DS3 Programme Transition Plan
Q4 2018 – Q4 2020

December 2018

EIRGRID SONI

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1. Background

The Delivering a Secure, Sustainable Electricity System (DS3) Programme began in 2011 in response to binding National and European renewable energy targets.

Ireland's binding EU target is for 16% of the country's total energy consumption to come from renewable energy sources by 2020. In order to achieve this there is a target of 40% of electricity consumption to be met by renewable sources by 2020.

In keeping with United Kingdom and wider European policy, Northern Ireland has a target to achieve 40% of its electricity consumption from renewable sources by 2020.

The aim of the DS3 Programme is to meet the challenges of operating the electricity system in a secure manner while achieving these 2020 renewable electricity targets. The DS3 Programme is designed to ensure that we can securely operate the power system with increasing amounts of variable non-synchronous renewable generation over the coming years. Achieving this level of renewable integration on a synchronous system is unprecedented and presents significant challenges for the real-time operation of the power system.

To date, the DS3 Programme has enabled EirGrid and SONI to increase levels of instantaneous system non-synchronous penetration (SNSP) from 50% to 65%, with the aim of increasing this incrementally to 75% in 2020.

The Programme involved many different stakeholders, including the Distribution Network Owners (DNO) in Northern Ireland, the Distribution System Operator (DSO) in Ireland, Regulatory Authorities, conventional and renewable generators as well as Government Departments.

To facilitate engagement with stakeholders, we established an Advisory Council to ensure that the views of all stakeholders are well represented.

1.1. Existing DS3 Programme Structure

To date the DS3 Programme structure has been based around three pillars, each vital to the success of the DS3 Programme. These are:

- System Performance
- System Policies
- System Tools

These three pillars were then divided into 11 workstreams, shown in Figure 1.

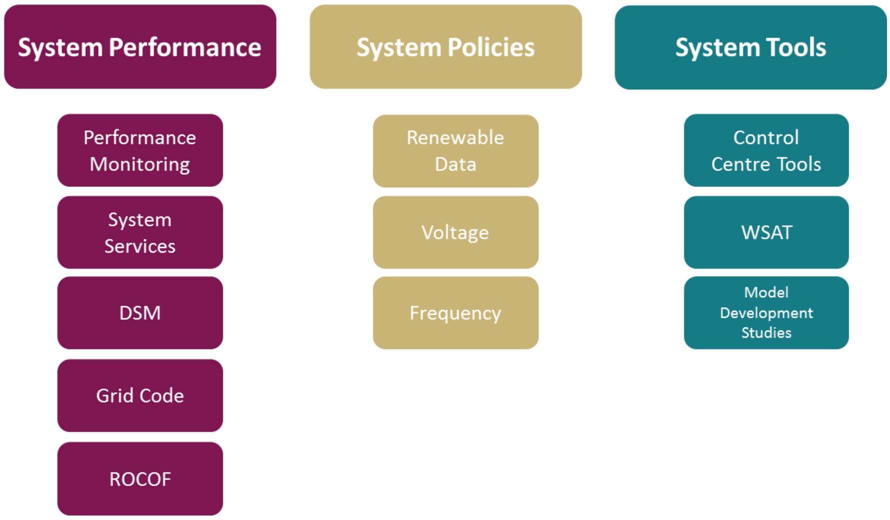

Figure 1: DS3 Programme Workstream Structure

To date, annual work plans have been published for each of these workstreams. These plans indicated work to be completed until the end of the DS3 Programme with target dates.

A recent review of this workstream structure and the associated plans has shown that several of the workstreams are complete and can therefore be closed. These are:

- Performance Monitoring;
- DSM;
- Grid Code;
- Renewable Data;
- WSAT; and
- Model Development & Studies.

This document contains closeout statements for each of these workstreams, including work completed and impact of the workstream on the overall DS3 Programme objectives.

