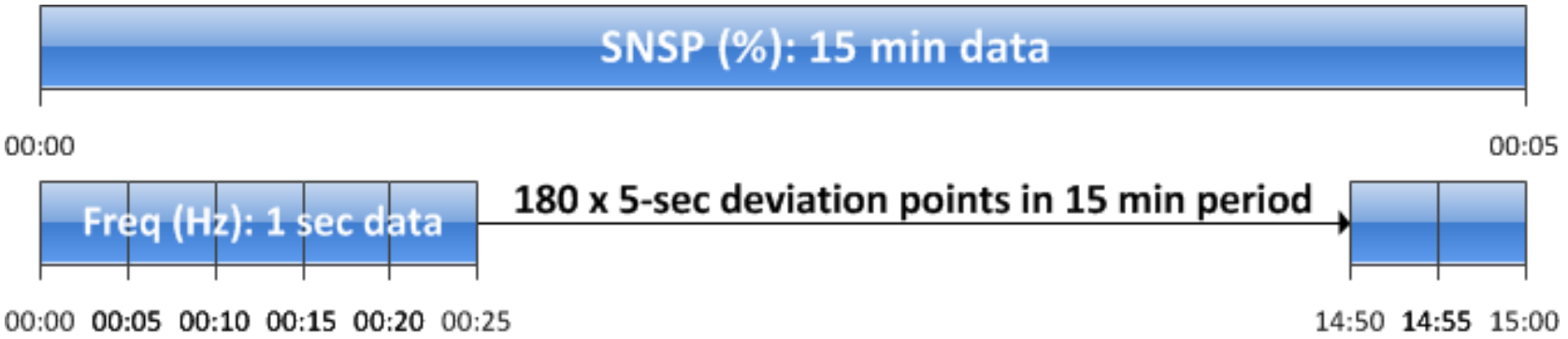
Frequency Regulation



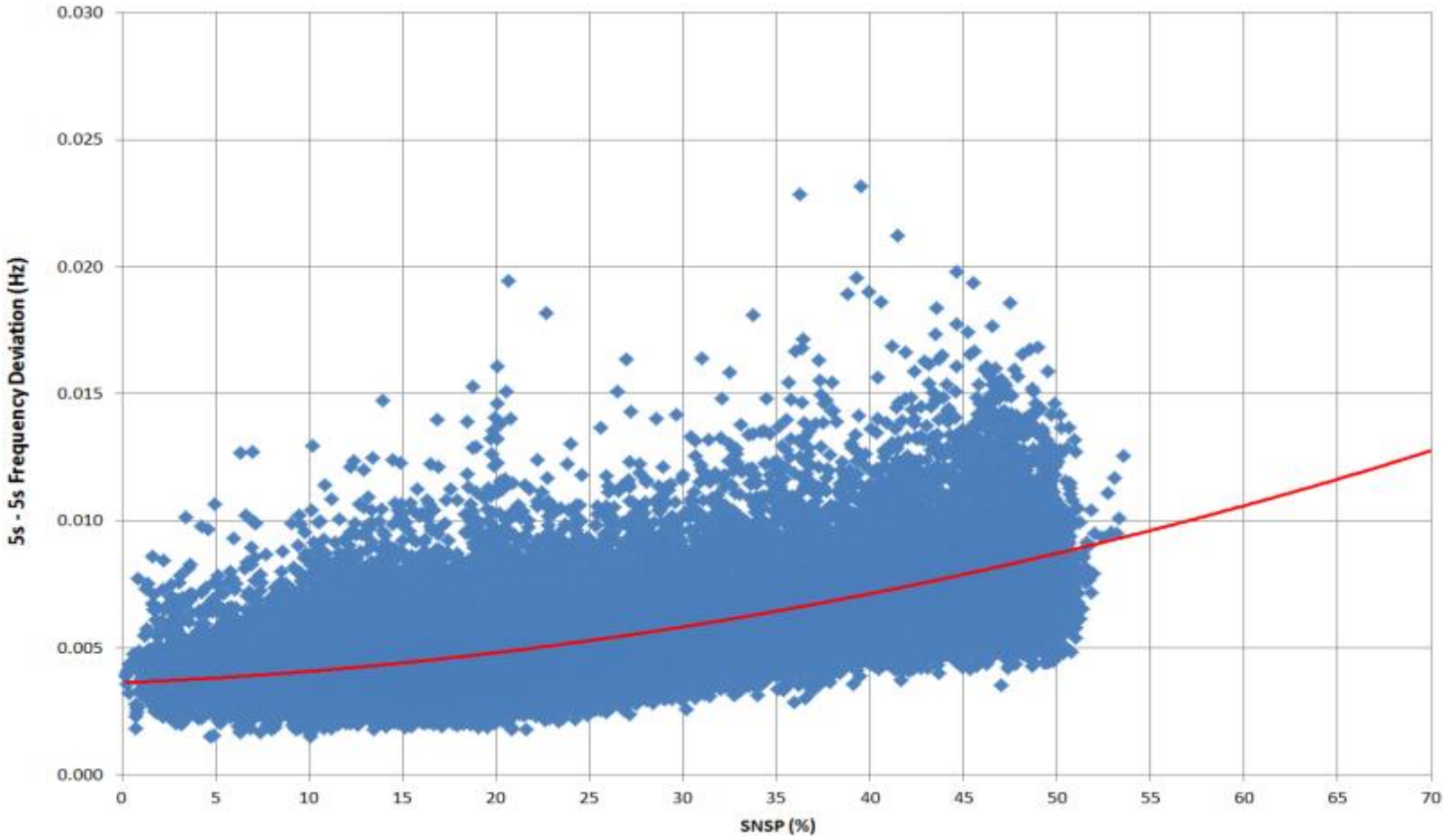
Confirmation of correlation between system parameters such as SNSP and frequency regulation

