DS3
Programme Overview

1 This document

EirGrid and SONI have carried out studies and analysis of the all-island system over the past number of years. The results of these studies can be found in the Facilitation of Renewables and "Ensuring a Secure, Reliable and Efficient Power System in a Changing Environment" reports respectively. The key messages from these studies are that the 2020 renewable targets set by governments in Ireland and Northern Ireland are achievable; however, significant challenges to the operation of the system will have to be overcome.

To manage the achievement of these targets over the coming years, EirGrid and SONI have established a programme of work entitled "Delivering a Secure Sustainable Electricity System (DS3)". This work programme includes enhancing generation portfolio performance, developing new operational policies and system tools to efficiently use the generation portfolio to the best of its capabilities, and regularly reviewing the needs of the system as the portfolio capability evolves.

This document provides an overview of the scope of the DS3 programme, its objectives, key workstreams and the interaction between workstreams. It also sets out the planned communications and stakeholder engagement process.

2 Policy Background

Recent policy and regulatory decisions in the renewable energy space are having direct implications for the role of system operators. These decisions will result in Ireland and Northern Ireland having more renewable generation on their power systems as a percentage of demand than any other Member State in Europe by 2020. The fundamental behaviour of the power system is changing with the addition of these significant volumes of renewable plant generation. The challenge is how to efficiently and effectively maintain system security while managing ever more increasing volumes of renewable plant generation.

Under the EU Renewable Energy Directive 2009/28/EC, the system operators (TSO and DSO as appropriate) are obliged to "take appropriate grid and market related operational measures in order to minimise the curtailment of electricity from renewable sources on the electricity system." In addition, if significant measures are taken to curtail the renewable energy sources in order to guarantee the security of the electricity system and security of energy supply, the TSOs shall report to the Regulatory Authorities on those measures and indicate which corrective measures it is intended to take in order to prevent inappropriate curtailments[1].

Ireland has set a target of 40% from renewable resources by 2020. Northern Ireland has set a similarly challenging policy goal of 40%. This equates to approximately 5100 MW of renewable plant power plant being installed by 2020 in an aggregate system peak load of less than 7500 MW. This level of renewable plant power plant penetration is unprecedented and poses significant challenges to the real time operation of the power system. To mitigate these challenges, in line with European requirements to minimize curtailment of these sources, EirGrid and SONI have carried out comprehensive pioneering studies to better understand the changing behaviour of the power system with increasing volumes of renewable plant. These studies, which are reported in the Facilitation of Renewables (FoR) studies and the follow up "Ensuring a Secure, Sustainable Power System", indicate that efficient management of the power system with large volumes of renewable plant power plants is possible. In particular, the FoR studies showed that it was possible to securely operate the power system up to 50% of the system coming from non synchronous generation (essentially HVDC imports and renewable plant generation) [Green Zone - Figure 1]. In addition, the

[1] SEM Committee Decision Paper (SEM-11-062) on the Principles of Dispatch and the Design of the Market Schedule in the Trading and Settlement Code: *"In the context of Article 16 of Directive 2009/28/EC the TSOs shall report on a quarterly basis to the respective Regulatory Authorities on incidences of curtailment of renewable generation in order to guarantee the security of the electricity system and security of energy supply indicating corrective measures employed to prevent inappropriate curtailments."*

studies indicated that it was possible to operate the system up to 75% of non synchronous resources [Amber Zone - Figure 1] but mitigating actions would be required to resolve a number of technical challenges. The studies indicated that secure operation beyond a 75% level was not possible given known technology capabilities.