The remaining workstreams will be transitioned into the new DS3 Programme plan that will adopt a project milestone and deliverable approach.

The new DS3 Programme plan only represents what is required to achieve the original goals of the DS3 Programme for meeting 2020 renewable electricity targets. Separate work is ongoing through the EU-SysFlex project to develop a roadmap for how the power system needs to evolve to meet 2030 renewable energy targets.

2. Workstream Closeout Statements

2.1. Performance Monitoring

2.1.1. Aim of Workstream

The system is undergoing a large change; at its core is the replacement of large thermal synchronous plant with variable non-synchronous renewable power plants. To manage this transformation it is essential that a detailed understanding of the changing characteristics of the power system is developed. At the core of this understanding is the need to systematically monitor the actual performance of all users over a wide range of operating conditions and disturbances. Performance monitoring, including both commissioning and on-going testing of generators, was required to evolve to meet these challenges.

The Performance Monitoring aspects of the workstream had the following objectives:

- Standardise the existing performance monitoring processes on an All-Island basis;
- Develop the business processes and operational policies required for an enhanced performance monitoring process;
- Develop requirements for and build an IT system to monitor the performance of users of the system;
- Engage with stakeholders throughout the project to ensure their requirements are captured; and
- Investigate the use of improved data such as high speed data recording devices.

The Testing aspects of the workstream have the following objectives:

- Carry out a review of the existing testing processes with stakeholders;
- Develop and implement recommendations to improve and standardise the testing processes; and
- Develop standardised testing processes arising from new Grid Code / Distribution Code modifications.

2.1.2. Workstream Deliverables

The first phase of the Performance Monitoring aspects of the workstream focused on standardising and documenting the existing processes in EirGrid and SONI. Monthly and quarterly All-Island reports are now produced on the aggregated portfolio performance which feed into the development of operational policy. The initial phase of Performance Monitoring also focused on identifying and documenting the TSO high-level business requirements for an enhanced All-Island performance monitoring process.

The workstream also focused on carrying out an industry review of the current commissioning and testing process and presenting recommendations to industry on areas for improvement in the current processes. The industry review was discussed at the Joint Grid Code Review Panel meeting in May 2012 and it was agreed to set up All-Island workshops to review the current processes employed for both conventional and wind farm power stations. The conventional generator and windfarm testing review workshops and the publication of the recommendations took place in late 2012.

The high level requirements for the enhanced performance monitoring system, developed in 2012, were presented to industry for comment in 2013 through a number of All-Island workshops. The findings from these workshops were published by the TSOs and where applicable were incorporated into the enhanced process. Following this, the TSOs worked on development of the detailed IT design specification for the new system.

The wind farm testing review recommendations were published in January 2013. Regular updates on the project progress and upcoming work were presented at the various DS3 Industry Forums and also at each Joint Grid Code Review Panel meeting.

The TSOs completed the detailed IT design specification at the beginning of 2014. Following this, development of the new IT system commenced and the Enhanced Performance Monitoring System (EMPS) system went live internally in December 2017. There is work ongoing regarding engagement with users and training on how to use the system.

Work completed in the Testing and Commissioning section of the workstream included the standardisation of testing procedures, where applicable, on an All-Island basis. A number of test procedure templates for both wind farms and conventional units were published for comment and are now in use during testing.

2.1.3. Conclusions

The following benefits were achieved through the completion of the workstream deliverables:

- Understanding and certainty as to how the system and the users connected to the power system are performing;
- Information on the actual performance of users of the system and use this to enforce all relevant Grid Code / Distribution Code standards;
- Use this information to inform operational policies and 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 non-sycnhronous generation; and

- Facilitating the appropriate regulation and incentivisation of Generator Performance Incentives and System Services products to ensure that the necessary aggregate portfolio performance is delivered.

