CER
Commission for Energy Regulation
An Coimisiún um Rialáil Fuinnimh

Utility Regulator
ELECTRICITY GAS WATER

Single Electricity Market

DS3 System Services

Consultation Paper

SEM-13-060

3rd September, 2013

1 Introduction

On 15th May 2013 EirGrid and SONI (the "TSOs") formally submitted their Recommendation Paper regarding DS3 System Services to the SEM Committee. This paper was published for information on 24th May. This concluded an extensive period of consultation with industry by the TSOs on their proposals to redesign the Ancillary Services arrangements in order to meet the needs of the system in 2020. The SEM Committee would like to take this opportunity to acknowledge the significant work by the TSOs in preparing this suite of recommendations.

2 Background

The TSOs formally commenced the DS3 Project in September 2011, following review by the Regulatory Authorities of the TSOs' Report on Ensuring a Secure, Reliable and Efficient Power System in July 2011. This followed a request by the SEM Committee for the TSOs to put in place a programme of work to solve the challenges which would occur with operating the electricity system in a secure manner as levels of wind penetration increase.

One of the key work streams in the DS3 programme is the Review of System Services (or Ancillary Services). The aim of the system services review is to put in place the correct structure, level and type of service in order to ensure that the system can operate securely with higher levels of wind penetration (up to 75% instantaneous penetration). The TSOs have statutory responsibilities in Ireland and Northern Ireland in relation to the economic purchase of services necessary to support the secure operation of the system. The SEM Committee at present approves the policy, rates and overall all-island monies for harmonised ancillary services as the cost is included in transmission charges and recovered from demand customers.

The TSOs have published three consultation papers and a Recommendations Paper on the System Services Review[1]. The TSOs also published a report carried out by KEMA into system services in international markets[2]. In addition to this the TSOs held a public workshop on their recommendations paper on 26th June 2013.

To date the TSOs have been responsible for the consultation process with industry. At the June meeting of the SEM Committee the TSOs presented their recommendations to the Committee. The Regulatory Authorities' advisors, Poyry, also presented their review of the Recommendations Paper. Following these discussions the SEM Committee has decided to publish the present consultation paper which;

- sets out the Committee's thinking on the TSOs' recommendations and how the Committee plans to proceed with the project; and

- invites comments on the Committee's initial conclusions on the technical aspects of the recommendations and, more specifically, on the services to be included in the project.

[1] TSO papers are available here
[2] KEMA Report available here

3 Related Documents

- TSO Recommendations paper (May 2013)
- Third TSO Consultation paper (December 2012)
- Second TSO Consultation paper (June 2012)
- First TSO Consultation paper (December 2011)
- Facilitation of Renewables Study (July 2011)

4 SEM Committee Position

The SEM Committee supports the need for a detailed review of system services and intends to make clear, evidence based and timely decisions on each aspect of this review. The DS3 programme, of which system services is one part, is an important part of the all island strategy to minimise curtailment levels. The SEM Committee will ensure the system services review proceeds as quickly as possible and without any unnecessary delay.

The SEM Committee acknowledges the considerable amount of effort on the part of the TSOs that has brought the system services work stream to this stage. The SEM Committee is of the view that the evidence provided from the results of the TSO's Facilitation of Renewables Studies (2010) and the Report on Ensuring a Secure, Reliable and Efficient Power System (2011) indicate that new and enhanced system services will be required to enable the TSOs to continue to operate the system in a secure and reliable manner as levels of wind generation on the system increase.

The SEM Committee accepts that there is a need for new system services, in particular services that will reward flexibility and assist in the delivery of the 40% renewable targets in Ireland and Northern Ireland. The SEM Committee is minded to agree with the technical aspects of the proposals in system services review.

The SEM Committee has reservations on the proposed economic rationale and commercial arrangements. In reviewing the TSO's recommendations and in arriving at its decisions on the system services review, the SEM Committee will apply the following principles:

- The SEM Committee's decisions will be taken with reference to the SEM Committee's principal objective is to protect the interests of consumers of electricity in Ireland and Northern Ireland by promoting effective competition wherever appropriate. When taking decisions on system services the SEM Committee will have due regard to its other statutory obligations[3][4].
- The SEM Committee will take into consideration the information provided by the TSOs, and will aim to make clear and timely decisions on each part of the system service review. If necessary, the SEM Committee will consider phased implementation of services;
- TSO Proposals for new systems services will be required to have a well-defined product design (including technical parameters), as well as the costs and benefits of the services to be identified and analysis provided.

[3] See Section 9BC of the Electricity Regulation Act 1999, as amended.
[4] See Section 9 of The Electricity (Single Wholesale Market) (Northern Ireland) Order 2007

- The SEM Committee will give consideration to other mechanisms, including market based instruments, to deliver the required services;
- The SEM Committee is cognisant of other important workstreams such as the Regional Integration Project. Whilst these workstreams remain separate, the SEM Committee will ensure that decisions in either workstream are not in conflict.