Freq. Regulation Analysis Scope

- Analysis of 2014 Data:
  - Percentage of time that frequency spent outside 49.9 – 50.1 Hz compared to SNSP, Wind and Inertia levels.
  - Analysis of average and maximum 5-second frequency deviations.

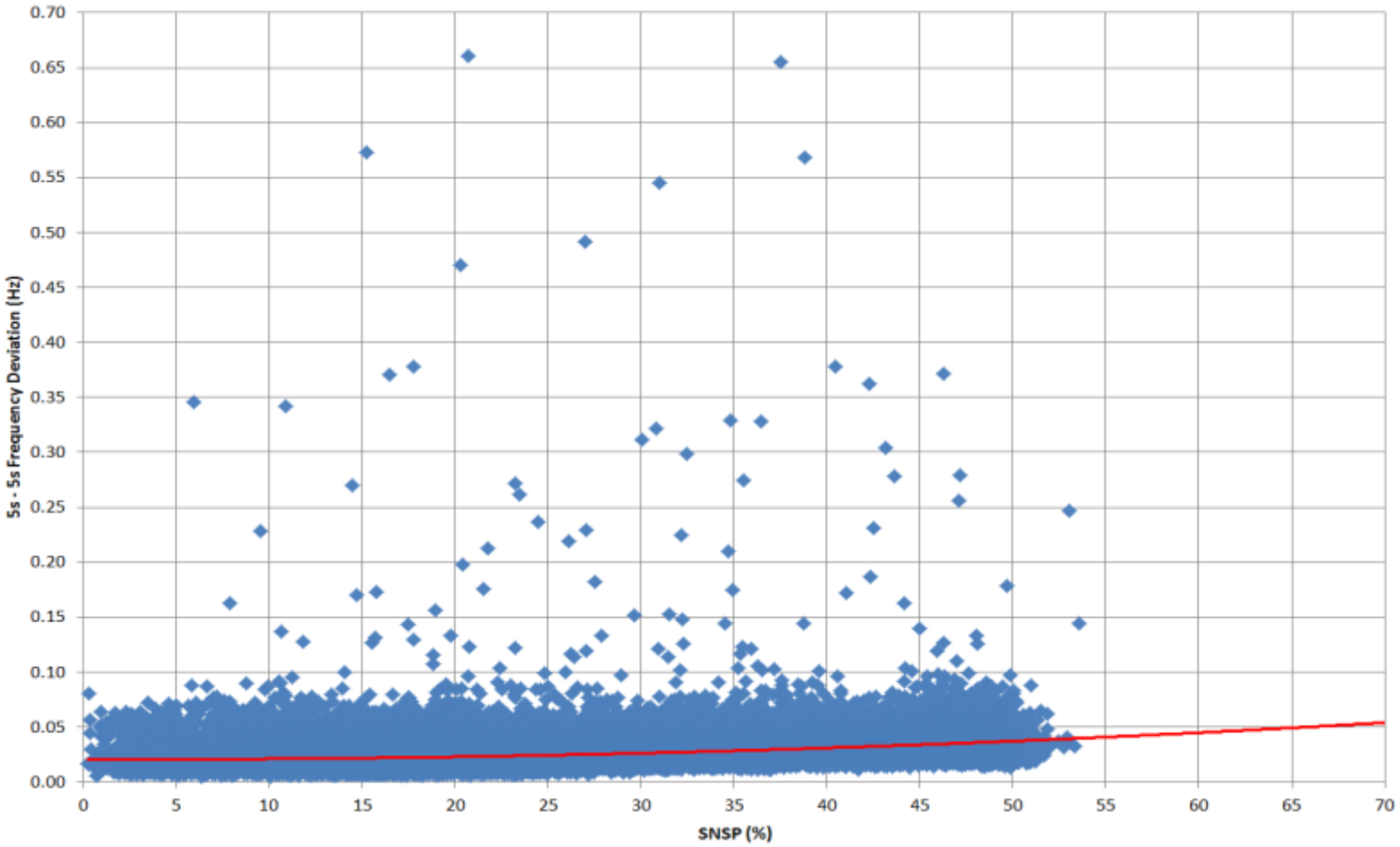


2014 Analysis: Average Freq. Deviations



- Increase in average deviations between 45% and 60% SNSP is approximately 0.003Hz based on extrapolation of data.

2014 Analysis: Maximum Freq. Deviations



- Increase in maximum frequency deviations are marginal as SNSP increases.

Summary

- There is a correlation between frequency regulation and parameters such as SNSP
