DS3:
System Services Consultation – New Products and Contractual Arrangements

8th June 2012

Contents

Executive Summary

The power system of Ireland and Northern Ireland is in a period of transition due to national and European policy drivers, particularly with respect to renewable energy. This transition will result in a fundamental change to the power system generation portfolio, the system operational characteristics under both steady state and transient conditions and significantly transform the composition and need for essential system services. To satisfy their respective obligations, under legislation and licence, to ensure System Services are available to meet the needs of the system in line with policy objectives, EirGrid and SONI (the TSOs) are undertaking a fundamental review of the System Services for the power system.

This consultation paper is part of a multi-stage consultation process within the System Services Review workstream of the DS3 Programme. This paper provides further information on the system needs, and presents proposals for new products, remuneration principles and the contractual arrangements for the services. It excludes proposals on the financial details, including funding and remuneration levels, which will be presented in the next consultation paper in Q3. These will be developed over the next few months by the TSOs, in conjunction with the Regulatory Authories, based on further analysis and financial modelling.

Building on the previous system services consultation and associated studies, a detailed analysis of the power system in 2020 from a system service perspective has been carried out for three distinct system plant portfolios. The portfolios, which are based on the 2020 portfolio in the Generation Capacity Statement 2012-2021, have sufficient wind generation (5,300 MW) to meet the Governments' targets for renewable electricity but have varying portfolios of conventional generation. The Generation Capacity Statement (GCS) portfolio includes over 800 MW of new conventional generation; the Deferred Conventional Investment (DCI) scenario has no new conventional generation; the Marginally Capacity Adequate (MCA) scenario has no new conventional generation and early retirement of approximately 1,400 MW of existing plant. While all of these portfolios meet capacity adequacy metrics, the analysis has indicated that they all are, to differing degrees, inadequate with respect to system services.

This consultation proposes a range of new System Service products to address and mitigate the identified system issues. In particular new products are proposed to address the challenges associated with frequency control and voltage control for a power system with high levels of variable non-synchronous generation. To this end, a Fast Frequency Response product is proposed for energy response in advance of Primary Operating Reserve timeframes. This is complemented by a Synchronous Inertial Response product which should incentivise lower outputs on large conventional plant and also new providers like synchronous condensers. For longer timeframes of more than one hour a new Ramping Product is proposed to incentivise those units that provide ramping capability to the TSOs over a range of future time periods.

For Voltage Control a re-definition of steady state Reactive Power capability is proposed. A product based on this redefinition is outlined, which better reflects the needs of the power system where up to 75% of the generation is coming from non-synchronous sources. In addition, a Dynamic Reactive Power response product is also proposed to facilitate high levels of wind penetration while maintaining the integrity and transient angular stability of the power system.

This consultation proposes an updated remuneration approach to system services. Firstly, providers will only be eligible to provide System Services where their capabilities meet (or exceed) the minimum Grid Code standards or as derogated by the appropriate regulator. Secondly, remuneration should be based on three core aspects: capability, availability and performance reliability. While system services to date have included availability and capability concepts, the new approach places a significantly increased focus on reliable delivery.

For a number of reasons, including the relatively small size of the market, the TSOs consider that regulated bilateral contracts between a System Service provider and the TSO are the most appropriate contractual mechanism. In addition, it is proposed that all units that are capable of producing the necessary system services, whether in the distribution or transmission system, should be eligible for these bilateral System Service contracts, provided they are operated under an agreed TSO operating protocol.

The current consultation will be supplemented with an industry forum where the options developed will be presented. The TSOs will then consider all responses received to the current paper and will develop proposed recommendations for the SEM Committee, which will be issued for consultation in Q3 2012. The third System Services consultation will provide a further opportunity for the industry to comment on the proposed products. It will also include details of the financial aspects and seek views on a range of possible remuneration levels to service providers and costs to consumers. Following a review of the responses to this third consultation, the TSOs will submit of a set of final recommendations to the SEM Committee; the SEM Committee has indicated its intent to publish a decision on these by end 2012 / early 2013.

1 Introduction

The Governments in Ireland and Northern Ireland have set ambitious renewable electricity targets. Driven by a combination of legal and policy requirements to increase energy security, enhance energy sustainability and reduce carbon emissions in the energy sector, Ireland and Northern Ireland have adopted 40% renewable electricity targets to be achieved by 2020. This will result in the highest penetration of wind power plants on a synchronous system in Europe.

To meet these policies with respect to renewable energy there is a shift away from conventional fossil fuelled generation towards renewable generation, much of which will be non-synchronous and will utilise variable energy sources. The principal renewable generation source will be wind (both on-shore and off-shore). In addition, the power system is changing because of other external policy drivers, e.g., increasing interconnection, SEM intra-day trading, future market coupling and the impact of increasing demand side management and SmartGrid initiatives.

Recognising these impending changes, the TSOs carried out a number of studies on the impact of high levels of variable, renewable generation on the power system of Ireland and Northern Ireland, culminating in the publication of reports in which the implications of the studies on the power system were presented and the Delivering a Secure Sustainable Electricity System (DS3) Programme[1] was outlined.

It was found that the behaviour of the power system will change with increasing levels of variable non-synchronous generation. In particular, the core operational functions of frequency control and voltage control will become more challenging, and a number of specific issues were identified that, if not mitigated, will limit the penetration of renewable generation. Maintaining system security in the context of these issues will require the provision of enhanced system services, which will therefore become a key enabler of a more sustainable power system.

The System Services Review, which forms a central component of the DS3 programme, was initiated to satisfy the respective obligations of the TSOs, under legislation and licence, to ensure system services are available to meet the needs of the system in line with policy objectives. It involves a multi-stage consultation process[2,3] and will be a key enabler for future operational policy changes in the areas of frequency control and voltage control. The objectives of the review are: to clarify system needs – now and projected for the future; to review the effectiveness of existing services and payment structures; to develop new services; to determine appropriate valuations of these services; to develop new/revised payment structures that foster a continued focus on performance and where appropriate drive investment; and to develop an appropriate timetable for the implementation of any new arrangements in order to provide early signals to investors.

A preliminary consultation published in December 2011 sought 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 wholesale market. Following this consultation, the TSOs met with interested parties on a bilateral basis, and have included a synopsis in this consultation based on

---

[1] DS3 programme
http://www.eirgrid.com/operations/ds3/

[2] System Services consultation process
http://www.eirgrid.com/operations/ds3/industryengagement/

[3] System Services review project plan
http://www.eirgrid.com/media/DS3%20System%20Services.pdf

the comments received. The responses to the preliminary consultation have also been published[4] by the TSOs.

In parallel with this consultation process, the TSOs also engaged independent consultants to carry out an international review of System Services. The report of their review contains a comparison of the system services (or ancillary services) arrangements in a number of markets around the world, with an emphasis on markets and/or services that are relevant to the SEM and the power system of Ireland and Northern Ireland. The resulting report was published on the EirGrid and SONI websites[5] and shared with the industry earlier this year.

This consultation provides more definitive analysis on the issues facing the power system and the proposed high level design of new products to combat the identified challenges. The TSOs, having reflected on the responses to the December 2011 consultation paper, also propose approaches to system services remuneration, the contractual arrangements and the eligibility of providers of system services. The third system services consultation, which will be published later this year, will provide recommendations on the structure and remuneration arrangements for system services for final approval of the SEM Committee.

The remainder of this paper is structured as follows:

- Section 1 sets out the introduction and the basis for the review;
- Section 2 provides some background and context for this review including the main points from the responses to the Preliminary consultation, subsequent bilateral discussions and a summary of the International Review;
- Section 3 describes the technical challenges facing the power system, as identified in the Facilitation of Renewables studies and subsequent studies and analysis;
- Section 4 outlines the proposed products;
- Section 5 provides the TSO view on the general remuneration approach and the contractual arrangements for system services;
- Section 6 is a summary of the main points and the next steps;
- Section 7 provides instructions on how to respond.

[4] Responses to the Preliminary Consultation
http://www.eirgrid.com/operations/ds3/industryengagement/

[5] System Services International Review
http://www.eirgrid.com/media/System%20Services%20International%20Review%20-%20Final.v2.pdf
http://www.soni.ltd.uk/upload/System%20Services%20International%20Review%20Final.pdf

2 System Services Review: Context and Process

EirGrid and SONI have licence and/or statutory obligations to ensure sufficient services are available to enable efficient, reliable and secure power system operation. System Services are those services, aside from energy, that are necessary for the secure operation of the power system. These services are also referred to as Ancillary Services (AS) and System Support Services (SSS). The existing Harmonised AS (HAS) arrangements were implemented in February 2010. Under these arrangements, service providers are remunerated based on regulated rates, which are reviewed annually. The total HAS allowance for the period October 2011 to September 2012 is approximately €50m. AS costs are recovered from the end consumer, via the System Support Services charge in Northern Ireland and via the Transmission Use of System charge in Ireland. Under the existing HAS arrangements, there are three main system services that are remunerated: Operating Reserve, Reactive Power and Black Start.

As part of the System Service Review, the existing Harmonised Ancillary Service arrangements and Generator Performance Incentives were examined. The existing arrangements, together with the introduction of GPIs and enhancement of performance monitoring, have brought about a number of benefits, including parity of treatment in both jurisdictions, improved transparency and a greater focus (from a number of generators) on performance capability and Grid Code compliance. A number of negative aspects were, however, also identified:

- Annual consultation on rates and services tends to produce incremental change to the initial arrangements.
- It can be difficult for generators to predict income and hence spend on maintenance of the service.
- Payment rates are viewed as too low and hence are not valued by a number of the generators in terms of maintenance and investment decisions; additionally, payment rates do not necessarily reflect the importance of the service to the power system.
- The charges for non-provision are possibly not onerous enough as there are generators which regularly perform badly and have not taken steps to improve. On the other hand, not all units are contracted for their full service potential capability because of a perceived risk of financial loss through charges for poor performance.

It should be noted that the annual tariff review for the Harmonised AS arrangements will continue in parallel with this work and is not part of the scope of this review.

The current consultation will be supplemented with an industry forum where the options developed will be presented. The TSOs will then consider all responses received to the current paper and will develop proposed recommendations for the SEM Committee, which will be issued for consultation in Q3 2012. The third System Services consultation will provide a further opportunity for the industry to comment on the proposed products. It will also include details of the financial aspects and seek views on a range of possible remuneration levels to service providers and costs to consumers. Following a review of the responses to this third consultation, the TSOs will submit a set of final recommendations to the SEM Committee; the SEM Committee has indicated its intent to publish a decision on these by end 2012 / early 2013.