The SEM Committee acknowledges that interested parties have engaged extensively with the TSOs over the course of the three consultation processes on the System Services Review to date. The SEM Committee is aware of the issues raised by the parties over the course of the review and indeed some parties have written separately to the SEM Committee outlining views and concerns. In reviewing the TSOs' recommendations and in moving the System Services Review forward, the SEM Committee understands of the importance of regulatory clarity for investors and developers in order to enable the required level of service provision in the appropriate timeframe.

5 Services

5.1 Proposed Decision

The SEM Committee has reviewed the TSOs' recommendations in relation to the proposed new services and has taken into account the assessment of the TSOs regarding the technical needs of the system in 2020. The SEM Committee considers that there is clear evidence that enhanced system services are required in order to maintain a secure and reliable electricity system under conditions of high wind penetration.

Having reviewed each of the services proposed by the TSOs the SEM Committee is minded to approve them. For the avoidance of doubt the proposal is confined to the approval of the services which should be procured by the TSOs and does not extend to the overall budget which may be allocated to System Services, any payments which may be made for the provision of these services, or the commercial terms that may apply to them.

The services are discussed in detail below, in summary the services are:

New Services		Existing Services	
SIR	Synchronous Inertial Response	**SRP**	Steady-state reactive power
FFR	Fast Frequency Response	**POR**	Primary Operating Reserve
DRR	Dynamic Reactive Response	**SOR**	Secondary Operating Reserve
RM1	Ramping Margin 1 Hour	**TOR1**	Tertiary Operating Reserve 1
RM3	Ramping Margin 3 Hour	**TOR2**	Tertiary Operating Reserve 2
RM8	Ramping Margin 8 Hour	**RRD**	Replacement Reserve (De-Synchronised)
FPFAPR	Fast Post-Fault Active Power Recovery	**RRS**	Replacement Reserve (Synchronised)

The SEM Committee welcomes respondents' views on the Committee's proposals:

1. Do you agree that enhanced system services are required?
2. Do you agree with the proposed definition of the services?

5.2 **Definition of Services:** Frequency Control

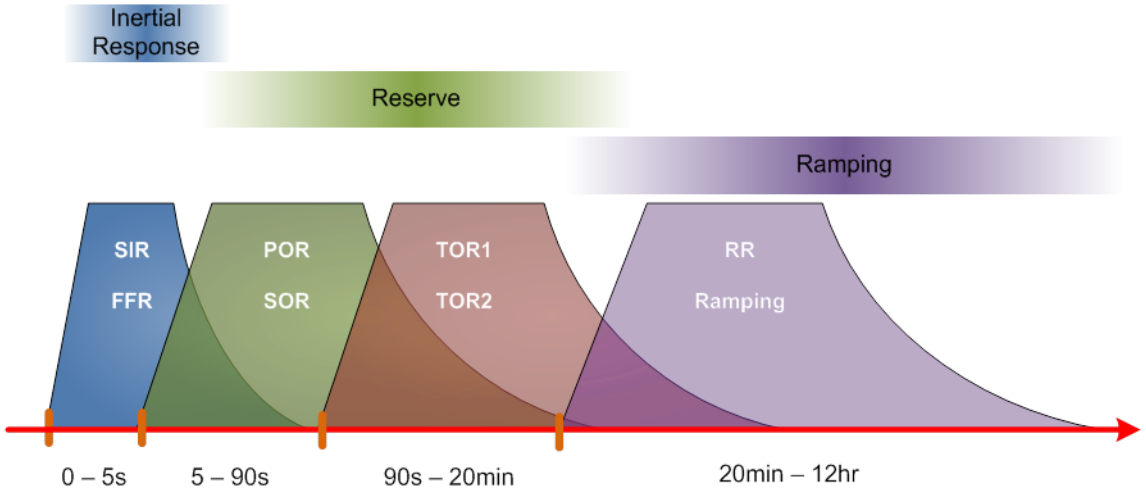

Figure 1: Frequency Control Services (Source: EirGrid)

The TSOs have proposed new services to complement the existing reserve services in order to control frequency. It is envisaged that these new services will provide a MW response in advance of the response time of Primary Operating Reserve and over a longer time horizon to account for the variability in generation due to intermittent generation sources.