- Historical data indicates that the system could be securely operated at higher levels of SNSP – not an immediate barrier
- An incremental approach should be implemented when increasing SNSP – recognizes weakness of extrapolation
- Frequency regulation will require diligent management into the future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Control Centre Tools and Capability

DS3 Industry Forum

4th June 2015

Michael Burke

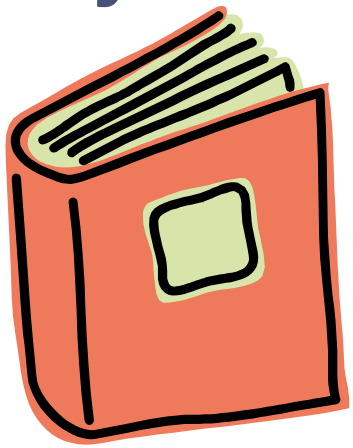
Presentation Summary

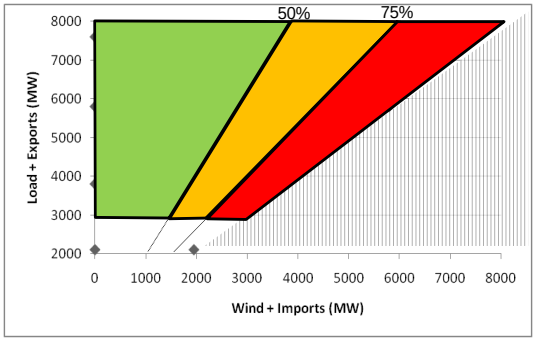
Workstream Overview

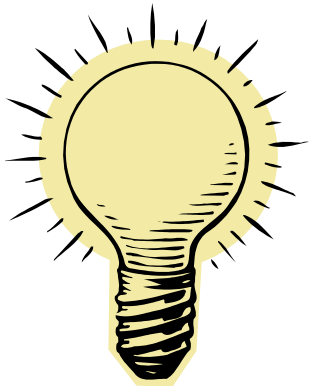
Where are we now?

Where are we going?

