Introduction

DS3 Advisory Council Meeting

21st May 2015

Andrew Cooke

Agenda

	Time	Speaker
Introduction	10.00	Andrew Cooke (5 mins)
Actions from last meeting **DS3 Programme Status Update**	10:05	Presentation: Robbie Aherne (30 mins) Discussion: All (10 mins)
Regulatory Authorities Update	10:45	Presentation: RAs (10 mins) Discussion: All (10 mins)
Industry Perspective	11.05	Presentation: Kenneth Matthews - IWEA (10 mins) Discussion: All (10 mins)
Rate of Change of Frequency (RoCoF)	11:25	Presentation: David Cashman (10 mins) Presentation: DSOs (10 mins) Discussion: All (10 mins)
System Services	11:55	Presentation: Eoin Kennedy (20 mins) Discussion: All (10 mins)
Control Centre Tools	12:25	Presentation: Michael Burke (20 mins) Discussion: All (10 mins)
Lunch & Networking (12:55 – 13:45)		
Voltage Dip Induced Frequency Dip	13:45	Presentation: Lisa McMullan (15 mins) Discussion: All (15 mins)
Frequency Regulation	14:15	Presentation: Norman Watson (15 mins) Discussion: All (15 mins)
Closing Remarks and Actions	14:45	Andrew Cooke (15 mins)
Session Closed / Networking	15:00	

DS3 Programme Status Update

DS3 Advisory Council Meeting
21st May 2015

Robbie Aherne

System Services

- The TSOs submitted a draft System Services Implementation plan to the SEMC on 18/03/2015.
- At a subsequent TSOs-RAs Director level meeting, it was decided that the plan would be published as a four-entity branded document.
- The revised version of the draft plan, along with the draft TSO Procurement Strategy document, is due to be published in Q2 2015.

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

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)

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

Advisory Council

- Membership update
  - Mark McGranaghan – EPRI
  - Kenneth Matthews – IWEA

- Gaps?
  - Existing Conventional Generator

Operational Capability Outlook

Complements 2015 workstream plans

Complementary Progress Essential

Industry Response
- Investment
- Grid Code

System Services

RoCoF

Operational Tools

Operational Policies

75% SNSP

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 policy and tools need to develop in parallel in a considered manner

Actions

Annual Wind Dispatch Down

	Wind Dispatch-Down (%)			Wind Capacity (MW) at year end		
	NI	IRE	AI	NI	IRE	AI
2011	1.3%	2.4%	2.2%	405	1,631	2,036
2012	0.7%	2.5%	2.1%	488	1,763	2,252
2013	1.9%	3.5%	3.2%	554	1,896	2,450
2014	In progress			614	2,210	2,824

System Oscillation

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

High Wind Speed Shutdown

10. TSOs to include correlation of the wind speed of individual WFPSs and prevailing wind direction of these farms when assessing HWSSD.

North-West
North
North-East
West
All
East
South-West
South
South-East
MW Output as a % of MEC
Wind Speed (m/s)
0%
10%
20%
30%
40%
50%
60%
70%
80%
90%
100%
0
5
10
15
20
25

EIRGRID

semo
Single Electricity Market Operator

SONI
System Operator for Northern Ireland

Regulatory Authorities Update

DS3 Advisory Council Meeting

21st May 2015

DS3

Delivering a Secure, Sustainable Electricity System

RA Update – Advisory Council

21 May 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

Industry Perspective

DS3 Advisory Council Meeting

21st May 2015

DS3 Advisory Council

Kenneth Matthews
Irish Wind Energy Association

Achievements and Aspirations

IWEA
Irish Wind Energy Association

"I want the EU to become the world number one in renewable energies"

8% of our overall 16% RES target reached with 6 years to go!

DS3 – Time to Deliver

2020 Grid Build Out (ROI)

2020 Grid Build Out (ROI)

Summary

information based on the range covered by the Grid Informed Scenario and an additional reduction of 30% as the IWEA position on the build out to 2020 which is as follows:

2015	***203MW***
2016	***301 - 430MW***
2017	***943 - 1347MW***
2018	***545 - 779MW***

Planning for Success

IWEA
Irish Wind Energy Association

DS3 Delivery

Retain Economic Signal

Secure
Market for RES

DS3 Delivery Signal

Securing Investment

De-Risk RES Targets

Policy

Certainty

>2017

Success: Retention of Signal for DS3 Delivery

IWEA
Irish Wind Energy Association

DS3 "Programme Delivery Review"

Success: Retention of Signal for DS3 Delivery

Impact of Curtailment on Industry (ROI/NI)