5.2.1 Inertial Response

5.2.1.1 Synchronous Inertial Response

Synchronous Inertial Response (SIR) is a new service. SIR is the response in terms of active power output and synchronising torque that a unit can provide following disturbances. It is a response that is immediately available from synchronous generators, synchronous condensers and some synchronous demand loads (when synchronised) because of the nature of synchronous machines and is a key determinant of the strength and stability of the power system. It has significant implications for rate of change of frequency (RoCoF) during power imbalances and for transmission protection devices and philosophy. With increasing non-synchronous generation this response becomes scarce and therefore it is proposed to explicitly request its provision as a system service. In particular, if synchronous inertial response can be provided at low MW outputs, the system can accommodate higher levels of non-synchronous generation.

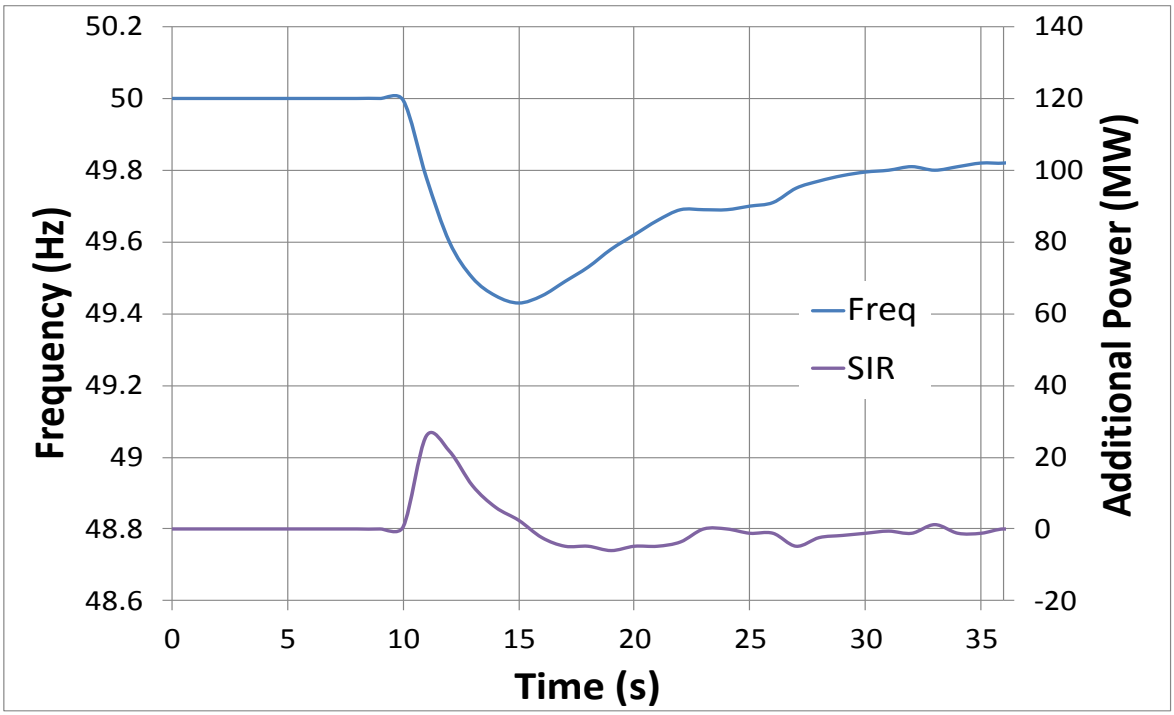

Figure 2: Illustration of inertial response

The proposed SIR service is defined as the kinetic energy (at nominal frequency) of a dispatchable synchronous generator, dispatchable synchronous condenser or dispatchable synchronous demand load multiplied by the SIR Factor (SIRF). The SIRF of a synchronous generator is the ratio of the kinetic energy (at nominal frequency) to the lowest sustainable MW output at which the unit can operate at while providing reactive power control. It will be based on the commissioned design capability of the plant as determined through appropriate testing procedures. It is proposed that the SIRF has a minimum threshold of 15 seconds and a maximum threshold of 45 seconds. It is proposed that the SIRF for a synchronous condenser or a synchronous demand load that can provide reactive power control is set at 45 seconds. It is proposed that the SIR Volume is calculated by the following formula:

SIR Volume = Stored Kinetic Energy × (SIRF – 15) × Unit Status

It is proposed to additionally introduce a variant of SIR requiring operating reserve to be provided at the lowest sustainable MW output at which the unit can operate at while providing reactive power control.

- Do you agree with the proposed service definition?
- Do you agree with the proposed method of calculating the SIR volume?
- Do you agree with the proposed service definition of the additional variant of SIR?