Tools and Capability







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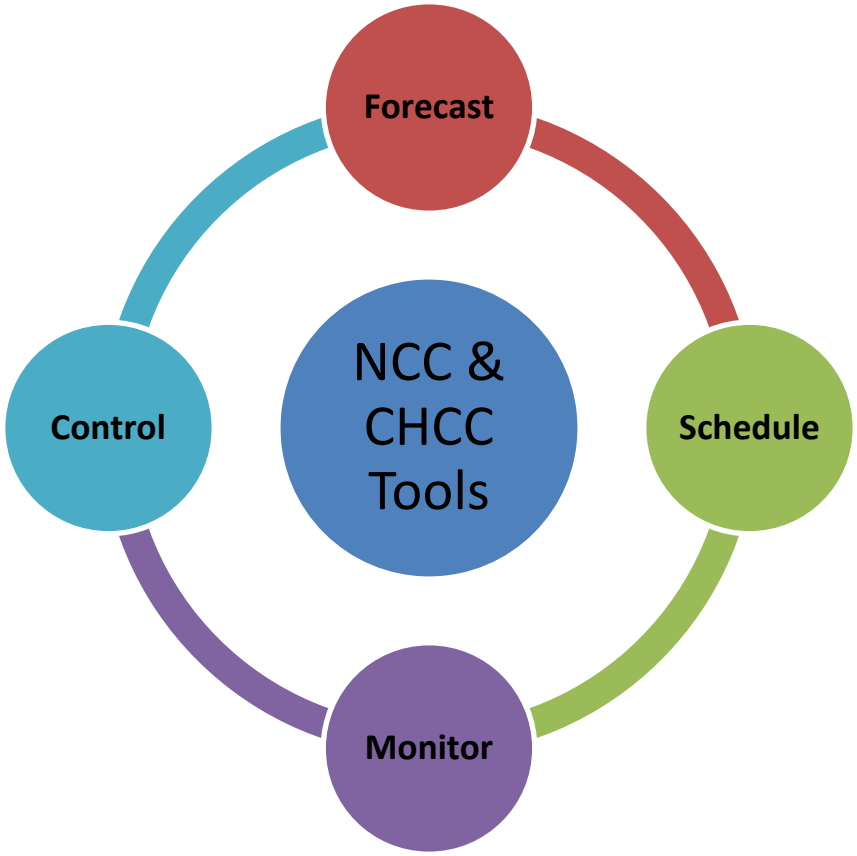
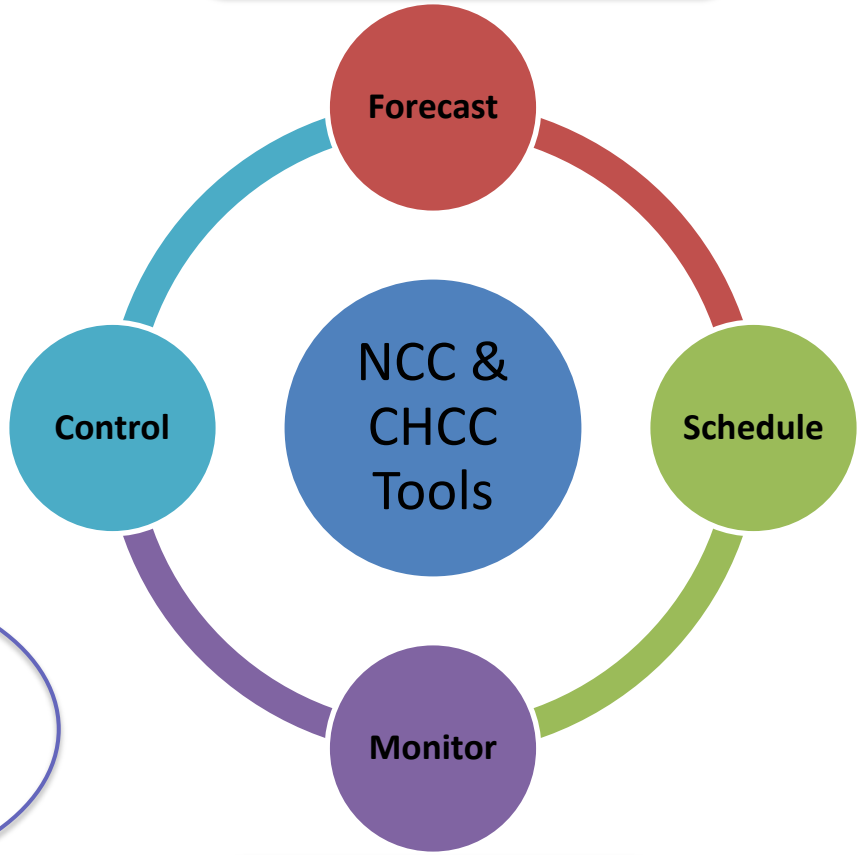
Control Centre Tool Types