2.2. DSM

2.2.1. Aim of Workstream

One possible method of achieving balance between electricity generation and demand is through demand reduction using Demand Side Management (DSM). This active consumer participation can help improve the use of electricity generation and grid infrastructure, thereby increasing the overall efficiency of the power system. Additional demand flexibility can also enable system operators to manage increasing amounts of wind on the power system.

At present, there are a number of Demand Side Units (DSUs) and Aggregated Generator Units (AGU) in both Ireland and Northern Ireland. These units operate commercially within the Single Electricity Market (SEM) and are centrally dispatched. A key objective of this workstream is to facilitate increased participation of DSUs and AGUs in the SEM. This can be achieved through changes to the Grid Codes, Trading and Settlement Code and the Regulatory Authorities' Supply Licence.

2.2.2. Workstream Deliverables

In late 2011 and early 2012, the Regulatory Authorities/SEM Committee approved changes to the Ireland and Northern Ireland Grid Codes, the Trading and Settlement Code and the CER Supply Licence. This removed many of the barriers to DSUs and AGUs participating in the SEM and becoming operational.

In 2012, Grid Code testing procedures were put in place by EirGrid and SONI and two DSUs became operational in Ireland in addition to the existing AGU in Northern Ireland.

In May 2013, DSU Grid Code modifications were brought to the Ireland and Northern Ireland Grid Code Review Panels following engagement with the DSU industry. The modifications were subsequently approved by the Regulatory Authorities. Further DSU workshops were held to promote demand side participation in the SEM. We also developed a DSU System Operator Interface Agreement which covers liabilities on both sides.

In November 2013, a DSU Joint Grid Code Working Group was established with the aim of reviewing and discussing current and future requirements for DSUs in the Grid Codes. In 2014, six DSU modifications were presented at the Grid Code Review Panel (GCRP) meetings which were held on 11th June 2014 in Dublin. Following further industry engagement, the six modifications were approved by the GCRP in Ireland for submission to the CER for decision in late 2014. The corresponding SONI DSU Grid Code Modification Consultation closed on 12th December 2014. A DSU switchover document was also developed which allows an individual site switch from one DSU to another.

Throughout 2014 and 2015, there was engagement with industry and the DSOs on an All-Island DSU application process. A cross-industry workshop on the proposed All-Island DSU Application form was held on 28th August 2015. Two further DSU Grid Code modifications were approved by the CER and UR.

A residential customer engagement project was undertaken outside of the DS3 Programme, known as Power Off and Save. This was a pilot programme, in Ireland only, which rewarded customers who agreed to reduce their energy use when electricity demand was high. EirGrid developed the Power Off and Save programme in partnership with Electric Ireland. It involved 1,500 residential customers and the pilot programme was completed in 2018. Those who signed up were asked to switch off appliances for approximately 30 minutes on ten occasions and were rewarded with up to €100 off their bill.

2.2.3. Conclusions

The aims of the workstream have been achieved through the range of work carried out in such as modifications to existing licences, codes and testing procedures, and industry engagement. The DSM industry in Ireland and Northern Ireland now has clear requirements in codes and testing and a clear process for application to connect and for the transfer of individual sites.

It is important to note that the TSOs consider further evolution of DSM to be esstential for meeting renewable energy targets for 2030. While this workstream is considered to be closed with respect to the original objectives of DS3 to 2020, DSM will be a large component in the roadmap for 2030.

2.3. Grid Code

2.3.1. Aim of Workstream

Technical studies carried out by the TSOs and consultants showed that operating the system at high wind penetration levels would necessitate Grid Code modifications to ensure continued secure electricity supply. The modifications to both the Ireland and Northern Ireland Grid Codes were discussed and managed through this workstream. This included all relevant Grid Code Working Group meetings, consultations, recommendations and implementation steps following regulatory approval.

As the Ireland and Northern Ireland system form a single synchronous area, where possible a consistent approach was applied in both jurisdictions. As a large amount of renewable generation is connected to the Distribution System, it was important to ensure standards were also reflected in the Distribution Code. Thus any subsequent Distribution Code modifications were also coordinated through this workstream.