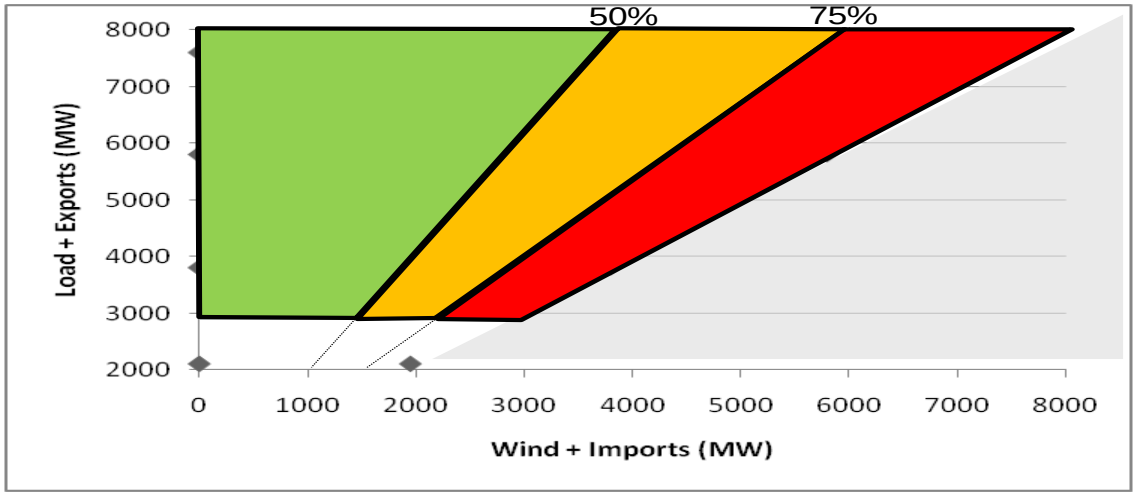


Figure 1 Operating Zones in the Ireland and Northern Ireland Power system (FoR Studies,2010)

The challenge now is how to develop the necessary system operational policies to utilise the system performance capability to efficiently and securely manage the power system of Ireland and Northern Ireland. To manage this work over the coming years, EirGrid and SONI have established a programme of work entitled "Delivering a Secure Sustainable Electricity System (DS3)"

3 Programme Objectives

It is generally accepted that the electricity network will play an increasing role in meeting the EU long term policy objectives of efficiency, sustainability and security. he electricity sector is undergoing a period of considerable change. This change has been characterised by a drive toward increased economic competitiveness and maintaining adequate energy security, and is being delivered primarily through a commitment to increase the levels of variable renewable generation on the power system. In that context, the key objectives of the all island DS3 programme are as follows:

- to maintain security of supply standards on the island in the context of a changing plant portfolio
- to assist in the delivery of the 2020 renewable policy targets set out in the Renewables Directive 2009/28/EC and detailed in legislation by minimising curtailment of renewable generation.

There are three main work areas within the programme:

3.1 System Performance

- To provide certainty around current and future plant performance capability and to ensure the continued reliable performance of all plant connected to the power system in Ireland and Northern Ireland by:
  - Enhancing existing performance monitoring processes
  - Ensuring compliance with Grid Codes by all parties
  - Ensuring that the appropriate controls/incentives are in place to deliver the necessary levels of plant performance
- To ensure the development of a portfolio of plant aligned with the long term needs of the system by:
  - Reviewing system services arrangements

3.2 System Policies

- Analysing, adapting and refining system operational policies, where appropriate, to assist in securely managing the voltage and frequency on the Ireland and Northern Ireland power system by:
  - Collation and analysis of data relating to renewable generation and using this to inform system operational policy development
  - Reviewing policies for ramping and reserve and standards for Rate of Change of Frequency (ROCOF) for plant connected to the system

3.3 System Tools

- Design, development and implementation of enhanced system tools in order to manage the increased operational complexity, including
  - Provide decision support tools to assist the operators in the Control Centres e.g. stability analysis tools such as WSAT, forecasting tools etc.
  - Updating system models with actual plant performance capability and carrying out further studies to investigate the secure system non synchronous penetration levels

4 Programme Workstreams

In order to achieve the deliverables in the DS3 programme, the programme can be further broken down into 11 workstreams [Figure 2]. Details of the content of each of these workstreams are published in separate documents.