It should be noted that the System Services Review timetable is dependent on the outcome of the consultations and the breadth of any changes identified in this review. To ensure that progress can be made, it is important that this review is cognisant of the wider industry structure, but does not seek to make fundamental changes outside the System Services arena.

2.1 Responses to December 2011 Preliminary Consultation[6].

The TSOs sought the views of industry on the scope and nature of the System Services review in a Preliminary consultation paper in December 2011. The issues for consideration were split into three areas as follows:

1) Remuneration approach
2) Contractual arrangements
3) Eligibility of providers

A total of 28 responses were received. Of these, 19 had generation affiliations (11 of which included wind plant), two had demand affiliations and the others were from a range of consultants, associations and academia. Most of the questions posed in the paper resulted in a clear majority response and these views have been included in the narrative below. On a few of the questions there was a much more diverse response often reflecting the respondents' particular circumstances. Non-confidential responses have been published[7] by the TSOs in conjunction with this paper.

Remuneration Approach

Questions posed
Should system service provision be unrewarded and left as a mandatory service or should there be remuneration for system service providers?
Should there be remuneration only above the minimum required level of service provision?

Respondent Views:- In general respondents believe that there should be mandatory Grid Code requirements for system services. However, they also believe that they should be paid for the full level of service that they are providing including the mandatory element.

TSO View:- The TSOs agree that there should be mandatory standards in the Grid Codes. They also consider that the mandatory nature of products and requirements is independent from a decision to separately reward a service. Historically, the mandatory services in the Grid Code have been based on or close to best in class performance from conventional plant. In many cases remuneration for these services has followed, particularly in the case of operating reserve and reactive power.

Mandatory requirements arise out of a consideration of the technology life cycle and reasonable prudent requirements that are debated in the industry and ultimately approved by the Regulatory Authorities. These mandatory services provide clarity for new entrants on minimum requirements and when appropriately enforced with performance monitoring can help reduce the scarcity of necessary system services. In particular, the TSOs consider that active power control, steady state reactive power production and frequency control capability should be mandatory requirements across all plant types. However, the exact expression of these requirements may vary.

The TSOs therefore consider that, in theory, the preferred approach is to have appropriate remuneration to reflect the value of the service to the system and variable payments dependent on supply availability and demand. In practice, there also needs to be an acceptance of some simplification in order to reflect the number of service providers, facilitate administration and provide reasonable certainty to system service providers. Details of the remuneration will be included in the next consultation paper.

---

[6] System Services Preliminary consultation paper
http://www.eirgrid.com/media/System%20Services%20Consultation%20(Preliminary).pdf

[7] Responses to the Preliminary Consultation
http://www.eirgrid.com/operations/ds3/industryengagement/

Questions posed

Should there be charges applied to Generators for non-provision of services?

***Respondent Views**:- Respondents believe that there should be charges applied to service providers for non-provision of services or that the providers should not receive payments for the relevant non-provided system services. It was stated that a distinction should be made between generators which fail to provide and those that decide not to provide, assuming minimum Grid Code requirements are met. A range of views were expressed, however, on the nature and extent of these charges including one respondent who believed that the charge should amount to the cost of procuring from another provider.*

TSO View:- The TSOs believe that payments for system services should reflect the reliability of provision and magnitude of capability provided. The TSOs also agree that there is a distinction between generators which fail to provide and those that decide not to provide, assuming minimum grid code requirements are met. Charges for failure to provide a service has proved successful in the past but the TSOs are open to considering other forms of incentive that can achieve the desired outcome.

Purpose of Payment

Questions posed

Should payments for System Services provide a signal for new investment or an incentive for ongoing maintenance of existing capabilities?

***Respondent Views**:- In general, payments should provide a signal for new investments and an incentive for ongoing maintenance of existing capabilities. A number believed that it should only be a signal for new investment while others think payments for system services should reflect the value to the system and should not unnecessarily differentiate between existing providers and potential new investors.*

TSO View:- The TSOs consider that the payments for System Services should ideally provide a signal for new investments and an incentive for ongoing maintenance of existing capabilities. It is acknowledged, however, that this is a difficult challenge. Over-payment or double payments to providers should, where possible, be avoided; on the other hand, inadequate incentive for necessary system services can lead to inefficient system operation ultimately at the net cost to the final consumer.

Remuneration Mechanism

Questions posed

Should there be direct or indirect payments for System Services?
How should services be procured (e.g. bilateral contracts, tendering process, market mechanisms, auctions)?
What payment mechanism(s) should be considered?

***Respondent Views**:- Direct payments are clearly the preferred method. There was a mixture of views on how services should be procured. Many believed that there should be different procurement methods appropriate to the different services ('one size does not fit all') and that any method should be open and transparent. These should be independently assessed for each service and kept as simple as possible.*

A few respondents believe that the current mechanism is not fit for purpose. Changes proposed include:

- ***Make more transparent, easier to understand and calculate.***
- ***Move away from fixed pot for provision of services.***

- ***Charges should be increased for unreliable provision of services. For an even stronger signal, charges could be recycled to reliable providers, although it is recognised that this revenue would be difficult to rely on from a financing point of view.***
- ***There should be a more rigorous process of performance monitoring and Grid Code compliance.***

TSO View:- The TSOs will provide greater detail on this in the next consultation paper later this year but consider that, due to the historically limited competitive market, the basis of all system services will probably be a bilateral contract between the provider and the TSO in their jurisdiction. The contract template will be publically available and it is envisioned that there will be full transparency on rates and potential system services revenues. The TSOs also consider that it may be appropriate to publish all revenues earned by system services providers in a similar manner that energy and capacity payments revenues are published currently.

The TSOs consider that the payment should, where necessary, incentivise not only appropriate investment but also enduring unit performance capability.

The TSOs agree with the respondents that it may be best to have different mechanisms for different services.

Basis of Remuneration

Questions posed
Should payments be focused on capability to provide services or utilisation of those services?
If capability-type payments are used, should payments depend on whether generators are synchronised or not?

Respondent Views:- The majority of respondents believe that this is dependent on the service and that a mix of both was appropriate for most services. Capability payments should reflect capital costs and be an appropriate reward for providers being available to provide services and utilisation payments should reflect operating costs. A large number of respondents thought that it should be based on capability alone.

Most respondents believe that capability-type payments should be independent of synchronisation. Generators believe that for some services at least it in no way diminishes their ability to provide the service or reduces benefit to the system. They stated that synchronisation is not entirely within their control as it generally depends on the dispatch decisions of the TSO. Some respondents suggested that if a plant can provide a service without being synchronised, the unsynchronised generator should be paid more, since it is likely that their constraint costs are lower.

TSO View:- The TSOs agree with the majority of the respondents and consider that the payment can be a combination of capability and utlisation and should be related to effectiveness of delivery of the service. The TSOs consider that products providing greater financial certainty are likely to be more effective especially where provision of the system service needed requires additional revenue to make an investment in technology. This is where payment for capability is likely to be better. Where there is sufficient existing capability in the portfolio then utilisation payment may be more appropriate to maintain levels of performance.

The TSOs consider that there is merit in paying for capability independent of whether the unit is synchronised in some situations, particularly where new investment is required. However in these cases careful consideration is required to ensure that the system is getting the value of the service in at least providing a margin or back up that can be utilised in a timely manner. If this cannot be achieved then it would not be appropriate to pay unsynchronised units for services they can only deliver when synchronised.

Interaction with SEM

Questions posed

What interaction, if any, should there be between the System Services arrangements and other revenue streams in the SEM?

Should a re-distribution of values between the various revenue pots in the SEM be considered in order to incentivise investment in system services? If so, how should this be achieved?

***Respondent Views:-* The majority of respondents believe that there should be minimum or no interaction between system services arrangements and other revenue streams in the SEM. One respondent believes that some services should be co-optimised with energy and market price derived for each component. One respondent believes that capacity payments should be weighted according to the system services required.**

Opinion was equally divided on whether a redistribution of revenue pots is the correct thing to do. Those in favour of redistribution suggested:

- ***Adjustment of the capacity payments to reward operating flexibility.***
- ***Moving a percentage from capacity payments to system services.***
- ***The reduction in constraints costs being re-distributed to pay for System Services and thereby providing a greater incentive for the development of flexible plant.***
- ***Significant reduction of the CPM in favour of the SS Pot.***
- ***Redistribution of the Capacity pots and infra-marginal rent by approximately 10% to Ancillary Services.***

TSO View:- The TSOs believe that the current limited interaction between Ancillary Service revenues and the SEM through the BNE calculation used in Capacity Payments in the market should remain the only formal interaction at this stage. The main reason for this position is that the SEM will need to evolve to the EU target model by 2016 and it expressly excludes ancillary services which are left to Member States to implement as they see fit. In addition, the challenges facing the power system of Ireland and Northern Ireland with respect to high volumes of non-synchronous RES are significantly different to those of other power systems and it is difficult to see how the needs of the system would be best served with a more formal link at this stage.

The TSOs believe, however, that system services will need to play an increasing role in long term investments if European policy moves towards higher RES penetrations to 2030 and beyond. It is in those policy objectives and timeframes that this should be reconsidered.

Contractual Arrangements

Questions posed

How should the contractual arrangements be implemented?

Should the duration of the contractual arrangements be indefinite or time-limited?

***Respondent Views:-* There was widespread agreement that contractual arrangements should be implemented through bilateral contracts. A recurring theme was that long term contracts are essential to incentivise new investment. Some respondents believe that the contractual arrangements should depend on service ('no one size fits all'). One respondent believes that an auction system should be used for system services that are not location sensitive. Where services are location sensitive, a framework agreement should be set up, facilitating long-term contracts for new generators or those investing in new infrastructure to provide system services.**

TSO View:- The TSOs consider that bilateral contracts that have appropriate transparency on potential monies earned and that are available to all parties capable of supplying the necessary service represent the most pragmatic mechanism with which to proceed.

The contract arrangements should be on a medium/long term basis. The contract rates and/or pots of money available to pay for system services should be reviewed on a frequency that does not overly recover monies at the expense of the cost to the consumer, provides reasonable certainty needed for new investment and allows for the evolving needs of the power system.