Additionally, the potential impacts of the European Network Code adoption on the existing and proposed Grid Code standards were also monitored at a high level. It is important to note that European Network Code adoption process is being managed outside of the DS3 Programme. However, prior to recommending any Grid Code modifications a cross-checking exercises was carried out to ensure no unintended conflicts.

2.3.2. Workstream Deliverables

This workstream has ensured the introduction of a range of Grid Code modifications in Ireland and Northern Ireland. This enhanced generator capability will facilitate secure system operation at times of high renewable penetration. These modifications are:

- Wind Farm steady-state control modes;
    - Performance monitoring and testing
    - WFPS voltage control
- Dynamic active and reactive power response – wind farms and conventional;
- Rate of Change of Frequency (RoCoF);
- Dynamic model requirements;
- Demand side management; and
- Biomass requirements.

The workstream also carried out the following activities:

- Engagement with the DSOs to develop Distribution Code modifications where required;

- Engagement with Regulatory Authorities;
- Review of new technologies e.g. waste-to-energy, marine energy, off-shore wind, smart devices and storage; and
- Consider interactions between European Network Codes and Grid Code modifications linked to DS3 and ensure unintended consequences.

2.3.3. Conclusions

The main aims of the workstream have been completed. In particular, appropriate classes of wind farms have implemented the three voltage control modes of operation required by the TSOs. These control modes can be changed remotely by Control Centre staff as required. A number of required DSM Grid Code modifications have been approved and implemented in the Grid Code. Outstanding work in terms of fully implementing the RoCoF modifications in the Grid Codes will be completed as part of on-going RoCoF work at the appropriate time.

2.4. Renewable Data

2.4.1. Aim of Workstream

The purpose of the renewable data workstream was to develop an All-Island repository for renewable related data for the EirGrid Group and to produce and publish a range of internal and external technical and non-technical reports that capture this development.

At this stage, the majority of the reports produced under this workstream have been completed for a number of years and as such the processes and procedures behind these reports are largely established and are part of business as usual processes.

The integration of the Wind Dispatch Tool in both control centres has been achieved and the reason codes for dispatch down are now logged for reporting purposes. This has led to the development of new more accurate calculation methodologies for dispatch down volumes which feed into the reviewed curtailment reports.

2.4.2. Workstream Deliverables

The following work has been completed through the Renewable Reporting workstream:

- Annual Renewable Reports: Four external reports were published from 2010 to 2013. This report outlines the policy around renewable generation, charts the progress being made in achieving policy objectives and the steps being taken both nationally and internationally. This report has been replaced by the Dispatch Down reports and the Smart Grid Dashboard.
- High Wind Speed Shutdown Reports: An internal report is created on an annual basis, documenting high wind speed shutdown events. The results are used to refine the operational policy with respect to high wind speed shutdown.
- All Island Annual Renewable Dispatch Down Reports: An external technical and non-technical report has been published from 2011 to date. This report outlines the volume of wind which was dispatched down, the reasons for the dispatch down and finally the measures being implemented by the TSOs to minimise the dispatch down.
- SNSP Trial Reports: An internal report is developed before and after an SNSP trial is carried out on the system. This report details analysis carried out to ensure the stability of the system isn't compromised whilst operating at an increased SNSP level. It is a key determinant on the permanent move to a new SNSP limit.
- Quarterly Wind Dispatch Down Reports: Initially reports were prepared for a subset of windfarms, as agreed with Industry, and issued on a quarterly basis from 2013 to the end of 2015. Since 2016 a more accurate report has been has

been issued to all controllable windfarms outlining the level of curtailment and constraint applied on a quarterly basis.

- Smart Grid Dashboard: We now publish real time and forecasted system data on the EirGrid Group and SONI websites. This information provides the highest level of transparency for system data.
- Monthly Statistics: A central internal repository has been developed which contains the following information:
    - Wind Capacity;
    - Wind Capacity Factor;
    - Wind Generation;
    - Wind Penetration as a percentage of demand;
    - System Demand; and
    - System Non-Synchronous Penetration.