5.2.1.2 Fast Frequency Response

Fast Frequency Response (FFR) is a new service. With appropriate control systems, both synchronous and non-synchronous generators can provide fast-acting response to changes in frequency that supplements any inherent inertial response. In particular, FFR provides a MW response faster than the existing Primary Operating Reserve times and may, in the event of a sudden power imbalance, increase the time to reach the frequency nadir and mitigate the

RoCoF in the same period, thus lessening the extent of the frequency transient. This product runs in conjunction with SIR so providers who can maintain or increase their outputs in these timeframes are eligible for both services. FFR is defined as the additional increase in MW output from a generator or reduction in demand following a frequency event that is available within two seconds of the start of the event and is sustained for at least eight seconds. The extra energy provided in the two to ten second timeframe by the increase in MW output must be greater than any loss of energy in the 10 to 20 second timeframe due to a reduction in MW output below the initial MW output (i.e. the hatched blue area must be greater than the hatched green area in Figure 3 below). It is proposed that the FFR volume be measured as the additional MW Output that can be provided when connected.

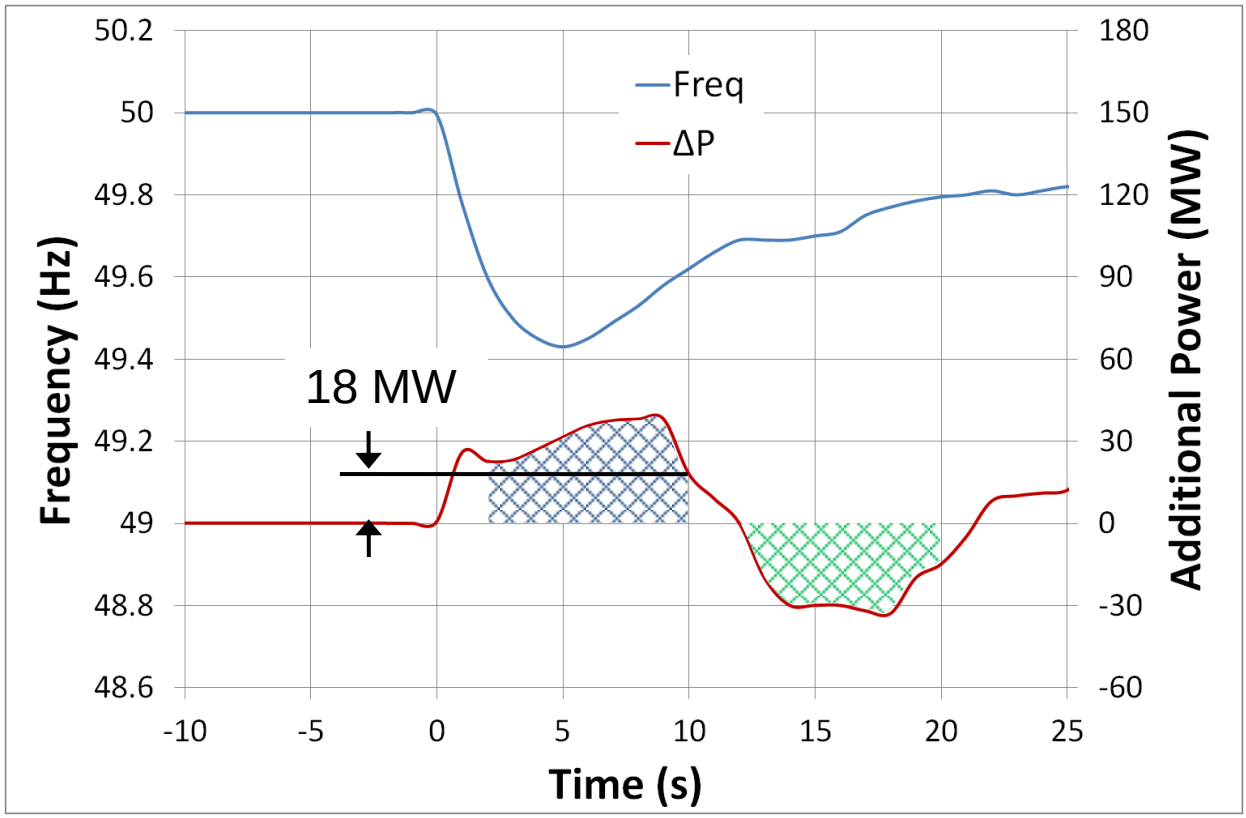

Figure 3: Fast Frequency Response

1. Do you agree with the proposed service definition?
2. Do you agree with the proposed approach to calculating the FFR volume?

5.2.1.3 Fast Post-Fault Active Power Recovery

Fast Post-Fault Active Power Recovery (FPFAPR) is a new service. Units that can recover their MW output quickly following a voltage disturbance (including transmission faults) can mitigate the impact of such disturbances on the system frequency. If a large number of generators do not recover their MW output following a transmission fault, a significant power imbalance can occur, giving rise to a severe frequency transient. Therefore the Fast Post-Fault Active Power Recovery service provides a positive contribution to system security. Fast Post-Fault Active Power Recovery is defined as having been provided when, for any fault disturbance that is cleared within 900 ms, a plant that is exporting active power to the system recovers its active power to at least 90% of its pre-fault value within 250 ms of the voltage

recovering to at least 90% of its pre-fault value. The generator must remain connected to the system for at least 15 minutes following the fault. It is proposed that the FPFAPR volume be based on MW output.