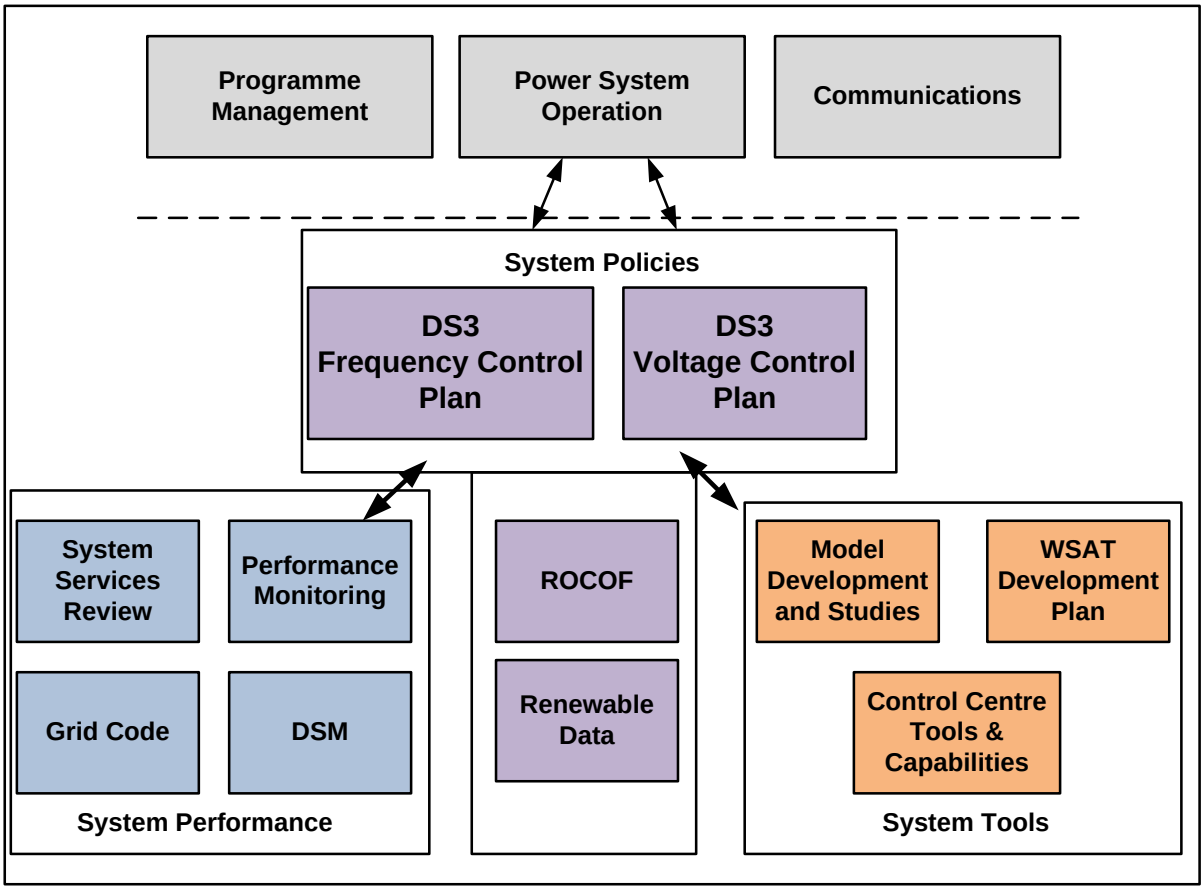


Figure 2: DS3 Workstreams

4.1 Workstream: Frequency Control

In a synchronous AC power system; such as we have in Ireland and Northern Ireland, all of the conventional generating units are synchronised together, producing electricity at a nominal frequency of 50Hz. When supply and demand are in balance, the frequency will be exactly 50Hz. If there is excess generation, the frequency increases; conversely, if there is insufficient generation, the frequency will decrease. As we move to a power system which has a higher penetration of variable renewable plant generation, frequency control is going to become more challenging for the System Operators. The key areas within this workstream are focused on frequency regulation, ensuring adequate system inertia and fast acting reserve following a system disturbance, ensuring sufficient ramping capability and that generation does not trip for a large rate of change of frequency (ROCOF). Several workstreams provide inputs into this frequency control workstream. At regular intervals, system operational policies in terms of frequency control will be reviewed in the context of decisions and work completed in other relevant workstreams. The outputs from ongoing performance monitoring of all plant will be a key input to this workstream in terms of operational policy review. It is planned that this workstream will include some demonstration projects which will assist in showing/trialling new concepts and standards of performance.

4.2 Workstream: Voltage Control

The all island system voltage is determined by the balance of reactive power production and absorption. Generators have traditionally been a primary source of reactive power, which compensates for the reactive power produced and absorbed by consumers and by the lines and cables on the network itself. The management of voltage requires a co-ordinated approach for reactive power control throughout the whole system as deficiencies in a local area at a certain point can have an inordinate impact on other voltages, potentially leading to a voltage collapse. The management of system voltage by all System Operators now needs to evolve due to the changing nature of the portfolio of plant connected to the power system. Key changes relate to the type of generation connecting and being decommissioned from the system, the location of said generation and the reactive power capability of the connected plant. Key areas within this workstream include reactive power standards, TSO/DSO voltage control and review of operational policies. Several workstreams provide inputs into this voltage control workstream. At regular intervals, system operational policies in terms of voltage control will be reviewed in the context of decisions and work completed in other relevant workstreams. The outputs from ongoing performance monitoring of all plant will be a key input to this workstream in terms of operational policy review. It is planned that this workstream will include some demonstration projects which will assist in showing/trialling new concepts and standards of performance.