The TSOs do not consider that the current yearly review process is appropriate to encourage additional investment in new capability. Similarily it would not seem appropriate to fix contractual values over 10 or 15 years as the potential for inefficiency is significant. It is likely that a three to seven year review period, depending on the service, would offer the best compromise between these often conflicting requirements.

The TSOs consider that there should be a reasonable expectation that contractual values should not change for the length of the financial review period. This arrangement may have to be open to consider exceptional conditions where changes could be made without forfeiting this.

Eligibility of Service Providers

Questions posed
What types of providers should be considered for System Services?
Is the value of service from different types of provider the same?

Respondent Views:- The majority of responses indicated that all providers should be considered. One respondent believed that only existing and contracted conventional Gate 3 plant should be considered.
Many respondents believed that the value of service from different types of provider is the same if the service is well defined and set out in a clear set of rules. However, some stated that the location (for reactive power in particular) and quality (conventional has better reactive power and operating reserve performance in terms of reliability, level and system impact to other types of generation) can affect the value of the service from different providers. One respondent stated that large scale generation proposals potentially have a greater value to the system. Another respondent believed that if a single provider can provide a number of services then the benefit is greater.

TSO View:- The TSOs agree with the view that all providers who can provide the necessary services should be eligible for payment. This, in the TSOs' view, includes distribution connected users and should be irrespective of plant type.

The TSOs agree that the value to the power system of a delivered service is the same, irrespective of the providers . The TSOs also agree that the location of the service can have an impact on its effectiveness. This is particularly relevant with reactive power services. However, there also needs to be a pragmatic approach in designing system services products that balance the complexities of the laws of physics with the need to provide clear,simple and effective financial incentives that work effectively. The TSOs therefore consider that in the power system of Ireland and Northern Ireland it is highly likely that the best compromise will, in general, be financial products that do not require any specific locational information and therefore all service providers of similar services should be treated the same.

Wind generators can provide some services and will be treated the same as other plant types where they can provide the same service. The payment structure and payment mechanism would need to, in certain circumstances, reflect the variability of wind.

New Technologies

Questions posed
What special services, if any, does the demand side or storage provide?
How can the full potential of new technologies in respect of System Services be realised?
Should there be alternative remuneration mechanisms for these providers?

Respondent Views:- A number of varied and specialist ideas for special services and achieving full potential were provided. There were mixed views in relation to remuneration and services provided by new technologies.

TSO View:- The TSOs believe that technologies such as storage and demand side arrangements are potentially capable of providing a number of the system services required to meet the policy objectives. At this stage, the TSOs do not consider it appropriate to design products specifically for these technologies. Where appropriately designed system services products reflecting the value to the system are available it is likely that these technologies will be able to make financial business cases for making the service available.

The TSOs are aware that in a number of other power systems there have been specific contracts for a small number of special technologies. The TSOs believe, however, that in principle, a more cost effective mechanism is to provide transparent prices and signals to incentivise the appropriate system services. The TSOs also believe that the generic new products proposed in this paper provide opportunities for new technologies, including, for example, Demand Side providers and large-scale storage. If, in future, this approach does not achieve the desired outcome, then the TSOs may have to consider developing bespoke contracts with individual services providers.

2.2 International Review

In parallel with this consultation process, EirGrid and SONI engaged independent consultants to carry out a review of system services arrangements in a number of international (mostly island) markets. This involved examination of what services were being used and included why and how they were being developed and deployed. The study was aimed at providing an insight into the various options that are in place internationally, the commercial frameworks that support them and their possible suitability for inclusion in the development of system services for use in Ireland and Northern Ireland in the future. The report has been published[8] on the EirGrid and SONI web sites.
The following key observations and conclusions were made in the study: -

- Wholesale energy is by far the largest component in relation to consumer costs and generator revenue streams. System services markets are generally a relatively minor consideration in the context of the broader wholesale energy market.

- High levels of variable wind generation introduce much greater challenges for system operation and greater need for system services related to frequency control and voltage control. Ireland and Northern Ireland in particular are facing much higher proportionate wind capacity than other countries which are already experiencing difficulties.

- All of the markets have mandatory requirements on generators, enforced through the network codes, to provide the necessary key services. Service payments are contracted for and settled

[8] System Services International Review
http://www.eirgrid.com/media/System%20Services%20International%20Review%20-%20Final.v2.pdf

based on a form of commercial arrangement and charges penalise poor performance. Costs for the provision of most system services are socialised. Market mechanisms only operate effectively where there are high levels of competition.

- In markets where there is little dynamic in the generation mix, market rules or market behaviour there has been little change in system services arrangements. Ireland and Northern Ireland are expected to see substantial change in market dynamics as the generation mix changes significantly over time, so it is appropriate that system service provision should evolve over time.

3 Identifying the Technical Challenges

The operational implications for a synchronous system with high penetrations of non-synchronous generation have been studied by EirGrid and SONI. In particular, the "Facilitation of Renewables" report[9] (FoR studies[10]) in June 2010 and the follow up "Ensuring a Secure, Reliable and Efficient Power System" report in June 2011[11] show that the integrity of the frequency response and the dynamic stability of the power system are compromised at high instantaneous penetrations of wind power plant. While there are mitigation measures which can be employed, it will be necessary to limit the aggregate output of wind power plants at times.

The key findings indicated that it would not be prudent to operate the power system above aggregate levels of System Non-Synchronous Penetration[12] levels (SNSP) of 50% without addressing a number of key issues. Furthermore, it is likely that operating the system above SNSP levels of 75%, even after addressing these key issues, would not be prudent given current technologies.

The FoR studies assumed performance in line with Grid Code standards. However, in reality generators do not always comply with these standards and, as such, non-compliance needs to be factored into greater operating margins to maintain security. The subsequent June 2011 report provided a review of the performance capability of existing plant on the system combined with the projected implications for a power system meeting the 2020 targets. This report showed that the plant performance in 2010 (calendar year) for a number of units does not reliably meet the required standards as outlined in the Grid Codes. Complementing this 2010 review, an hour by hour economic model of the 2020 power system with an assumed portfolio (based on current generator connection applications) was conducted using the Plexos tool. This produced hourly generator commitment status and output levels based on assumed prices and operational policies. Trends in overall system services performance in a power system with high penetrations of wind power plants could then be identified.

The analysis and studies indicate that there are a range of challenges that need to be addressed in order to successfully manage the Ireland and Northern Ireland power system with high penetrations of non-synchronous plant. Due to the diversity of challenges and the implicit interaction that solutions in one area may impact another, the DS3 programme was initiated to facilitate a comprehensive approach to move the theory and analysis provided here into actual performance and practice in the power system. The TSOs recognise that this can only be successfully achieved with the appropriate legislative, regulatory, technical and market mechanisms, which requires active input from a diverse range of stakeholders.

In this consultation document the analysis is expanded and three distinct 2020 portfolio scenarios are presented. These portfolios are all derived from the 2011 Generator Capacity Statement[13] for 2020.

---

[9] Facilitation of Renewables report
http://www.eirgrid.com/media/FacilitationRenewablesFinalStudyReport.pdf

[10] Facilitation of Renewables study
http://www.eirgrid.com/renewables/facilitationofrenewables/

[11] Ensuring a Secure, Reliable and Efficient Power System report (June 2011)
http://www.eirgrid.com/media/Ensuring_a_Secure_Reliable_and_Efficient_Power_System_Report.pdf

[12] SNSP is a measure of the instantaneous level of non-synchronous generation on the system. It is the ratio of the real-time MW generation from wind and HVDC imports to demand plus HVDC exports.

[13] All-Island Generation Capacity Statement 2012-2021
http://www.eirgrid.com/media/All-Island%20GCS%202012-2021.pdf

Each scenario has sufficient installed wind generation (5,300 MW) to meet the Government targets for renewable but have varying portfolios of conventional generation as follows:

- The Generation Capacity Statement (GCS) portfolio includes over 800 MW of new conventional generation
- The Deferred Conventional Investment (DCI) scenario has no new conventional generation
- The Marginally Capacity Adequate (MCA) scenario has no new conventional generation and early retirement of approximately 1,400 MW of existing plant.

The Plexos tool was used to produce an hour by hour economic model of the 2020 power system for each of these portfolios under a range of operational strategies (e.g. different SNSP limits). In addition, it has been assumed that all necessary infrastructure projects have been completed. Thus, network constraints have not been modelled.

The analysis of all scenarios indicates that while they all meet necessary capacity adequacy metrics, they are deficient, to varying degrees, in system services.

The GCS scenario was found to meet most, but not all, of the requirements for system services with shortfalls in inertia and reactive power control. The DCI and MCA scenarios were found to be materially deficient in inertia, reactive power and ramping capability.

As a result, significant investment in system service capability is required to maintain the required level of system security out to 2020 and to meet the renewable energy policy objectives. In particular the analysis showed that new System Services were needed in three specifc areas:

- Frequency Response
- Ramping
- Voltage Control

The specifics around the challenges and issues in each of these areas are outlined in the sections below. In Chapter 4 the details of the proposed new System Services to address these issues and challenges are outlined.

3.1 Frequency Response

Variations in electricity demand or generation result in fluctuations in frequency. Control of these fluctuations is effected via two mechanisms: inertial response, the inherent electro-mechanical response of the synchronous system and operating reserve, the rapid, active control of power output.

The maximum rate of change of frequency (RoCoF) is inversely proportional to the aggregate synchronous system inertia. On the Ireland and Northern Ireland power system, ensuring adequate levels of synchronous inertia are available is critical due to the relatively small size of the synchronous power system and the potential for a significant rate of change of frequency. In the future, the largest single contingency[14] could result in rates of change of frequency greater than 0.5 Hz/s. This in turn could lead to the cascade tripping of all generators on the system as they are not currently obliged under the Grid Codes to withstand RoCoFs in excess of 0.5Hz/s. In addition, protection settings on distribution connected units, many of which use RoCoF protection to manage islanding situations, would also be a factor.

Analysis completed by the TSOs over the last four years has indicated that RoCoF will exceed 0.5 Hz/s at levels above 50% penetration of non-synchronous generation due to the displacement of synchronous

[14] The largest single contingency includes the loss of the largest single in-feed (at a single location) and the loss of a number of in-feeds due to the effect of a single transmission fault.

plant. Analysis of the 2020 hourly modelled system shows that the level of synchronous inertia falls, on average, by up to 33% compared to a 2010 baseline. Without implementing appropriate mitigation strategies, this reduced inertia has implications for secure power system operation particularly following the loss of a large in-feed.