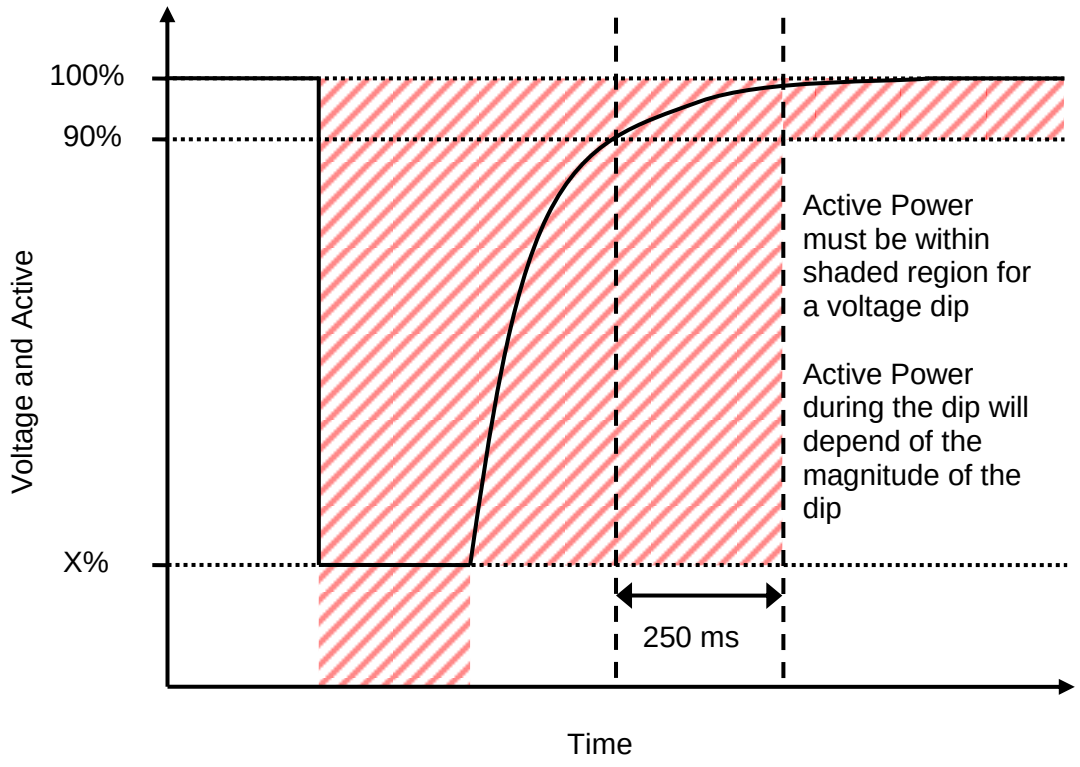

Figure 4: Fast Post Fault Active Power Recovery Service

1. Do you agree with the proposed service definition?
2. Do you agree with the proposed approach to calculating the FPFAPR volume?

5.2.2 Reserve

5.2.2.1 Primary Operating Reserve

Primary Operating Reserve (POR) is an existing service, no change to the current definition is proposed.

POR is the additional MW output (and/or reduction in demand) required at the frequency nadir (minimum), compared to the pre-incident output (or demand) where the nadir occurs between 5 and 15 seconds after an event. If the actual frequency nadir is before 5 seconds or after 15 seconds after the event, then for the purpose of POR monitoring the nadir is deemed to be the lowest Frequency which did occur between 5 and 15 seconds after the event.

5.2.2.2 Secondary Operating Reserve

Secondary Operating Reserve (SOR) is an existing service, no change to the current definition is proposed.

SOR is the additional MW output (and/or reduction in demand) required compared to the pre-incident output (or demand), which is fully available and sustainable over the period from 15 to 90 seconds following an event.

5.2.2.3 Tertiary Operating Reserve 1

Tertiary Operating Reserve 1 (TOR1) is an existing service, no change to the current definition is proposed.

TOR1 is the additional MW output (and/or reduction in demand) required compared to the pre-incident output (or demand) which is fully available and sustainable over the period from 90 seconds to 5 minutes following an event.

5.2.2.4 Tertiary Operating Reserve 2

Tertiary Operating Reserve 2 (TOR2) is an existing service, no change to the current definition is proposed.

TOR2 is the additional MW output (and/or reduction in demand required compared to the pre-incident output (or demand) which is fully available and sustainable over the period from 5 minutes to 20 minutes following an event.