IWEA
Irish Wind Energy Association

Year	Total Installed Wind	Curtailment	
		DS3 On Schedule	SNSP Limit Fixed at 50%
2012	2114	1.3%	1.3%
2014	2717	0.3%	1.1%
2015	3143	0.6%	2.8%
2016	3569	1.3%	5.3%
2017	3994	1.9%	
2018	**4420**	**3.0%**	**>10%**

Success: Need for a Balanced Approach

IWEA
Irish Wind Energy Association

Position

Tie-Break (SEM-13-010)

"The SEM Committee is of the view that based on the programme plans set out by the TSOs, the DS3 programme will be substantially in place by 2018 which will ensure that levels of curtailment are lower than they might otherwise have been. The SEM Committee will continue to over-see and support the work of the TSOs in this regard. The SEM Committee believes that given these expected developments, it is appropriate to signal now that the compensation for curtailment will only be carried up to a defined point (2018 at the latest)"

Legislation

RES-E Directive:

Article 16.2(c) states:

"appropriate grid and market-related operational measures are taken in order to minimise the curtailment of electricity produced from renewable energy sources."

Moving Forward

1. Revised well thought out programme in place for Curtailment Mitigation delivered no later than Q1 2016
2. Removal for compensation for curtailment to be linked to DS3 delivery.
3. TSO incentivised to maximise counter trading of E-W IC until new market fully functional
4. Regulatory commitment to decision making process

Asking industry to take financial and investment risk with limited DS3 programme delivery is totally unbalanced and counter to stated Gov Policy and RES-E Directive

System Flexibility Curve - Enabling Wind Energy

Rate of Change of Frequency Update

DS3 Advisory Council Meeting
21st May 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 quarterly update published and SONI report due shortly
  - 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

EIRGRID

semo
Single Electricity Market Operator

SONI
System Operator for Northern Ireland

DS3 Advisory Council
ESBN Update

Tony Hearne

21th May 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
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip	Trip	NO TRIP	1.825	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	NO TRIP	Trip	NO TRIP	1.586	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip	Trip	NO TRIP	1.825	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by OF	Trip by OF	Trip by df/dt	NO TRIP	Trip	NO TRIP	1.745	Trip by df/dt	Trip by df/dt	NO TRIP	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by OF	Trip by OF	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	1.824	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by OF	Trip by OF	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	1.585	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by OF	Trip by OF	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	2.062	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt
	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP
	NO TRIP	Trip	NO TRIP	Trip	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	2.334	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt
	NO TRIP	1.581	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	Trip	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP
RoCoF 0.6 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	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip	Trip	NO TRIP	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	NO TRIP	Trip	NO TRIP	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip	Trip	NO TRIP	Trip	Trip by df/dt	Trip by df/dt	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	1.745	Trip by df/dt	NO TRIP	Trip by df/dt	Trip by df/dt
	Trip	Trip	Trip	Trip	Trip by df/dt	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
	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
	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	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP
	NO TRIP	Trip	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	Trip by df/dt
	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	NO TRIP	Trip by df/dt	NO TRIP	Trip by df/dt	NO TRIP
RoCoF 1.0 Hz/s	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
	Trip	Trip	Trip	Trip	Trip by OF	Trip by OF	Trip by OF	Trip by OF	NO TRIP	NO TRIP	NO TRIP	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	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	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: E - Full Converter Connection *(Please use drop-down list)*
(See flow chart)

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 Settings 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 settin Yes

Confirmation of change

For numerical relays, please attach a copy of the relay settings file, with any changes reflected and confirm that the settings 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 Advisory Council Meeting
21st May 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 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

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PART F: Qualification Process

PART G: Assessment Principles for DS3 System Services Procurement

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PART I: Information Provision

APPENDIX A: Product Description

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

SEMC Decision on Volume Calculation Methodology and Scenarios
Q4 2015

→

Publication of Indicative Volumes
Q2 2016

→

SEMC Decision on Final Volumes
Q4 2016

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

SEMC Decision on Detailed Auction Design
Q4 2015

→

Complete Procurement of IT Auction Platform
Q2 2016

→

Complete IT Design and Build of IT Auction Platform
Q4 2016

→

Run First Auction
Q1 2017

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

WS5 – Contract Design

Contractual Principles Paper Issued
Q3 2015

→

SEMC Decision on Final Contract
Q2 2016

→

HAS Contracts Terminated and Interim Tariff Contracts Processed
Q3 2016

→

New contracts from Auction / Regulated Tariff Processed
Q3 2017

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

Scalar Methodology Developed
Q3 2015

→

SEMC Decision on Scalar Methodology
Q1 2016

→

Go-live of Volume, Product and Scarcity Scalars
Q4 2016

→

Go-live of Performance Scalar
Q1 2017

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 DS3 & 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