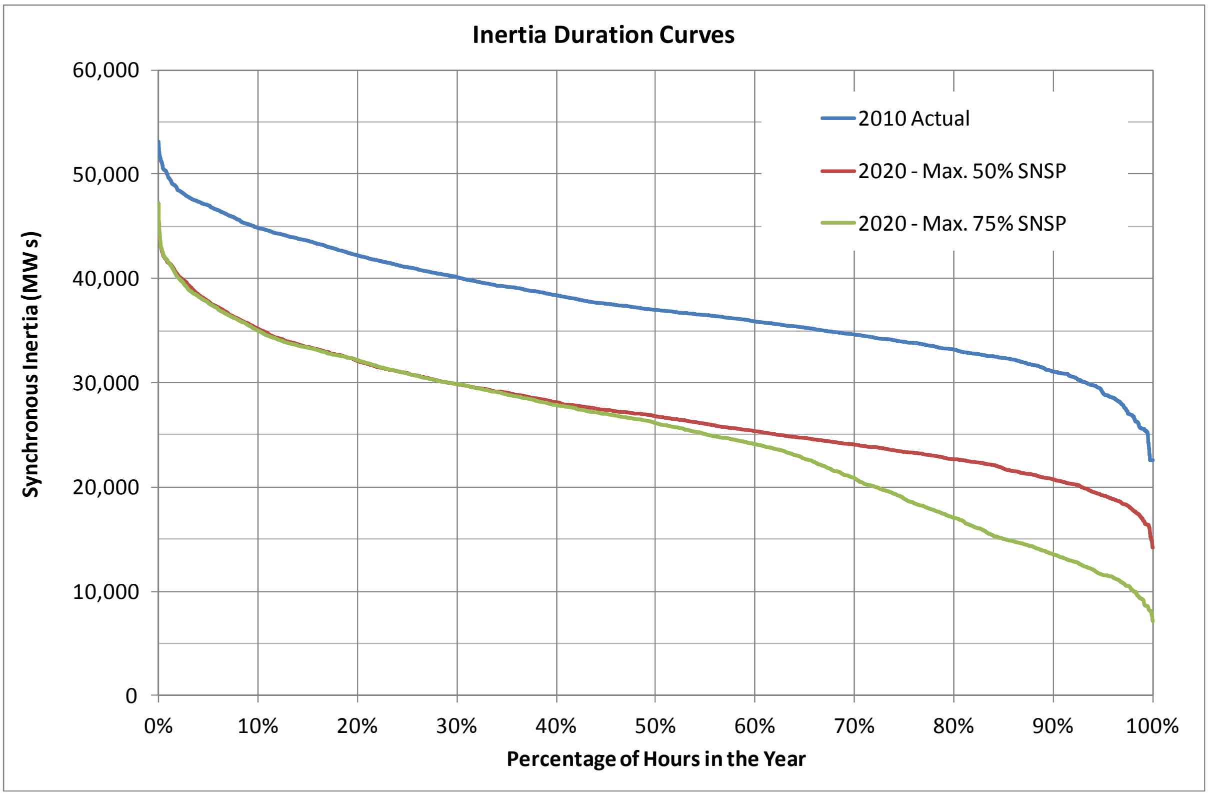

Figure 1: Synchronous Inertia Duration Curves calculated from actual 2010 and modelled 2020 data

The RoCoF issue is being tackled in two ways by the TSOs. The first approach is to determine if all generators could withstand a higher rate of change of frequency without significant modifications. This examination is being conducted through the DS3 Joint Grid Code working group and is on-going at this time. The extent to which all large generators can tolerate (ie ride-through) higher RoCoFs will dictate the extent to which specific system services will need to be designed and procured to effectively manage the system within whatever the RoCoF standard ultimately is.

The second way in which the RoCoF issue is being tackled is the introduction of new System Services products to mitigate the risks. These products, which are discussed in section 4.2, include Synchronous Inertial Response and Fast Post-Fault Active Power Recovery.

A key element in managing the frequency response of the system is to have greater certainty in the performance capability of the plant. Systematic performance monitoring during events is a key aspect of this. Given the relatively fast nature of the response, it is imperative that the quality and sampling rate of the disturbance recorders on all generators is sufficient.

3.2 Ramping Duty and Requirements

Over very short timeframes (seconds and minutes), imbalances between generation and demand are managed using frequency response services (e.g. operating reserves). Over longer timeframes, additional factors can cause an imbalance which, if not managed, would result in unacceptable frequency excursions. These factors include changes in demand, wind generation, interconnector flows and generator availability. The net effect of these combined factors determines the ramping duty of the system at a point in time. The ramping duty represents the change in output that is required from centrally dispatched generation. In addition, there is always uncertainty about the future generation/demand balance which should be prudently accounted for. Therefore, a margin is required in addition to the projected ramping duty to securely manage the balance of generation and demand while allowing for unforecast variations. The sum of ramping duty and ramping margin comprise the ramping requirements. This is illustrated in Figure 2 below.

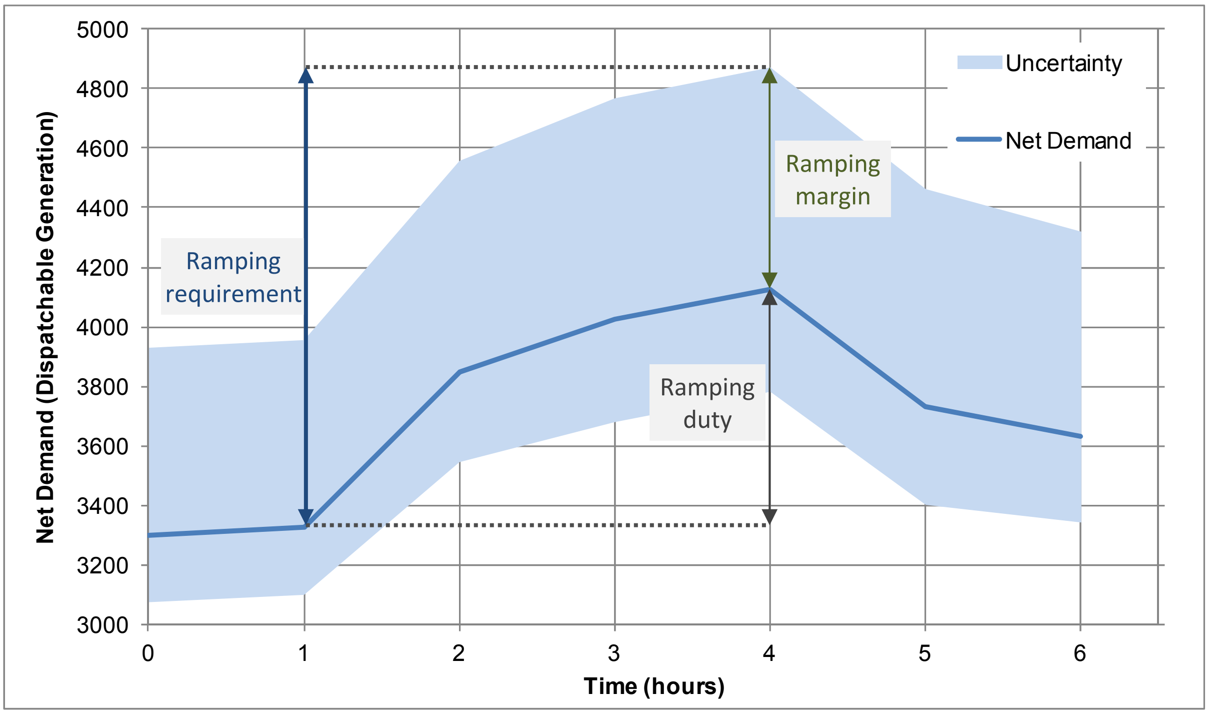

Figure 2: Illustration of ramping duty, margin and requirement (for a 3-hour horizon)

To quantify the ramping duty and requirements with increased wind power plants, an examination of aggregate wind generation output in Ireland in 2010 was conducted. The initial analysis showed that the maximum potential one-hour change in wind power output on a given day was approximately 20% of the maximum level of wind on that day. This illustrates the impact that wind can have on the ramping duty required on the system. The precise impact on ramping duty at a point in time will depend on the level of wind generation.

The ramping duty will, however, also vary depending on the time horizon considered. Higher ramping capabilities are likely to be required as the time horizon extends. As described in the June 2011[15] report, the normalised change in wind output over one hour is relatively small, with 99.9% of the variations between plus and minus 15% of installed capacity. Over a 12 hour period, the data shows that much larger variations can be expected; more than 1% of 12-hour changes exceed 50% of the installed capacity. In addition, in the longer timeframes the potential forecast error increases.

To examine the potential for a ramping requirement operational policy the TSOs developed an initial simple standard based on experience. This policy accounted for the changes in demand and aggregate wind power plant output, loss of largest in-feeds and allowed a margin for uncertainty in respect of load and wind forecasts in the horizon time period in question. A review of the actual outputs from 2010 enabled calibration and quantification of the implicit ramping service policy. This policy was then applied to the three 2020 portfolio scenarios described previously. The outputs show that in all

[15] Ensuring a Secure, Reliable and Efficient Power System report (June 2011)
http://www.eirgrid.com/media/Ensuring_a_Secure_Reliable_and_Efficient_Power_System_Report.pdf

scenarios there is a shortage of ramping capability in each of the time horizons studied (see Figure 3). The deficit increases as the total system generation capacity decreases.