5.2.3 Ramping

5.2.3.1 Replacement Reserve (De-Synchronised)

Replacement Reserve (De-Synchronised) (RRD) is an existing service however it is proposed to modify the service. It is proposed that, to avoid overlap with the 1 hour ramping service described below, the timings associated with the RRD service are redefined.

Therefore it is proposed that RRD is the additional MW output (and/or reduction in demand) provided compared to the pre-incident output (or demand) which is fully available and sustainable over the period from 20 minutes to 1 hour following an Event.

- Do you agree with the proposed modification to this service?

5.2.3.2 Replacement Reserve (Synchronised)

Replacement Reserve (Synchronised) (RRS) is an existing service however it is proposed to modify the service. It is proposed that, to avoid overlap with the 1 hour ramping service described below, the timings associated with the RRS service are redefined.

Therefore it is proposed that RRS is the additional MW output (and/or reduction in demand) provided compared to the pre-incident output (or demand) which is fully available and sustainable over the period from 20 minutes to 1 hour following an Event.

- Do you agree with the proposed modification to this service?

5.2.3.3 Ramping Margin (1 Hour, 3 Hour, 8 Hour)

The Ramping Margin (RM) services are new services. The management of variability and uncertainty is critical to a power system with high levels of wind penetration. Detailed analysis by the TSOs has shown that portfolios that are capacity adequate are unlikely to be adequate in terms of ramping over all the necessary timeframes to efficiently and effectively manage the variable renewable sources and changes in interconnector flows while maintaining system security. The TSO analysis has also indicated that a ramping-down product is not currently required and therefore the SEM Committee does not propose to introduce a ramping down product at this time. The new ramping-up service is being proposed over three distinct product time horizons; one, three and eight hours.

Ramping Margin is defined as the guaranteed margin that a unit provides to the system operator at a point in time for a specific horizon and duration. The TSOs are proposing horizons of one, three and eight hours with associated durations of two, five and eight hours respectively. The Ramping Margin is defined by *both* the minimum ramp-up and output durations. Thus the Ramping Margin represents the increased MW output that can be delivered by the service horizon time *and* sustained for the product duration window.

RM Service	Ramp-up Requirement	Output Duration
RM1	1 hour	2 hours
RM3	3 hours	5 hours
RM8	8 hours	8 hours

The following are proposed in relation to the RM services:

- The ramping-up capability of the plant will be based on Technical Offer Data submitted to the SEM and will include ramp rates, dwell times, break points, etc. as applicable.
- The measurement of this service will be based on half hour figures of MW output and availability.
- Performance metrics will be based on a consideration of performance against dispatch instructions, technical offer data and start reliability (e.g. failure to synchronise).
- The three proposed services are not mutually exclusive. Providers capable of providing all three products are eligible to receive payment for all three, similarly for two.
- Both synchronised and non-synchronised plant are eligible to provide the service.

5.3 **Definition of Services:** Voltage Control

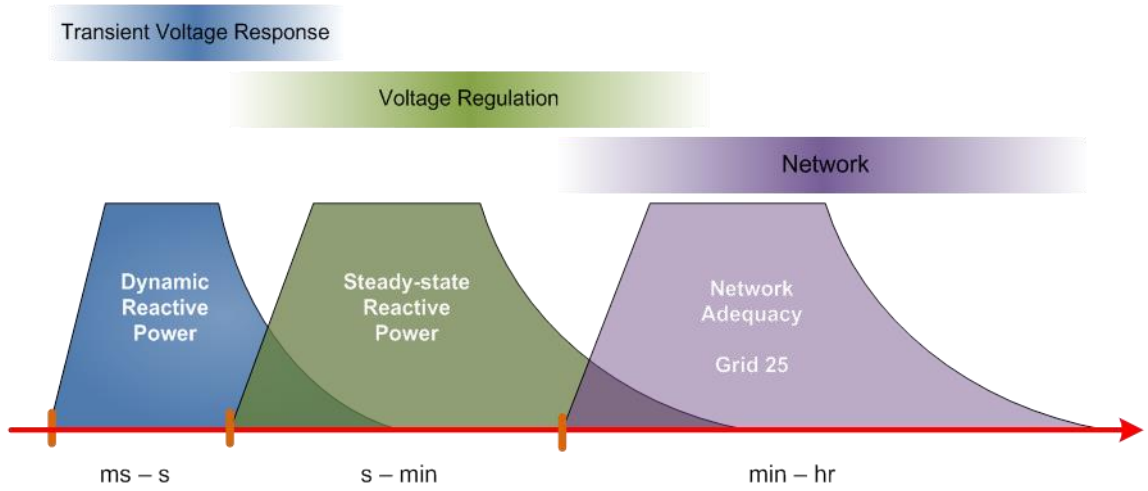

Figure 5: Voltage Control Services (Source: EirGrid)

5.3.1 Dynamic Reactive Response

Dynamic Reactive Response (DRR) is a new service. At high levels of instantaneous penetration of non-synchronous generation there are relatively few conventional (synchronous) units left on the system and the electrical distance between these units is increased. The synchronous torque holding these units together as a single system is therefore weakened. This can be mitigated by an increase in the dynamic reactive response of wind farms during disturbances. Therefore, this new service is particularly important at high levels of renewable non-synchronous generation. In line with the proposed changes to the Grid Codes previously approved by the Regulatory Authorities, a Dynamic Reactive Response service is proposed.