Recent Developments

- Improved Graphical User Interface
- Regional Forecasts
- Accuracy incentives
- Wind Forecast Tender



Wind Dispatch Tool

RCUC: Inertia & ROCOF

EMS Integration Q4 2015

- Online Short Circuit Tool
- WSAT Frequency Security
- WSAT Regional Transfers
- Phasor Monitoring

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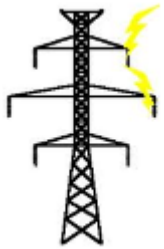
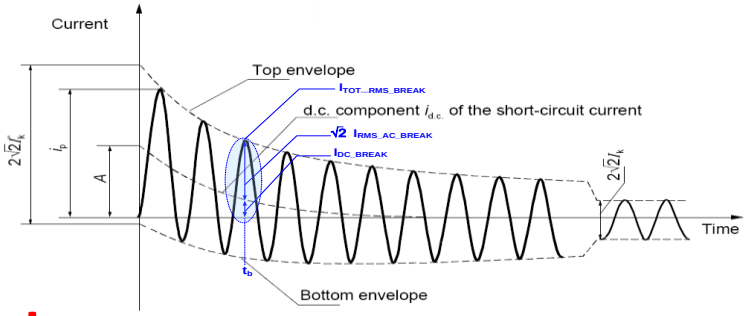
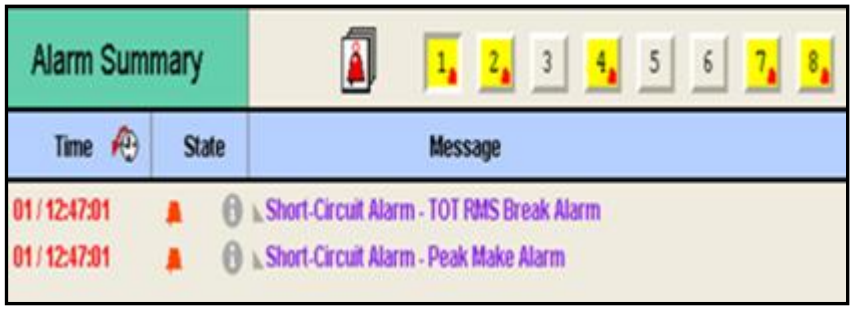
Real Time Short Circuit Tool



- G74 Methodology, 1ph & 3ph
- Runs automatically & alarms
- Offline Study functionality



More Proactive Network Management



Substation	Voltage	Breaker	Fault Id	Type
	50%	60%	70% 80%	90%
CRKMINES	220	CKM2ARK1ICBK	CRKMINES220A1_3	3-P
CRKMINES	220	CKM2DSN1ICBK	CRKMINES220A2_3	3-P
FINGLAS	110	FIN1GLA1ICBK	FINGLAS110A1_3P	3-P
FINGLAS	110	FIN1MCD1ICBK	FINGLAS110A2_3P	3-P
FINGLAS	110	FIN1SVN1ICBK	FINGLAS110A3_3P	3-P
FINGLAS	110	FIN1GLA1ICBK	FINGLAS110B1_3P	3-P
FINGLAS	110	FIN1MCD1ICBK	FINGLAS110B2_3P	3-P
FINGLAS	110	FIN1SVN1ICBK	FINGLAS110B3_3P	3-P