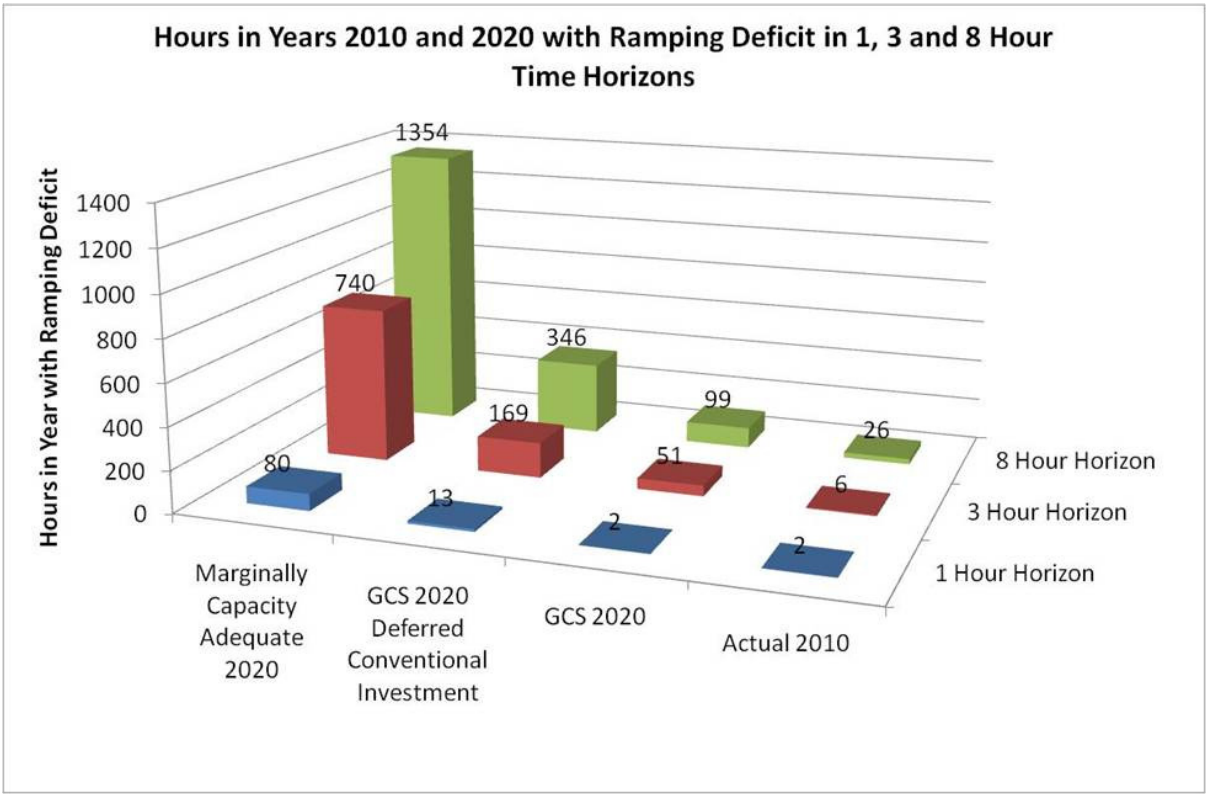

Figure 3: Ramping deficit hours for 2010 and projected 2020 portfolios

The implications of not meeting the ramping requirements would likely necessitate generation re-dispatch, including the commitment of additional ramping sources, resulting in increased Dispatch Balancing Costs and increased dispatch down of variable renewable generators. Operational policies and strategies are required to manage this issue successfully and to ensure that the demand can be met at all times. However, the results indicate that the nature of the portfolio will have a key impact on the capability of the system in respect of ramping services. The evolution of the plant portfolio will be driven by the commercial incentives in place. Any strategy to ensure appropriate ramping services and plant portfolio are available will need to be reflected in some manner in the commercial incentives available.

3.3 Voltage Control

With the addition of significant volumes of wind power plants onto the system, the on-line reactive power sources, both static and dynamic, available to the system operator to control the voltage will fundamentally alter.

This occurs for three primary reasons. Firstly, the location of the wind power plants will be further from load centres than traditional conventional plant. An analysis of the applications for wind power plant connections in Ireland and Northern Ireland shows that over half of the expected 5,300 MW will connect to the distribution network (prior to 2005 the system had all the significant active and reactive power sources directly connected to the transmission network).

Secondly, the reactive power capability from wind power plant as defined in the Grid Code and typically to be found in globally available wind power plants has a reactive power capability of 0.95 p.u.

leading/lagging power factor at maximum wind power output. This compares to conventional plant that are required to meet wider ranges of 0.93 leading to 0.85 p.u. lagging (0.8 p.u. for some units in Northern Ireland) power factor at their maximum MW output level and can give even more Mvar outputs at lower setpoints. Therefore, even if all generators on the system are compliant with the required standards, with the addition of 5,300 MW of wind power plant there is a potential reduction in aggregate Mvar control capability.

Finally, the nature of the reactive support will change. The form will move from that provided by synchronous generators, which have fast acting excitation systems and the ability to provide constant reactive current during voltage disturbances, to that provided by doubly fed induction generators, static compensators or static var compensators depending on the nature of the wind power plant (and the technology employed). This has implications for the transient stability of the power system, for managing voltage collapse phenomena, and ultimately network design.

To examine some of these issues a review of the actual available reactive power on the Ireland and Northern Ireland power system was performed for 2010. This used the actual hour to hour dispatched output of each unit on the system in 2010, combined with their known reactive power capability curve. From this it was seen that the available lagging Mvar ranges between 2,500 Mvar to just over 5,000 Mvar.

To understand the change in Mvar capability on the system, the 2020 hour by hour model was analysed in a similar manner. Comparing the 2010 with the 2020 model using an annual duration curve, there is a noticeable reduction in on-line synchronous reactive power available all through the year. This is shown in Figure 4 below. When transmission connected wind power plants are included (and assumed to provide a reactive power capability in line with the current Grid Code), there is an increase in the available reactive power on the 2020 level (red curve), but it still does not meet the levels in 2010. There is therefore less reactive power capability to manage voltage in the 2020 power system at high penetrations of wind power plant. However, if windfarms provided an enhanced reactive power capability (i.e. full reactive power range across full MW output range), the reactive power capability (red dotted curve) is very similar to the 2010 level.

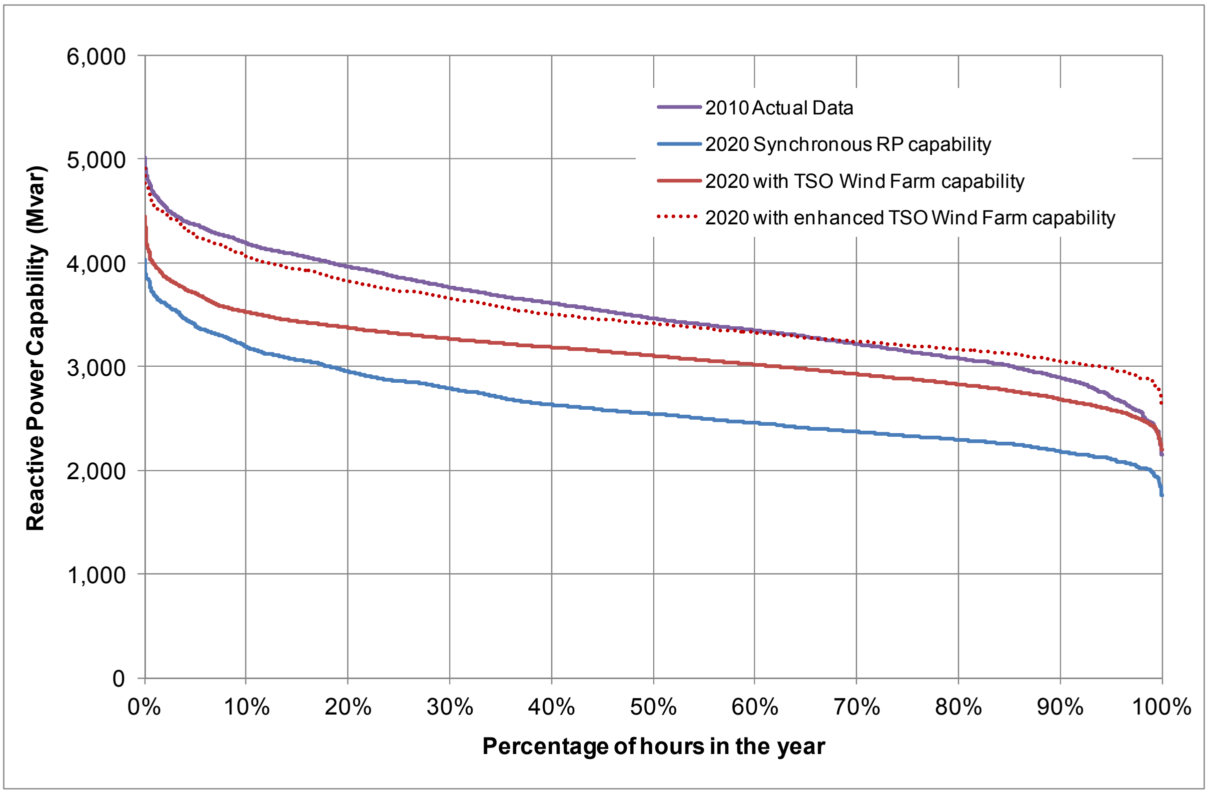

Figure 4: Reactive Power duration curves – evaluated from 2010 actual data and modelled scenario for 2020

With the addition of significant volumes of non-synchronous generation, the FoR studies identified that the transient stability integrity of the power was compromised at high instaneous penetrations of windfarms. This arises through a complex interaction between increasing non-synchronous penetration, conventional generator characteristics and their relative spacial distribution around the network. In particular, the synchronising torque between remaining on-line conventional units is reduced as there are fewer of these units and the effective electrical distance and impedance between them increases. In the absence of mitigation strategies, it was found that where windfarms only met basic capabilities of dynamic reactive power production, the security of the power system would be materially compromised at SNSP levels in excess of 60%.

Figure 5 below, which is taken from the FoR studies, shows that as the instantaneous penetration of wind increases relative to system demand (and exports) the percentage of contingencies (faults) with a critical clearance time (CCT) less than 200ms increases. Since critical clearance time is a measure of the transient stability of the system (with higher CCT denoting greater stability), this means that the system becomes less transiently stable at high wind penetrations relative to system demand.