  This is used by Customer Relations and External Affairs when responding to external stakeholder queries.

2.4.3. Conclusions

Through the Renewable Data workstream a central repository of renewable data has been developed, therefore ensuring that there is a consistent source of all externally published data. Through the use of this data a number of new internal and external reports have been published and developed over the last number of years.

2.5. WSAT

2.5.1. Aim of Workstream

The aim of this workstream was to introduce the All-Island Wind Security Assessment Tool (WSAT) in to the Belfast and Dublin control centres. To ensure this tool became a core on-line tool used in the control centres to assess system security in real-time and support off-line analysis in order to maximise renewable penetration.

2.5.2. Workstream Deliverables

The WSAT has been in operation in the Dublin Control Centre since September 2010. The tool was originally developed for the power system of Ireland and was used for guidance in operating the system securely in terms of voltage and transient stability.

In November 2012, WSAT was extended to analyse the All-Island power system. This version was launched simultaneously in both the Dublin and Belfast Control Centres on 19 November 2012. The tool provided us with updated operational security assessment every 15 minutes.

In December 2014, frequency security criteria were included in WSAT. This followed an extensive period of refining and validating the tool. Additionally, a process for validating the dynamic models used within WSAT was concluded and a User Guide created. A number of models were adjusted and new features added. This process will continue to occur periodically to assess dynamic model behaviour against actual behaviour during system events.

In 2016 WSAT was upgraded through the replacement of three servers to enable the operational security assessments to now run every 5 minutes as opposed to the original 15 minute timeframe.

2.5.3. Conclusions

The All-Island WSAT has been developed and installed in the Dublin and Belfast Control Centres since November 2012. The tool assists us in maximising the utilisation of wind energy whilst continuing secure, reliable and economic operation of the all island power system.

There is work on-going within the DS3 Control Centre Tools Project to further enhance the TSO on-line study capability through the introduction of look-ahead functionality. This work will be reflected in the updated transition plan.

2.6. Model Development & Studies

2.6.1. Aim of Workstream

The main aim of this workstream was to inform future operational policies related to the integration of large amounts of wind onto the Ireland and Northern Ireland system. In order to do this a range of technical studies and analysis was performed. This analysis included steady-state load flow, voltage stability, short-circuit, dynamic stability, transient stability and frequency response analysis. A significant element of this workstream was to develop and validate the dynamic model of the Ireland and Northern Ireland system so that the TSOs could have confidence in the results of the studies carried out using those models. Another aim was to streamline and automate the studies process, so that extensive studies on different aspects of power system operation can be carried out in shorter timeframes.

2.6.2. Workstream Deliverables

This workstream developed a range of new modelling capability and study techniques to enable the TSOs to carry out enhance technical analysis. This analysis has resulted in the development of new and modified operational policy. The deliverables of this workstream were:

- Develop an All-Island Power System Model (PSSE & WSAT);
- Develop tuneable wind farm model;
- Establish metrics for assessing system security and stability;
- Model validation process;
    - Exciter models
    - All-Island models against system events
- Automated approach to large scale dynamic studies; and
- Complete a wide range of technical analysis:
    - Loss of largest in-feed study;
    - Study of ramping requirements;
    - Voltage dip-induced frequency dip study;
    - Over-frequency generation shedding settings schedule study;
    - Distributed voltage control and dynamic voltage support study;
    - Voltage stability analysis (PV analysis); and
    - All-Island minimum generation study.

2.6.3. Conclusions

The main aims of the workstream have been completed. In particular, as a result of this workstream, the TSOs now have an accurate dynamic model of the All-Island system with a process in place for the ongoing validation of the model against real system events. The TSOs have also developed the innovative Automated Dynamic Studies (ADS) tool which allows full voltage, transient and frequency stability analysis to be carried out on an hourly annual Plexos economic dispatch. This allows studies of the same order of magnitude as the Facilitation of Renewables to be carried out in only a few days and is leading to the development of more robust operational policies.