4.3 Workstream: System Services Review

The nature of the all island power system is changing to meet Government policies with respect to renewable energy. This has significant implications for the needs of the power system, particularly in respect of system services. A comprehensive review of system services in Ireland and Northern Ireland is now required. This review will include an identification of system needs – now and projected for the future, a review of the effectiveness of existing services and payment structures and the potential development of new services and new/revised payment structures. A multi-stage consultation process approach is proposed. The initial consultation will be high level and seek views from the industry on the scope of the review, the structures for system services, eligibility considerations, the contractual arrangements and the degree of interaction with the other components of the wholesale market.

4.4 Workstream: Demand Side Management (DSM)

There is provision within SEM for demand side participation in the form of Demand Side Unit (DSU) and Aggregator Generator Unit (AGU). Units like this could assist with the operational integration of renewable generation by providing system services. The RAs have undertaken a programme of work to develop a Strategic Demand Response Programme for the Island of Ireland. In this regard, a Decision Paper entitled “Demand Side Vision for 2020” was published in May 2011. Key areas of work within this workstream include the Grid Code, System Services, Contracts & Licensing and overall readiness for operation of such units.

4.5 Workstream: Grid Code

The Grid Codes in Ireland and Northern Ireland set the (minimum) standards relating to the operation and use of the respective Transmission Systems making up the all island system for plant or apparatus connected to the Transmission or Distribution system. Recent technical studies carried out by EirGrid and its consultants have shown that very high renewable plant penetrations will necessitate further Grid Code changes to ensure system stability. These changes form a key part of the DS3 project. The changes/modifications to the Grid Codes/Distribution Codes will include renewable plant farm performance standards, ROCOF standards, demand side management and new technologies.