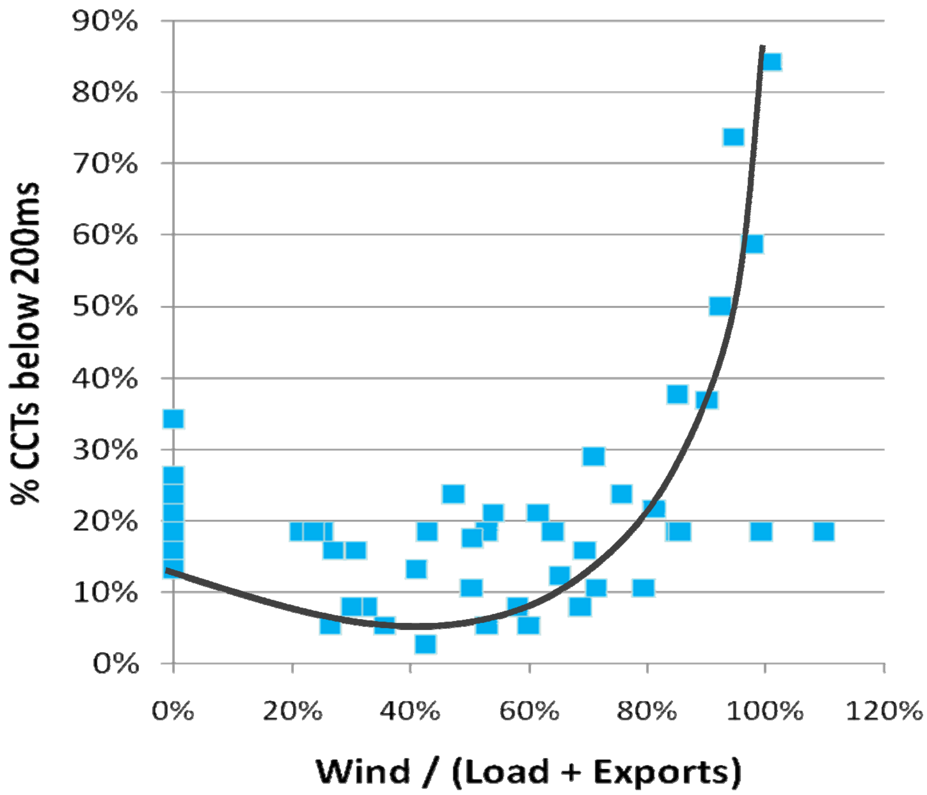

Figure 5: Percentage of contingencies causing Critical Clearance Times (CCT) lower than 200ms vs SNSP (FoR studies)

However, it was found that increased system transient robustness could be achieved with the addition of devices that could dynamically support voltage during disturbances. To that end an analysis of a specific system dispatch and load with 80% SNSP was investigated. This analysis showed that the addition of synchronous condensers or the improvement of the response of either doubly fed induction or full convertor wind generators could mitigate some if not all the issues. The impact of these mitigation strategies is shown in Figure 6 below.

Based on the analysis, it would appear that there are significant efficiencies to be gained for a small increase in dynamic reactice power response from windfarms as compared to the installation of synchronous compensators. This is because windfarms are distributed ubiquitously across the system, both at transmission and distribution nodes, whereas the synchronous compensators are only in two locations. The TSOs consider that synchronous compensators could achieve the same effect but this would require a significant roll-out of these technologies in multiple locations in the network.

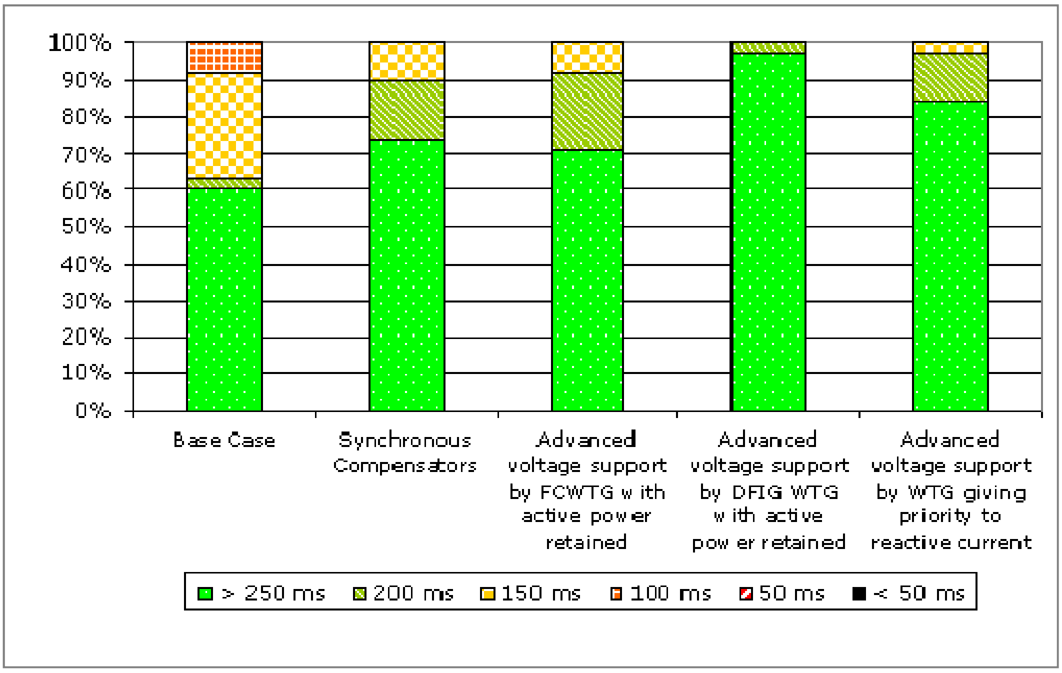

Figure 6: Impact of mitigation strategies for improving transient stability issues on Critical Clearance Times (FoR Studies)

4 Proposed System Services

New system services are proposed below and have been informed by detailed technical analysis of the changing system requirements and the views of respondents to the previous consultation.

4.1 General Principles and Approach

New products should be system service specific and, where practicable, technology independent. Accurate definitions of the proposed products will be key to their successful procurement and deployment. For existing services, they should generally be retained with minimal change unless there is a clear, specific and justifiable reason for changing them. The basis of financial remuneration for these services will, however, be reviewed.

4.2 Frequency Control

The frequency of the power system is a key metric for any synchronous power system. It indicates whether or not energy demand and generation are balanced. The frequency should be maintained within 4% of the nominal value (50 Hz) to avoid damage to users of the system. To manage this balancing requirement over the full range of variability and uncertainty that is encountered in normal system operation a suite of frequency control services are needed. These services range from short term capabilities, from milliseconds to seconds, to longer term requirements, minutes to hours. The following products are being proposed to address some of the technical challenges that have been identified.

4.2.1 New Service: Synchronous Inertial Response

Synchronous Inertial Response (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 (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 there is therefore a need to incentivise it. In particular, if synchronous inertial response can be provided at low MW outputs, the system can accommodate higher levels of non-synchronous generation.

The proposed SIR product is defined as the kinetic energy (at nominal frequency) of a synchronous generator multiplied by the SIR ratio, which is the ratio of the kinetic energy 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. The SIR ratio will need to exceed a certain threshold [suggested 20 s] for the provider to be eligible. Payments for SIR will use a rate with a sliding scale based on the SIR ratio and threshold.

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.

Potential providers of these services include all synchronous generators with (low minimum generation levels), irrespective of generation technology. Synchronous compensators could also provide this service.

4.2.2 New Service: Fast Frequency Response

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

Option 1: *The proposed FFR product is defined as the automatic additional aggregate MW response from a unit during a frequency disturbance event from the start of the event to the beginning of the Primary Operating Reserve window. This needs to be maintained at least at a constant ratio of this additional energy output to the integral of the frequency deviation in the same time period. A minimum capability will need to be specified that can be provided at all MW output ranges in normal operation (a unit operating between its Minimum Stable Generation and Registered Capacity).*

Or

Option 2*: Fast Frequency Response is defined as the additional increase in MW output from a generator (and/or reduction in demand) following a frequency event that is available within 2 seconds of the start of the event and is sustained for at least 15 seconds.*

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.

Potential providers of these services include conventional generators, demand customers with static under frequency relays, synchronous generators, synchronous storage untis, HVDC interconnectors and some full convertor type windfarms with advance control mechanisms (e.g. providing an emulated inertial response).

4.2.3 New product: Fast Post-fault Active Power Recovery

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. It is proposed to introduce a service that rewards generators that make a positive contribution to system security.

Fast Post-fault Active Power Recovery is provided where a generator recovers its active power to at least 90% of its pre-fault value within 250 ms of the voltage recovering to at least 85% of its pre-fault value. The generator must remain connected to the system for at least 15 minutes following the fault.

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.

Potential providers of these services include conventional generators, synchronous storage devices and full convertor windfarms with advanced voltage control.

4.2.4 Existing product: Operating Reserve

As per current definitions – no changes to the definitions of the POR, SOR, TOR1 and TOR2 services are proposed.

4.2.5 Existing product: Replacement Reserve

It is prosposed that, to avoid overlap with the 1 hour ramping product described below, the timings associated with the Replacement Reserve product are redefined.

Replacement Reserve 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.

4.3 Ramping

The management of variability and uncertainty is critical to a power system with high levels of wind farms. The detailed analysis has shown that portfolios that are capacity adequate are unlikely to be ramping adequate over all the necessary timeframes to efficiently and effectively manage the variable renewable sources and changes in interconnector flows while maintaining system security.

4.3.1 New product: Ramping Margin

To incentivise the portfolio to provide the necessary margins to securely operate the power system a new ramping product is being proposed over three distinct product time horizons.

Option 1: *Ramping Margin is defined as the guaranteed margin that a unit provides to the system operator at a given point in time for a specific horizon. The TSOs are proposing horizons of one, three and eight hours (RM1, RM3 and RM8) respectively. The Ramping Margin for the unit at the starting point is defined as the ramp-up capability of the unit in the horizon time limited by the lowest availability during the horizon window (e.g. from 0 to 3 hours for RM3), less the maximum increase in MW output during the horizon window.*