3. New DS3 Programme Structure

The TSOs are proposing a new programme structure that will adopt a project milestone and deliverable approach as opposed to the workstream approach adopted to date.

Drivers:

- Re-align deliverables to the original DS3 Programme goals;
- Previous delieverables can be misleading – the wording of the deliverable means it is achieved; however, work is still ongoing and critical to DS3 Programme success, i.e. Control Centre Tools;
- A number of outstanding actions to be completed may be outside the TSOs control i.e. RoCoF; and
- Many previous deliverables crossover between several workstreams and are being double counted i.e. RoCoF and Nodal Controller.

Proposal:

- Review and replace previous workstream structure;
- Link deliverables to key programme milestones – future increases in SNSP;
- Provide clarity around who is responsible for deliverable (TSO/DSO/RA/Industry); and
- Transparent deliverable requirements for future operational policy movements.

3.1. Transitional Workstreams

The new programme will take all outstanding applicable deliverables from the remaining DS3 workstreams and restructure them into what is required to deliver on the 70% SNSP and 75% SNSP operational milestones.

The workstreams which include elements to be transitioned into the new plan include:

- RoCoF;
- Voltage;
- Frequency; and
- Control Centre Tools.

In addition to these workstreams, there are separate deliverables relating to the System Services workstream which are covered under the separate System Services programme of work.

The updated SNSP timeline, and the associated areas of delivery to achieve these are given in Figure 2.

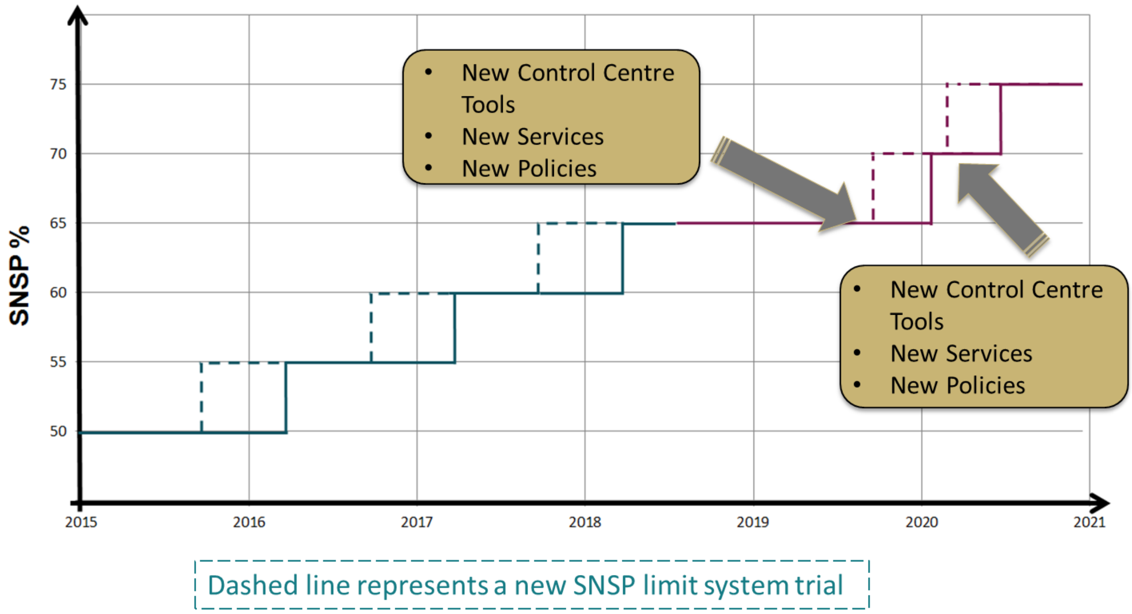

Figure 2: SNSP Timeline and associated deliverables to achieve new SNSP limit

3.2. 70% SNSP Workstream

The following sections give an overview of the primary deliverables required to transition from 65% SNSP to 70% SNSP. The scheduled date to begin a power system trial of 70% SNSP is Q4 2019. The deliverables to achieve 70% SNSP are summarised in Table 1.