4.6 Workstream: Performance Monitoring

Central to the DS3 programme is the need to systematically monitor the actual performance of all users of the all island power system over a wide range of operating conditions and disturbances. Performance monitoring supports three core aspects of managing this transformation, namely increasing certainty of how the system is performing, using this information to improve the modelling of the power system in order to provide greater certainty in how the power system is likely to behave with higher penetrations of renewable plant power plant and facilitating the appropriate regulation and incentivisation of necessary products to ensure that the necessary aggregate portfolio performance is delivered. Performance monitoring, including both commissioning and on-going testing of generators, needs to evolve in the coming years to meet these challenges. The approach proposed is to advance the performance monitoring activities in each jurisdiction on both transmission and distribution connected generators, to harmonise across jurisdictions where appropriate on performance monitoring approaches and testing procedures and to develop a long term view of the requirements of performance monitoring including the required instrumentation, sampling speeds and measurands required.

4.7 Workstream: ROCOF

The "Facilitation of Renewables" report indicated that the key limit to allowing real time penetrations of renewable plant power plants on the all island system was the rate of change of frequency (ROCOF). From operational experience and analysis ROCOF in excess of 0.5 Hz/s are likely to be encountered when the system exceeds a 50% system non-synchronous penetration (SNSP) level or the synchronous inertia falls below 25,000 MWs. The objective of this workstream is to ensure that an operational policy is developed which clearly understands the issues of ROCOF and seeks to systematically address the critical areas in order to be able to operate a power system with respect to ROCOF issues at up to 75% SNSP. The key parts of this workstream are determining the best approach to managing these ROCOF issues, setting appropriate standards for all plant and reviewing the use of ROCOF for loss of mains protection for distribution connected plant.

4.8 Workstream: Model Development & Studies

The main aim of this workstream is to inform future operational policies related to the integration of large amounts of renewable plant onto the power system, and to develop the dynamic model of the Ireland and Northern Ireland system. Future studies will include analysis of secure minimum conventional generation levels, frequency regulation, ramping requirements, voltage control/dynamic reactive power and a re-run of the previous Facilitation of Renewables studies.

4.9 Workstream: Renewable Data

The key objective of this workstream is to develop a detailed library of information associated with the integration of renewable integration on an all-island basis. This information will feed in to a range of internal reports and external publications – both technical and non-technical. An example of this would be the National Renewable Energy Action (NREAP) and the Annual Renewable Report. This data will also feed into developing system operational policies.

4.10 Workstream: Wind Security Assessment Tool (WSAT)

WSAT monitors the real time stability of the system by carrying out transient and voltage stability assessments every 15 minutes. WSAT has already been launched in the Control Centre in Dublin in September 2010 as a tool that can assist Grid Controllers in assessing the maximum levels of renewable generation that can be allowed on the system while maintaining the system security at an acceptable level. The next stage is to launch WSAT in the Control Centre in Belfast.

4.11 Workstream: Control Centre Tools & Capabilities

Due to the changing system plant portfolio, there is a need to review the tools required in the Control Centres. This will include analysis of whether additional tools are needed by the Controllers

in the Control Centres and whether existing tools need to be modified. An example would be the Wind Dispatch Tool, the Energy Management System (EMS) and wind forecasting tools.

Note: The Control Centre Tools & Capabilities workstream document will be published in Quarter 1 2012.

5 Communications/Stakeholder Engagement

The DS3 project is of significant importance to the Ireland and Northern Ireland electricity industry. To this end, the TSOs will engage systematically with industry through the following processes:

- For all Grid Code related matters, the Ireland, Northern Ireland and Joint Grid Code Review Panels will be the primary mechanism for engaging with industry.
- A DS3 industry Advisory Council has been established to share relevant information related to the implementation of the Programme and to provide a forum to discuss stakeholder views and concerns on those issues which impact on the implementation of the Programme
- For the System Services workstream, along with the necessary consultation processes, the TSOs with RA participation will set aside a week where all participants are invited to bilaterally meet and discuss issues that they believe are relevant for consideration in the System Services review.
- In conjunction with the publication of significant consultation papers, an open forum/industry workshop will be held for interested stakeholders.
- At least two industry forums will be held each year to outline programme progress.
- Regular updates will be provided on the EirGrid and SONI websites.