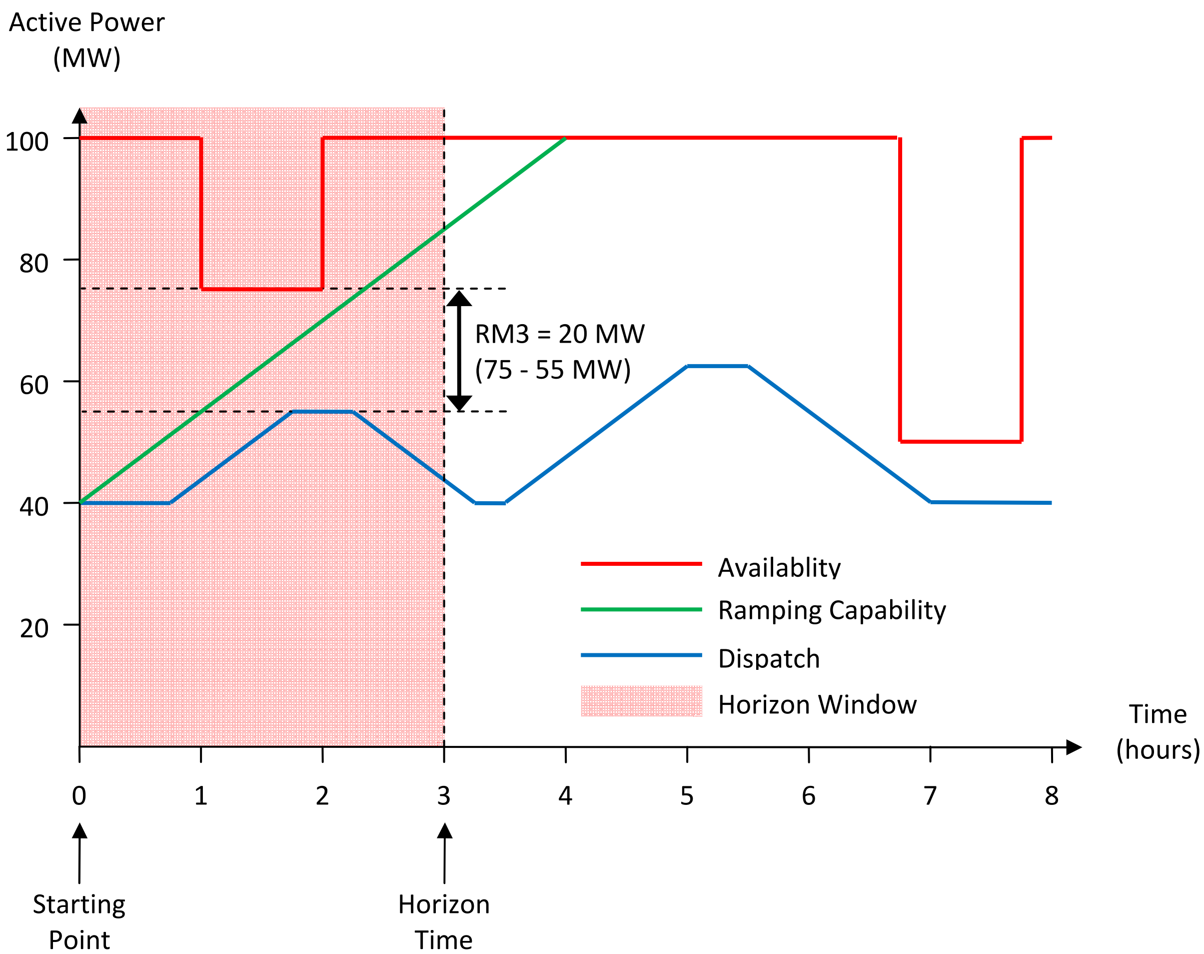

Figure 7: Illustration of 3-hour ramping margin product option 1 for a 100 MW generator (that can ramp at 15 MW/hr)

or

Option 2: *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 products are called (RM1, RM3 and RM8) respectively. The Ramping Margin for a unit at the starting point is the ramp-up capability of the unit in the horizon time limited by the lowest availability in the duration window (e.g. from 3 to 8 hours for RM3). Thus the Ramping Margin represents the increased MW output that can be delivered by the product horizon time and sustained for the product duration window.*

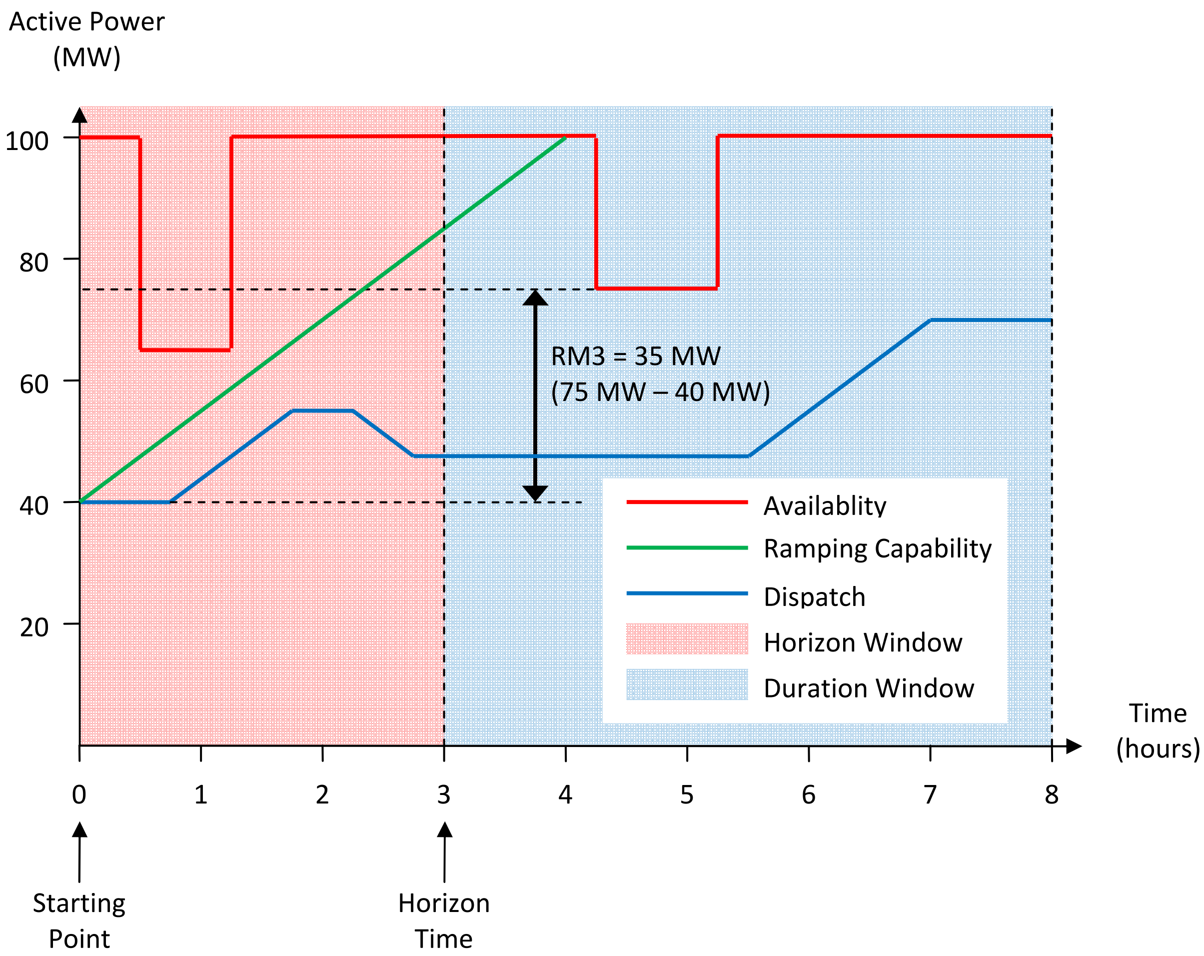

Figure 8: Illustration of 3-hour ramping margin product option 2 for a 100 MW generator (that can ramp at 15 MW/hr)

The measurement of this product will be based on half hour figures of MW output, availability and technical offer data contained in the SEM systems. Performance metrics will be based on a consideration of performance against dispatch instructions, technical offer data and start reliability (e.g. failure to synchronise).

Potential providers of these services include conventional generators that are not dispatched to their maximum output, storage devices, demand side providers and windfarms that have been dispatched down. In the future with the potential for implicit continous gate closures, interconnector particants with excess capacity for importing may also be able to provide this service.

4.4 Voltage Control

System voltage is a key performance metric of the power system. It must be maintained within prescribed ranges at every node on the power system to avoid damage to system users. This is achieved by balancing the generation and consumption of reactive power on the system. A number of voltage control services are needed to ensure that this balance is maintained in normal operation and in the event of a disturbance to the system, dynamic reactive power response is required to maintain system stability.

4.4.1 Existing Product: Steady-state reactive power

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.

The Reactive Power Capability product is defined as the reactive power range (in Mvar) that can be provided across the full range of active power output (i.e. from minimum generation to maximum generation).

Payment for Reactive Power Capability will be based on a rate that is scaled by the ratio of the active power output range (Maximum Generation – Minimum Generation) to the Registered Capacity of the generator.

It is proposed that payment is based on the reactive capability, irrespective of the dispatched output of the generator. This re-structured product definition is illustrated in Figure 9 below for a hypothetical 100 MW generator.

Payment will be based on:

$$Q_{range} \times \frac{P_{range}}{Registered\ Capacity}$$

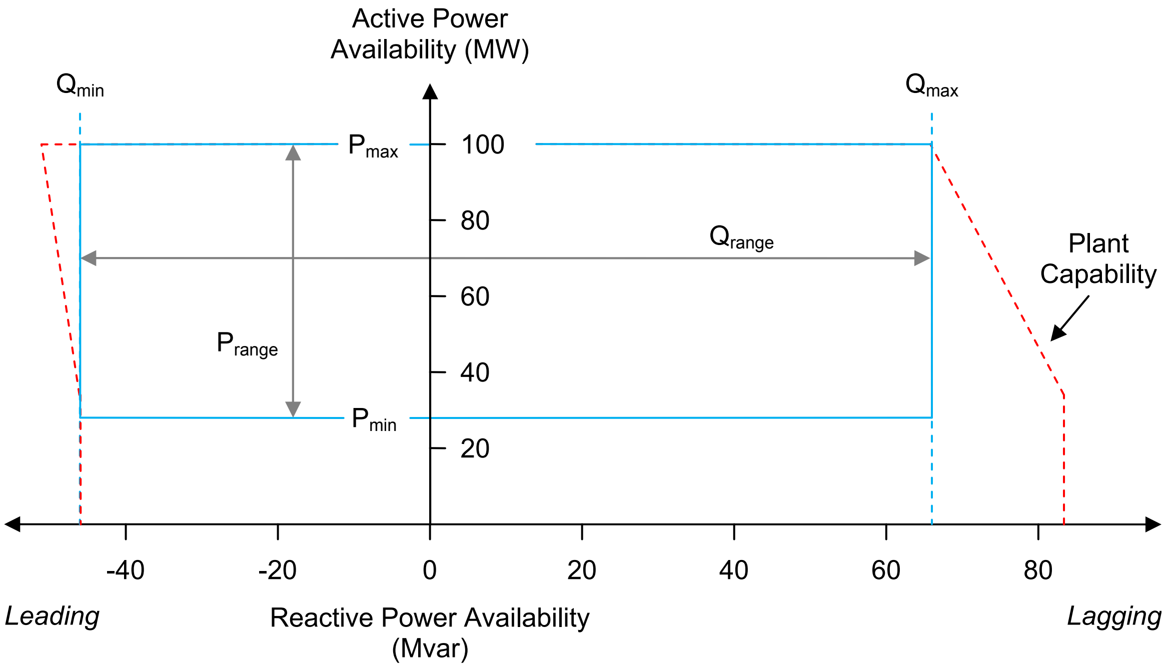

Figure 9: Illustration of Reactive Power product for a 100 MW generator

Synchronous and non-synchronous generators are eligible for this product. Synchronous compensators are also eligible.