Operational Change	***Expected Delivery***
RoCoF transition to 1Hz/s	Q3 2019
Inertia Floor – 20,000 MWs	Q3 2019
Operational Policy	
Ramping Policy	Q1 2018
SNSP 70% Policy	Q2 2019
Operational Reserves Policy	Q1 2019
RoCoF & Inertia Floor Policy	Q2 2019
Control Centre Tools	
Ramping Tool	Q4 2019
Look Ahead WSAT	Q4 2019
System Services	
11 existing services + FFR	Q3 2018

Table 1: DS3 deliverables required to achieve 70% SNSP

3.2.1. RoCoF Transition to 1 Hz/s

A programme of work is ongoing to transition the operational limit for largest allowable system RoCoF from 0.5 Hz/s to 1 Hz/s. In order to move the operational limit, the vast majority of generation on the power system must prove compliance with the new standard. At present there are outstanding large synchronous generators in Ireland and Northern Ireland who have not proven compliance with the new standard. There is also a significiant quantity of small scale generation on the distribution system in Northern Ireland which is not compliant with the new standard. Based on current estimated completion dates, the expectation is a system trial of 1 Hz/s operational limit can begin at the end of Q3 2019.

3.2.2. Inertia Floor – 20,000 MWs

The current operational limit for the system inertia floor is 23,000 MWs. When the power system transitions to 1 Hz/s RoCoF limit, a concurrent trial will take place on the system to decrease the inertia floor to 20,000 MWs. This will allow the power system to operate with less synchronous machines online for frequency stability.

3.2.3. Ramping Policy

The ramping policy sets out the power system ramping requirements for 1, 3 and 8 hour ramping periods. These requirements are set by the control centre Ramping Tool and are fed into the market scheduling system. The ramping policy ensures there is sufficient ramping capability margin in the power system to withstand any issue relating to generator trips, generators failing to start correctly, or forecasting errors of renewable generation.

3.2.4. SNSP 70% Policy

An update of the existing SNSP Policy is required in order to increase the SNSP limit from 65% to 70%. This will give control centre operators further guidance on how to operate the power system at these high levels of SNSP.

3.2.5. Operational Reserves Policy

The Operational Reserves Policy requires an update in order to set a requirement for Fast Frequency Response (FFR). This requirement will be treated in the same manner as the requirement for Primary Operating Response (POR), or any of the other reserve categories, in the scheduling of generation in the control centre. A further update of the Operational Reserves Policy may be carried out at a later date to investigate dynamic setting of reserve requirements based on the available reserve providers portfolio.

3.2.6. RoCoF & Inertia Floor Policy

The operational policy for RoCoF and Inertia Floor requires an update to implement the operational changes described in sections 3.2.1 and 3.2.2 in the control centres.

3.2.7. Ramping Tool

A new control centre tool is required to calculate the ramping requirements for the power system, in accordance with the Ramping Policy outlined in section 3.2.3. This tool will dynamically update the ramping requirements for the time periods of 1, 3 and 8 hours in advance. These requirements will be an input into the scheduling of generation.

3.2.8. Look Ahead WSAT

An update of the WSAT control centre tool is required to ensure system frequency, voltage and rotor angle stability with higher levels of non-synchronous generation on the power system. The updated WSAT will not only carry out stability analysis of the real-time power system, but will look-ahead a number of hours to assess the future stability of the power system. This will identify potential instabilities in advance of the issues manifesting on the power system. The tool will also offer guidance to the control centre operators on possible mitigation measures to take to avoid the instability.