The planned stakeholder interactions are illustrated in Figure 3 below.

5.1 Stakeholder Engagement

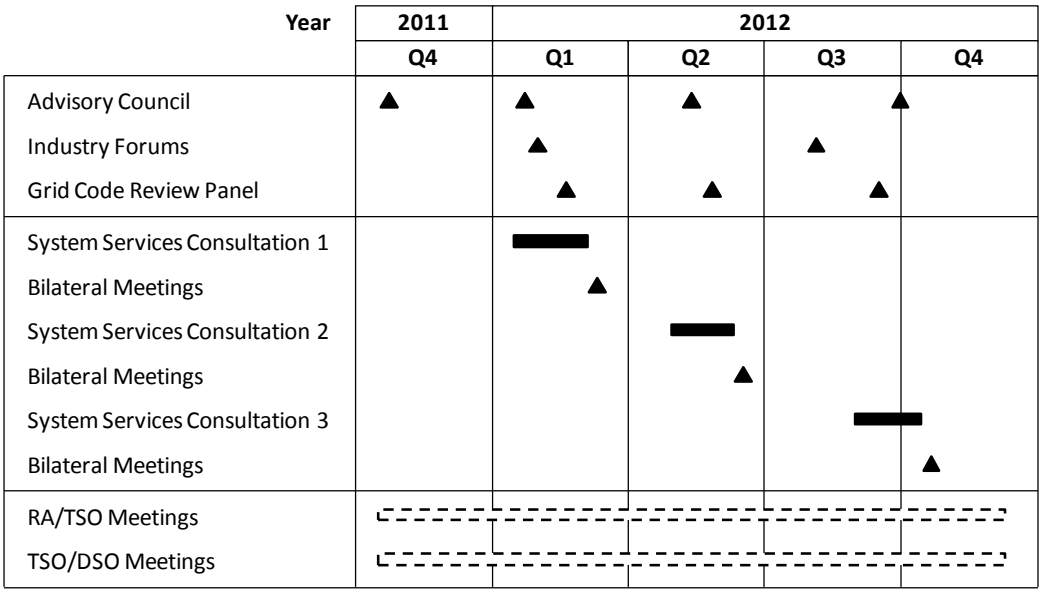


Figure 3: Overview of Planned Stakeholder Engagement

6 Programme Management

To ensure the successful delivery of the DS3 programme, CER, NIAUR, EirGrid and SONI will work closely together. The objective of all parties is to ensure that the 2020 renewable policy targets are delivered in a cost efficient manner while maintaining security of supply standards of the all island power system.

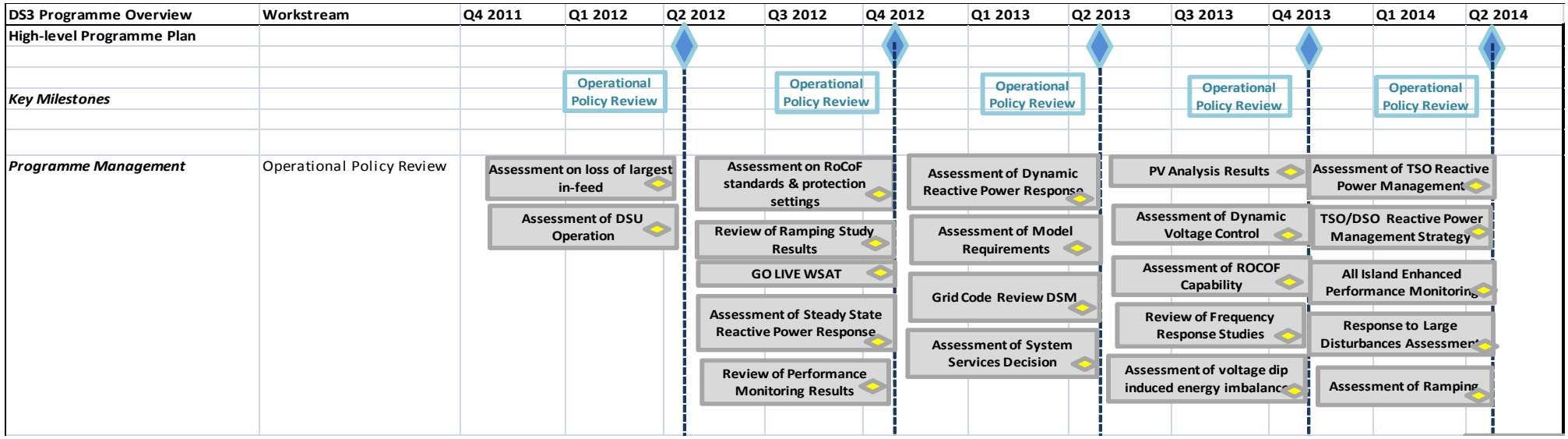
The TSOs and RAs will hold a monthly meeting to discuss the programme and workstream progress; deliverables, issues, risks and constraints. From time to time, the DSOs will also be invited to attend these meetings. The TSOs and DSOs will schedule regular meetings to work through the key issues per their programme plans.