Week 1
Consultation Opens

Week 2
Industry Workshop (where appropriate)

Week 4
Bilateral Meetings (where appropriate)

Week 6
Consultation Closes

Example timeline assuming 6 week consultation period

Next Steps

Next Steps

- Techno-economic consultancy support and expertise due to be appointed by end of May
- Develop greater certainty on the timelines for IT systems
- Continue to undertake implementation work

Summary of Approach in 2015

March 2015
Draft Plan and Draft TSO Procurement Strategy submitted to RAs

End May 2015
- Consultants appointed to assist with development of principles and methodologies for auction and tariff

September 2015
"Firmed-up" Project Plan

Dec 2015

Planning

Implementation

Scenarios for Volume Calculation	C.1 Consultation
Volume Calculation Methodology	C.2 Consultation
Methodology for Regulated Tariffs	C.3 Consultation
Qualification Criteria and Other Requirements	C.4 Consultation
"Competition Metrics"	C.5 Consultation
Detailed Design of Auction	C.6 Consultation
Contractual Principles	C.7 Consultation
Scalar / Performance Monitoring Methodology and Enduring Process	C.8 Consultation

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

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Control Centre Tools and Capability

DS3 Advisory Council Meeting

21st May 2015

Michael Burke

Presentation Summary

Workstream Overview

Where are we now?

Where are we going?

Tools and Capability

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

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

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

- Ramping Studies & Policy
- Reserve from Wind
- Regulation Studies

Frequency Control

- TSO/DSO Nodal Control
- Voltage Trajectory Study
- Voltage Control Policy

Voltage Control

- Scheduling & Monitoring:
  - Ramping
  - SIR
  - FFR

System Services

Tools and Capability

Identification of further requirements

Other Tools?

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

Questions?

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Voltage Dip-Induced Frequency Dip Analysis

DS3 Advisory Council Meeting
21st May 2015

Lisa McMullan

Presentation Overview

- Explanation of a VDIFD event
- Study setup
- Validation against real system records
- Simulation results
- Conclusions

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

Study Setup

Study Setup

- 10 WSAT snapshot cases for a range of real system scenarios throughout 2013/14
  - SNSP above 46%
  - Inertia 20,149 – 30,334 MWs
  - Wind 1,523 – 2,272 MW
- 3-phase busbar faults applied to known problem busbars across the system
- RoCoF relays set to operate at 0.5 Hz/sec

Key Differences from Previous Analysis

- Improved network model
- Validation of wind farm fault ride through behaviour
- Validation of voltage dip propogation across the system during a fault

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

500 ms Grid Code Limit

Validation of Fault Induced Voltage Dip Propogation

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

Fault: Cashla - Prospect 220 kV, 68 ms								
Disturbance Recorder Location			Recorded pre V	TSAT pre V	Recorded fault V	TSAT fault V	Recorded % Ret	TSAT % Ret
Station	Feeder	Voltage						
Cashla	Prospect	220 kV	230.7	231.5	53.0	59.1	23.0	25.5
Glenree	T142	110 kV	117.1	116.5	57.3	68.7	48.9	59.0
Tynagh	T2001/2	220 kV	230.0	231.7	119.9	122.2	52.1	52.8
Shannonbridge	T104	110 kV	113.6	113.5	82.4	81.2	72.5	71.6
Moneypoint	T4002	220 kV	398.1	418.7	293.5	303.9	73.7	72.6
Lodgewood	Castledockrell	110 kV	113.8	114.0	99.4	92.6	87.4	81.2

Simulation Results

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

RoCoF Relay Operation

- Calculation of RoCoF during a transmission system fault.

Highest Recorded Wind Export Levels

Conclusions

Conclusions

Validation Conclusions

- **Wind Farm Fault Ride Through Behaviour**
  - Revised active power recovery rate settings assumed
  - Grid Code active power recovery rate compliance issues for some wind farms
  - Shows importance of System Services for example: fast post-fault active power recovery
- **Voltage Dip Propogation**
  - Simulation voltage dip propogation is realistic.

Simulation Conclusions

- Fault on a busbar show low frequency nadirs, & high RoCoFs
- Validation of RoCoF calculation in the models - underway
- ESBN Review of Protection relay operation - underway
- Inertia levels on the system play a part in VDIFD events
- Further fault analysis is being carried out.

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All-Island System Frequency Regulation Investigation

DS3 Advisory Council Meeting
21st May 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 <u>0.003Hz</u> 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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Closing Remarks and Actions

DS3 Advisory Council Meeting

21st May 2015

Andrew Cooke