The DRR service is defined as the ability of a unit when connected to deliver a reactive current response for voltage dips in excess of 30% that would achieve at least a reactive power in Mvar of 31% of the registered capacity at nominal voltage. The reactive current response shall be supplied with a Rise Time no greater than 40 ms and a Settling Time no greater than 300 ms.

It is proposed that the volume is based on the unit's registered capacity when connected and capable of providing the required response. The measurement of this product will require high quality phasor measurement units to be installed at the provider's site with appropriate communication and access arrangements agreed with the TSOs.

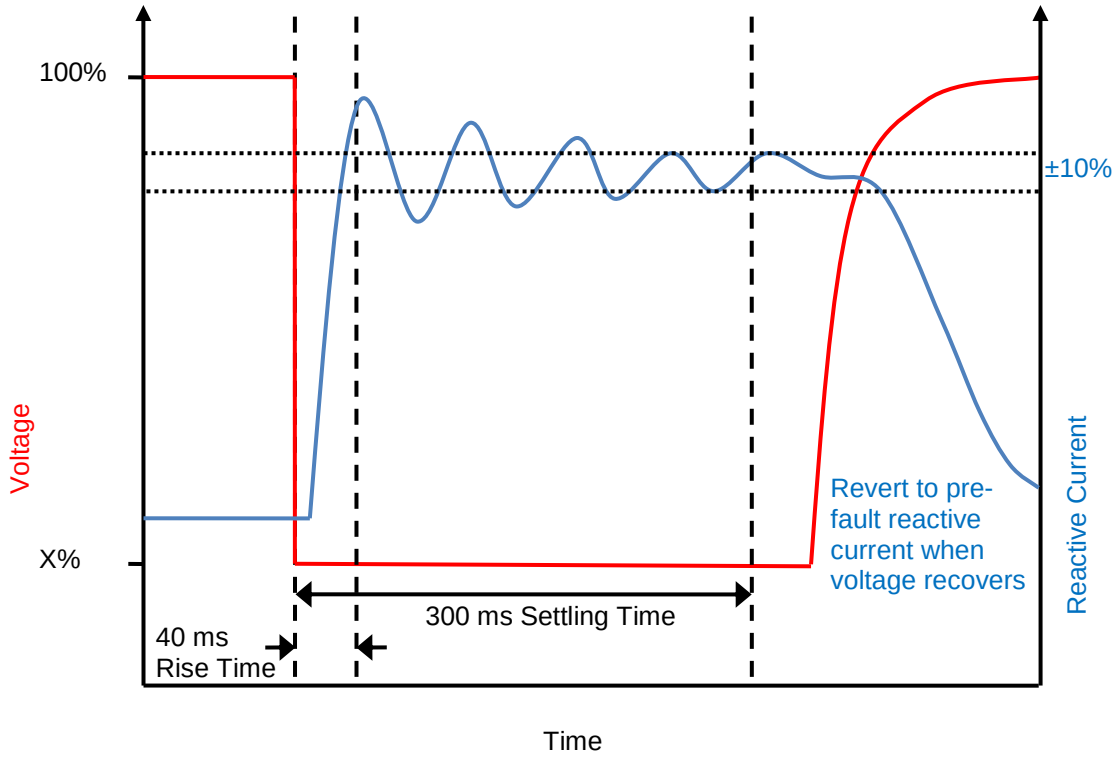

Figure 6: Dynamic Reactive Response Service

- Do you agree with the proposed definition?
- Do you agree with the proposed method of determining the volume?

5.3.2 Steady-state Reactive Power (SRP)

Steady-state Reactive Power (SRP) is an existing service which the TSOs have proposed to modify. The need for reliable steady-state reactive power control is important for the control of system voltages and for the efficient transmission of power around the system. Both synchronous and non-synchronous sources can contribute to this requirement.

The need for reactive power varies as demand varies and as the sources of generation vary. Since reactive power is difficult to transmit over long distances (unlike active power), reactive sources are required to be distributed across the system. Thus there is not necessarily a strong link between the need for active power and reactive power from the same sources. It is therefore proposed that the reactive power product is re-structured in a way that incentivises reactive capability across the widest possible active power range (P_{range}).