3.2.9. New System Services – FFR

The implementation of a new system service, FFR, is needed in order to transition from 65% SNSP to 70% SNSP. FFR provides fast acting response of less than 2 seconds following a frequency event on the power system. FFR is essential to the operation of the power system when operating the system to a limit of 1 Hz/s and reducing the inertia floor.

3.3. 75% SNSP Workstream

The following sections give an overview of the primary deliverables required to transition from 70% SNSP to 75% SNSP. The scheduled date to begin a power system trial of 75% SNSP is Q1 2020. The deliverables to achieve 75% SNSP are summarised in Table 2.

Operational Change	*Expected Delivery*
Implement Enduring OFGS	Q4 2019
Inertia Floor – 17,500 MWs	Q1 2020
Minimum Units Online – 7	Q1 2020
Operational Policy	
Min Sets Policy (Voltage & Inertia)	Q2 2019
SNSP 75% Policy	Q4 2019
VDIF Policy	Q4 2019
Control Centre Tools	
Voltage Trajectory Tool	Q1 2020
System Services	
11 existing services + FFR + DRR + FPFAPR	Q3 2019

Table 2: DS3 deliverables required to achieve 75% SNSP

3.3.1. Implement Enduring Over Frequency Generation Shedding

In order to securely operate the power system with electricity exports up to 500 MW, an over frequency generation shedding (OFGS) scheme must be in place. The current OFGS includes wind generation and convetional generation. The scheme is required to be updated to the Enduring OFGS scheme which only includes wind generation. This will allow the power system to operate with higher levels of non-synchronous generation during times of high levels of electricity exports.

3.3.2. Inertia Floor – 17,500 MWs

The operational limit for the system inertia floor is required to decrease from 20,000 MWs to 17,500 MWs in order to operate the system with less synchronous machines online. This limite will be lowered following the successful completion of the power system operational trial at 20,000 MWs.

3.3.3. Minimum Units Online – 7

There are operational constraints which require a minimum number of generation units online in each jurisdiction, along with a number of more specific locational constraints. These constraints include a requirement for a minimum of 8 large generation units to be online on the power system – 5 in Ireland and 3 in Northern Ireland. When the Voltage Trajectory Tool (section 3.3.7) is implemented in the control centre, the minimum units online can be reduced from 8 minimum units online to 7.

3.3.4. Minimum Units Online Policy

In order to reduce the minimum number of large synchronous generation units online, an operational policy is required to provide guidance to the control centre operators on the best practices for operating the power system in these conditions.

3.3.5. SNSP 75% Policy

An update of the SNSP Policy is required in order to increase the SNSP limit from 70% to 75%. This will give control centre operators further guidance on how to operate the power system at these high levels of SNSP.

3.3.6. Voltage-Dip Induced Frequency Event Policy

An operational policy is required to mitigate the possibility of a voltage-dip induced frequency event during times of very high levels of wind generation on the power system. This situation manifests itself when there is a fault on the system and a delay to the active power recovery of wind generation as a result. Two new System Services – Dynmaic Reactive Response (DRR) and Fast Post-Fault Active Power Recovery (FPFAPR) – will help to mitigate this pheonomenon.

3.3.7. Voltage Trajectory Tool

A new control centre tool is required to provide guidance to control centre operators on the best methods of managing voltage on the power system with a reduced number of synchronous generators online. This tool will help the control centre operators to plan the steps to take to maintain voltage standards as synchronous generator units are dispatched off and then later dispatched on again. The delivery of this new control centre tool allows the minimum units online to decrease from 8 units to 7 units.

3.3.8. New System Services – DRR & FPFAPR

The implementation of new system services, DRR and FPFAPR, is needed in order to transition from 70% SNSP to 75% SNSP. Both DRR and FPFAPR provide fast acting response of reactive power and active power following a fault or trip on the system. These fast injections are required to maintain system stability at very high levels of non-synchronous generation.