The programme and the interactions between the various workstreams are illustrated in section 6.1 below. This graphical illustration simply provides a high level overview of the DS3 project and its dependencies and should not be used to analyse the programme in detail.

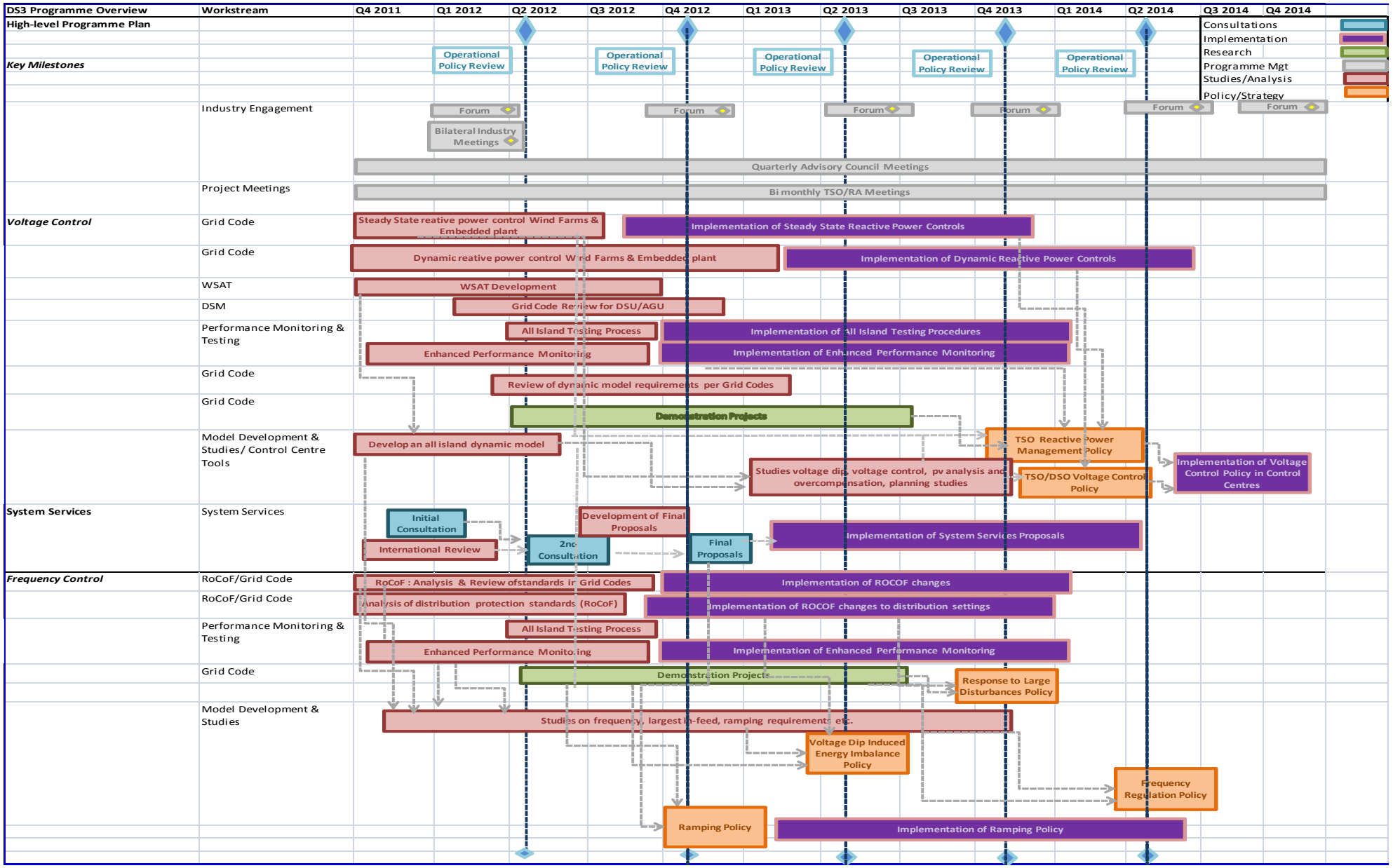
It is important to note that the delivery of the key parts of this programme will only be achieved with the full engagement and support of stakeholders across the electricity sector.