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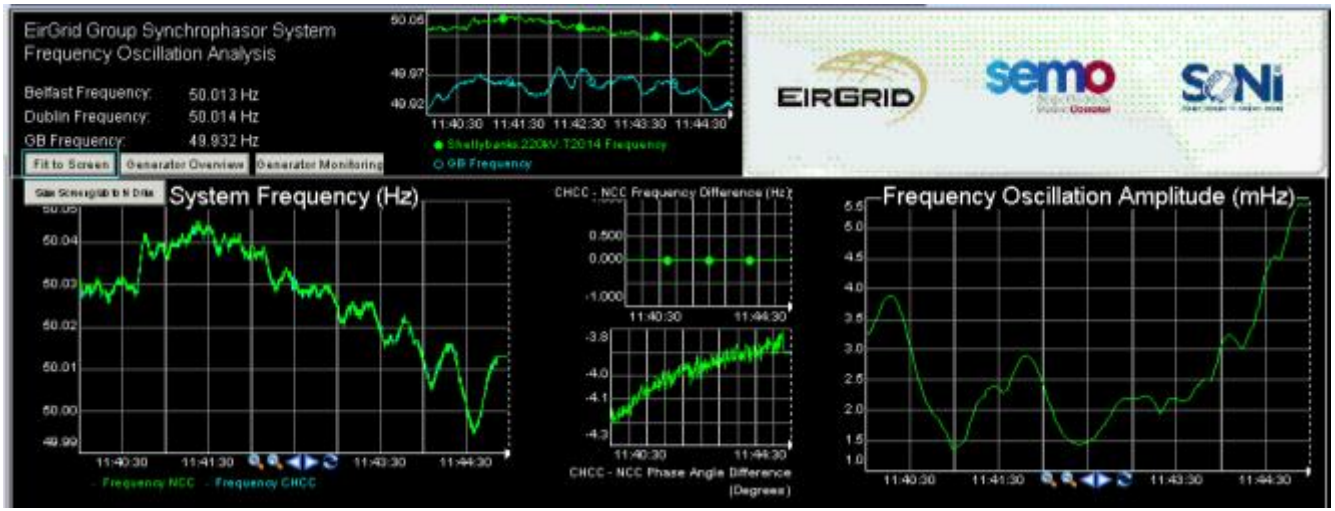
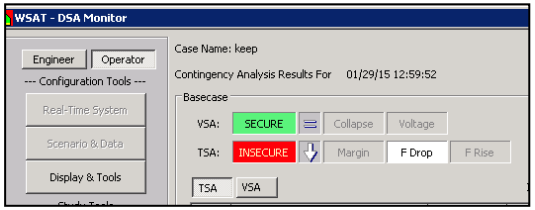
Real Time use of Phasor Monitoring

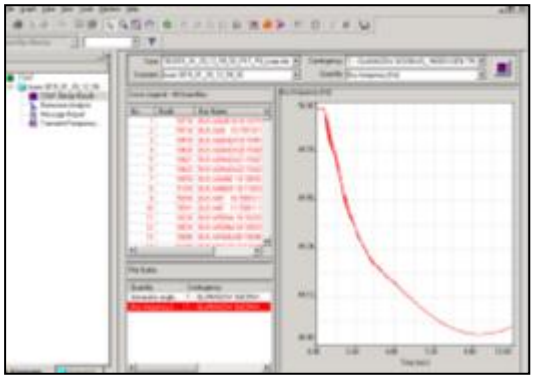
- Higher sampling rate of system
- Oscillation Monitoring
- Post Event Analysis



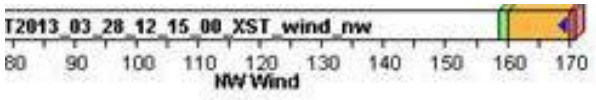
WSAT Development

- Frequency Security Assessment
  - Predict nadir/zenith
  - Continuous Validation vs PMU data

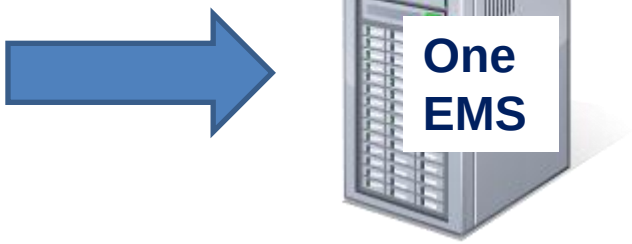




- Regional Transfers
  - Identify amount of wind constraint necessary
  - Show margin to insecurity
  - Overloads & Voltage monitored



Energy Management System Integration

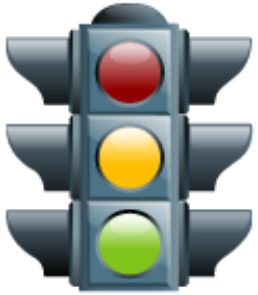


- Fully integrated all island EMS
- Facilitates more effective all island power system operation
- Improved powerflow analysis
- Q4 2015