SRP is defined for conventional generators as the dispatchable reactive power range in Mvar (Q_{range}) that can be provided across the full range of active power output (i.e. from minimum generation to maximum generation). For wind farms SRP is defined as the dispatchable reactive power range in Mvar (Q_{range}) that can be provided across the active power range from registered capacity down to at least 12% registered capacity.

$$RP\ Factor = \frac{Power\ Output\ range\ (P_{range})\ that\ Q_{range}\ can\ be\ provided}{Registered\ Capacity}$$

SRP Volume = Q_{range} x RP Factor, while able to provide reactive power.

It is proposed that the variant of this product, where the provider is required to operate under the control of an AVR[5], is additionally retained.

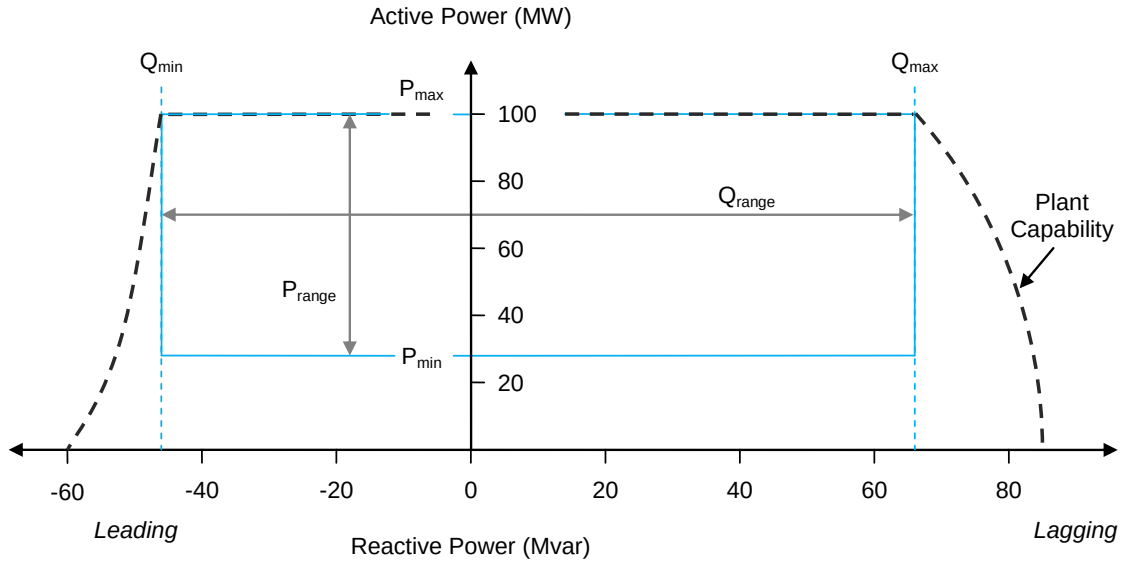

Figure 7: Illustration of the Q/P ranges for the SRP service

- Do you agree with the proposed definition?
- Do you agree with the proposed method of determining the volume?

5.4 Blackstart

The TSOs have not recommended any change to the definition of the Blackstart service. The SEM Committee does not propose to make any change to the Blackstart service at this time.

[5] Automatic Voltage Regulator

6 Next Steps

A phased approach will be taken to the SEM Committee's decision making process on system services. The Committee considers that before reaching a final decision in relation to the total amount of money that may be made available for the new System Services framework or the appropriate contractual terms and remuneration for each service it is necessary to conduct further economic analysis. This reflects the SEM Committee's reservations in relation to the economic rationale and commercial arrangements put forward in the TSO's recommendations paper.

This will involve a detailed Cost Benefit Analysis on System Services, the details of which, including final Terms of Reference will be published by the SEM Committee by the end of Q3 2013. This CBA will be an important tool to inform the SEM Committee's decisions on the economic and commercial arrangements for System Services. The Regulatory Authorities are currently considering holding a workshop with industry in October.

Responses to this paper are requested by **17.00 11th October, 2013**. Following a review of the responses to this paper the SEM Committee will publish its decision on the proposals set out in this paper, by the end of 2013.

Responses should be sent to Robert O'Rourke (rorourke@cer.ie) and Andrew McCorriston (Andrew.McCorriston@uregni.gov.uk). Please note that the SEM Committee intends to publish all responses unless marked confidential.[6]

Robert O'Rourke
Commission for Energy Regulation
The Exchange
Belgard Square North
Tallaght
Dublin 24

Andrew McCorriston
Utility Regulator
Queens House
14 Queen Street
Belfast
BT1 6ED

[6] While the SEM Committee does not intend to publish responses marked confidential please note that both Regulatory Authorities are subject to Freedom of Information legislation.