6.1 Overview of Programme and Workstream Interactions

The following table provides an overview of some of the milestones within the DS3 project.



The table on the next page provides a high level overview of the main tasks within the DS3 programme and the various interactions between workstreams.


DS3 Programme Overview
Workstream
Q4 2011
Q1 2012
Q2 2012
Q3 2012
Q4 2012
Q1 2013
Q2 2013
Q3 2013
Q4 2013
Q1 2014
Q2 2014
Q3 2014
Q4 2014
High-level Programme Plan
Consultations
Implementation
Research
Programme Mgt
Studies/Analysis
Policy/Strategy
Key Milestones
Operational Policy Review
Industry Engagement
Forum
Bilateral Industry Meetings
Quarterly Advisory Council Meetings
Project Meetings
Bi monthly TSO/RA Meetings
Voltage Control
Grid Code
Steady State reative power control Wind Farms & Embedded plant
Implementation of Steady State Reactive Power Controls
Dynamic reative power control Wind Farms & Embedded plant
Implementation of Dynamic Reactive Power Controls
WSAT
WSAT Development
DSM
Grid Code Review for DSU/AGU
Performance Monitoring & Testing
All Island Testing Process
Implementation of All Island Testing Procedures
Enhanced Performance Monitoring
Implementation of Enhanced Performance Monitoring
Review of dynamic model requirements per Grid Codes
Demonstration Projects
Model Development & Studies/ Control Centre Tools
Develop an all island dynamic model
TSO Reactive Power Management Policy
Studies voltage dip, voltage control, pv analysis and overcompensation, planning studies
TSO/DSO Voltage Control Policy
Implementation of Voltage Control Policy in Control Centres
System Services
System Services
Initial Consultation
Development of Final Proposals
International Review
2nd Consultation
Final Proposals
Implementation of System Services Proposals
Frequency Control
RoCoF/Grid Code
RoCoF : Analysis & Review ofstandards in Grid Codes
Implementation of ROCOF changes
Analysis of distribution protection standards (RoCoF)
Implementation of ROCOF changes to distribution settings
Demonstration Projects
Response to Large Disturbances Policy
Studies on frequency, largest in-feed, ramping requirements etc.
Voltage Dip Induced Energy Imbalance Policy
Frequency Regulation Policy
Ramping Policy
Implementation of Ramping Policy