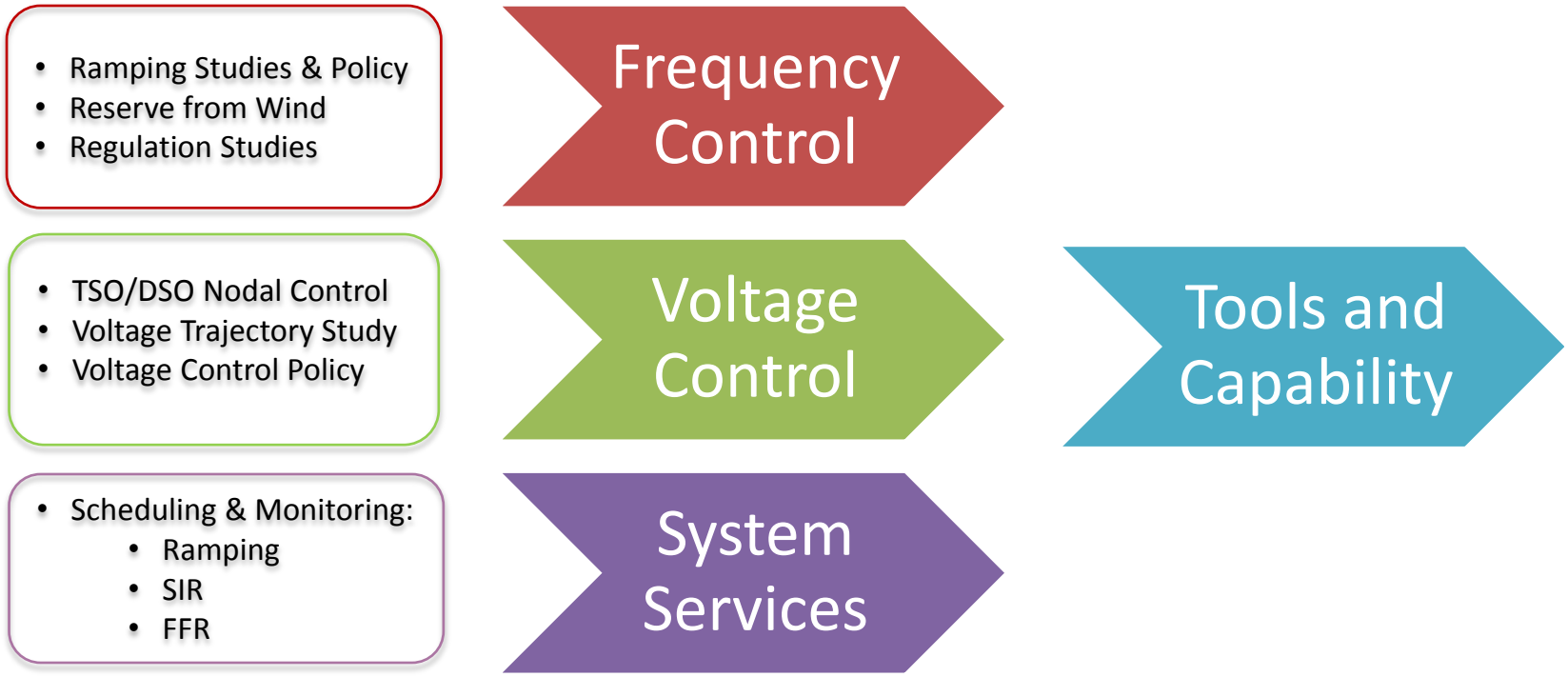
EMS – Facilitating DS3

Situational Awareness

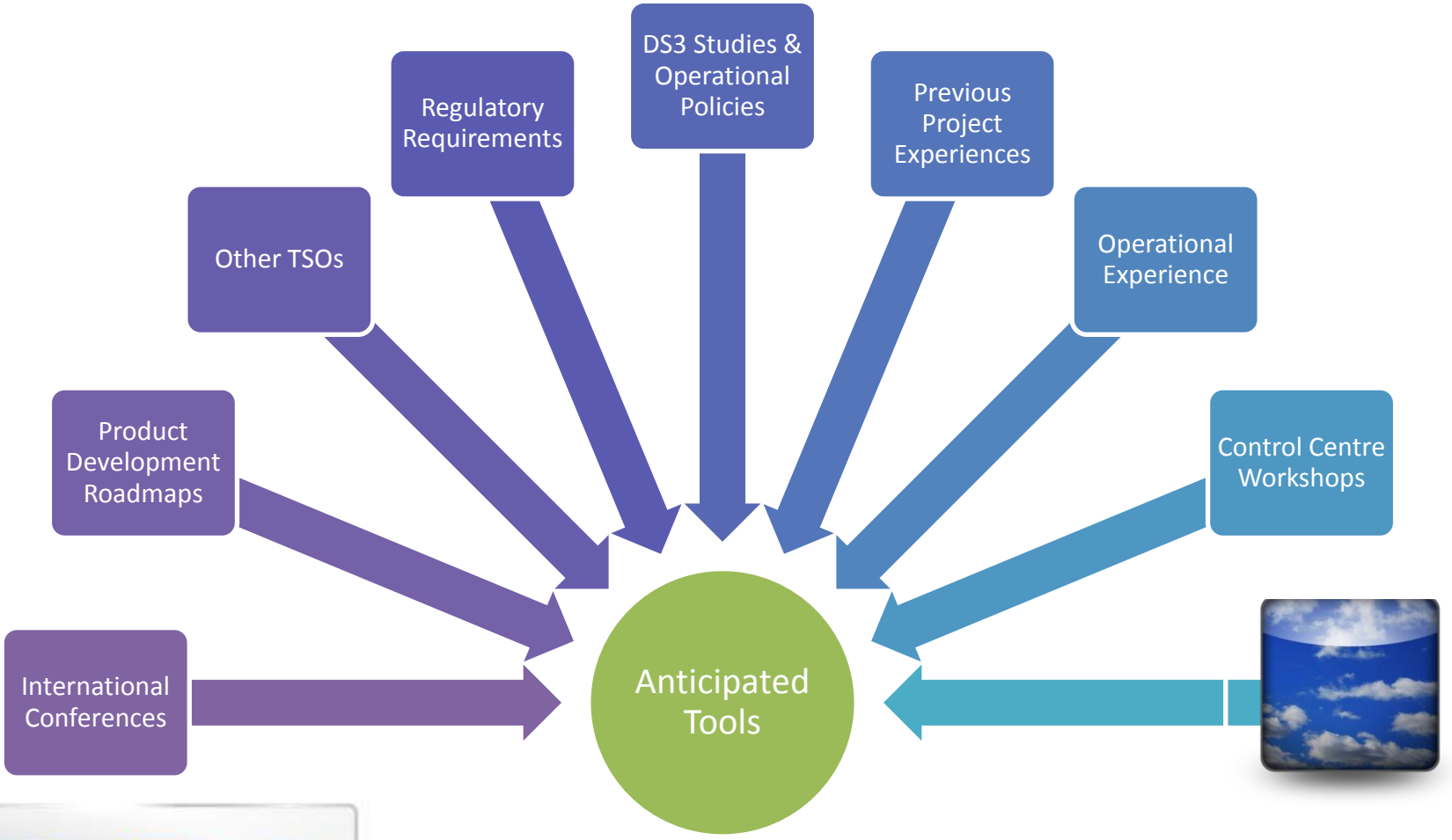
- More Information
- More Tools
- More Policies and Procedures
- **Timely & Effective Decision Making**



Future Tools: Key DS3 Inputs

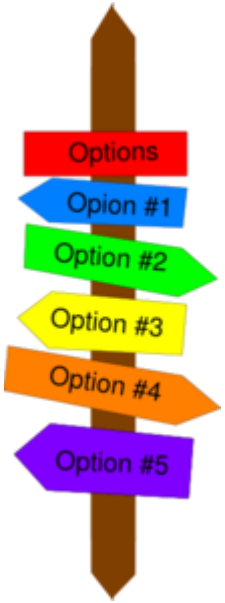


Identification of further requirements



Other Tools?

- Look Ahead Analysis
- Demand Side Management
- Smart Grids
- Intelligent Alarm Processing
- Probabilistic tools



Questions?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Closing Remarks

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Louis Fisher