4.4.2 New product: Dynamic Reactive Power capability

At high levels of instantaneous penetration of non-synchronous generation there are relatively few conventional plant 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 power capability of windfarm units during disturbances, therefore a new service is proposed to incentivise this type of capability, which is particularly important at high levels of renewable non-synchronous generation. In line with the proposed changes to the Grid Codes, a Dynamic Reactive Power product is proposed.

The Dynamic Reactive Power product is defined as the capability of a generator to deliver a reactive response that shall be proportionate to the magnitude of the Voltage dip. The Reactive Power response shall be supplied with a Rise Time no greater than 70ms, a percentage Overshoot of no greater than 20%, and a Settling Time no greater than 500ms.

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.

Any unit, synchronous or non-synchronous, who can provide this performance is eligible for the product. This includes conventional generators, storage devices and windfarms with advanced voltage controls.

5 Remuneration Approach and Contractual Arrangements

The previous sections of this paper highlighted the changed nature of the power system given a range of assumed portfolios that meet the energy and adequacy standards currently in place. However, as has been shown, these scenarios require additional system services. Any shortfalls will will ultimately result in increased costs to the consumer and a reduced effectiveness of the emerging renewable plant portfolio. This has repercussions for the electricity consumer and the binding European Member State energy policy objectives. The TSOs are also mindful of the fact that, to make these proposals work, a commitment to investment by stakeholders in the industry is required.

5.1 Basis of Remuneration

The TSOs consider that the level of remuneration for system services should better reflect the value of those services to the power system. This is different to existing arrangements where ancillary services have historically been priced around the cost of their production. While this may have been appropriate before, with the fundamentally changing needs of the system and the need for new system service products it is not clear that this approach is still suitable and will deliver a long term cost efficient solution to the consumer.

In practical terms it can difficult to determine accurately the value of system services, particularly as benefits and/or costs may occur outside of the electricity market (e.g. increased RES-E sources, reduced CO_2 production, penalties for breaches of binding EU energy targets). However, as a first step, portfolio scenarios can be simulated that show the reduced Dispatch Balancing Costs where appropriate system service provision has been assumed.

In many energy market designs around the world, the facilitation of greater levels of low variable cost generation would result in lower energy prices to the consumer. While this value is not to be found in the current SEM design as it is priced assuming all wind (with firm network access) is in the market in the first place, that may not always be the case. In particular the recent Single Electricity Market Committee (SEMC) consultation on tie-breaks (SEM-12-028) and the previous SEMC consultation on "Wind Generation in the SEM" (SEM-08-002) both requested views from market participants on wind only being afforded market quantities in respect of what was physically achievable. If this type of market structure was introduced the value of system services for facilitating large scale deployment of variable non-synchronous resources could be considerably increased and the benefits would directly impact on the system marginal prices seen by all consumers.

5.2 Remuneration and link to Grid Code

Compliance with obligations and connection conditions on users in the Grid Code do not in themselves oblige the TSO to contract for them. For example, frequency regulation is a service provided by conventional plant today without reward. However, significant focus and importance has been placed on adherence to the Grid Code by the TSOs in recent years. This was in part to increase standards at least to a minimum level, but also to give the industry confidence that a level playing field was provided to all third parties. To date there is clear evidence this focus has improved compliance over a wide range of connection conditions leading to more effective and efficient operation of the power system. This review of system services should complement this changed industry culture and if possible reinforce it.

To this end the TSOs propose that system service providers need to be fully compliant with distinct Grid Code requirements related to specific services before they are eligible to be contracted for such services. Where there is a system service product where the unit meets all requirements including Grid Code compliance then the TSO is obliged to contract for this up to the Grid Code requirements. Contracting for capabilities in excess of the Grid Code requirements is at the discretion of the TSO.

Where a generator has sought a derogation, which has been approved, they are deemed compliant with the Grid Code as derogated. In this case the unit would be eligible for contracting for a distinct system service to the derogated capability.

5.3 Payment for Capability, Availability or Utilisation

Payments for system services based solely on capability, availability or utilisation are valid remunerations mechanisms. The effectiveness and efficiency of the choice of mechanism to incentivise and mitigate system scarcity will depend on the nature of the service. More specifically, if significant new investment is required, remuneration mechanisms that are based on utilisation are riskier to the developer compared to capability payments. However, the corollary is that capability payments, as they provide greater certainty to the developer, may be at the expense of the consumer and this needs to be considered carefully.

Capability payments, which are broadly analogous to capacity payments in the SEM, provide payments based solely on contracted capability and declared availability (i.e. independently of dispatch). These parameters are in the control of the developer/generator and thus reduce revenue uncertainty for providers.

Utilisation payments, if structured correctly, are likely to ensure existing investment capability is maintained at a high level of performance. This is efficient from a cost to consumers as the units are only paid when called on to do so. However, unless the level of reward is sufficient there is evidence to suggest that units are not incentivised to maintain performance levels as it is not certain that they will recover their costs in doing so. Utilisation payments are also appropriate to situations where there are material incremental operating costs associated with the provision of a system service.

Availability payments that depend on the dispatched output of a provider represent a hybrid approach. These payments (e.g. payment for reactive power under the current HAS arrangements) can be focussed more specifically at the system needs and can be targeted to those providers that offer better value services. However, payment revenues are more difficult to predict (since they depend on dispatched output) and do not reward system service margin that may be required.

The nature of scarcity in the system and how it will be best resolved should dictate whether payments are more capability-focused or utilisation-focused. The TSOs consider that capability payments structures are likely to be more appropriate to provide the incentives needed for the challenges facing the system although mechanisms to mitigate undue costs to the consumer need to be developed.

5.4 Remuneration Approach: Focus on Reliable Performance

In principle, the TSOs consider that the reward for a system service should be based on a combination of capability, availability and reliability. The unit that is more capable, more available and more reliably provides the needed system service when asked to do so should be rewarded more than those units who are less capable, available and reliable. In particular while capability and availability have been utilised in ancillary service payments the concept of reliable system service provision has not been significantly utilised. In this regard this is where the TSOs consider that more focus is required.

A unit that performs consistently when called to provide a service gives a greater degree of certainty to the system operators than a unit that performs sporadically. This certainty of performance should be rewarded as it facilitates the system operator in running the system more efficiently and reducing operational margins to maintain a given level of security. The implementation of published performance assessment standards will be used to measure the delivery and subsequent payments for the specific services. The standard will indicate the form of measurement to be utilised, the number of events that constitute a statistically significant number in a rolling period (possibly a 12 month rolling period) and the standards of certainty to be met to achieve full reward with regard to performance delivery. The proposed acceptable performance metric would be that the service was provided to at least the required level on at least 90% of the times it was called for. A scale of reducing payment rates for performance below 90% but above 50% would be utilised. There should be no payment for performance below 50% as this is inherently unreliable service provision. A process for handling situations where there are too few events to statistically ascertain performance levels would need to be developed. This process will need to at least identify situations where a unit is commissioning, has been unavailable for a long period of time and/or the measuring equipment is unavailable.

In addition there may be a need to include a financial incentive each time a unit fails to perform when called upon to do so. The immediate impact of these incentives are more effective in focussing the attention of some service providers and particularly necessary for units which have moved into a region of unreliable performance.

A key enabler in successfully monitoring the provision of system services, particularly the proposed new services, will be the availability of high resolution data (such as that provided by high-speed disturbance recorders) at the service provider locations. This is being progressed as part of a separate DS3 workstream.

Units that are more available for a system service provision compared to other units, should receive higher rewards (notwithstanding that the value of the service to the system in theory may vary from time to time). Specific system service availability declarations that are audited are the ideal way to determine availability payments for distinct system services. However, these are limited in number without significant new processes and possible logging systems in control centres and generator control offices. Thus where there is no easily obtained system service availability declaration that is robustly audited then the energy availability can be substituted as a proxy. In essence when the unit was available for energy it is deemed available for the system service.

Finally the capability of performance is another key determinant. In this regard the TSOs consider that where a unit is contracted for a higher capability there should be a proportionate increase in reward.

5.5 Contractual arrangements

There are multiple mechanisms for contracting including clearing markets, auctions, tenders and fully regulated bilateral contracts. In theory, where there is liquidity and competitive structures, the TSOs support more market-based mechanisms for determining the value of the service. However, there are concerns that the Ireland and Northern Ireland power system may not be sufficiently large to allow truly competitive system services markets to develop. Therefore it is unlikely in the near future that system services could be usefully obtained through market structures as the relatively small size of the market precludes competition in these.

Tenders are also an efficient mechanism to establish a market in products. Unfortunately some of these services themselves will be specific to small areas and are not suited to tendering. For those that are suitable in this regard it is difficult to see how participants will get a deep understanding of the true costs and implications of consistently delivering these new products. This is likely to lead to inefficient tendering processes in the first place and delays in procuring the necessary system services to meet the governments' targets by 2020.

To this end, the TSOs consider that regulated bilateral contracts between TSO and system service provider are the most pragmatic way forward at this stage of the evolution of system services in the

SEM. Building on the existing legal and contractual structures already in place, given the new nature of the proposed system services products, bilateral contracts provide a degree of pragmatic familiarity.

5.6 Eligibility of providers

The TSOs consider that any system service provider that can deliver a system service to the TSOs should be eligible for system service payments. These providers can be directly connected to the transmission system or to the distribution network and must be controllable by the TSO (or by the DSO acting as an agent of the TSO). This includes but is not limited to generators, windfarms, interconnectors, demand side units (DSU) and aggregated generator units (AGU).

However, at this time, it is not clear that distribution-connected service providers can be utilisied in respect of all system services (e.g. steady state reactive power provision). While there is agreement in principle between the DSOs and TSOs to have similar capability standards on transmission and distribution-connected generators, it is not clear if it is technically possible or desirable to achieve this. These issues are being worked through under the DS3 Grid Code workstream. Until such time as these issues have been addressed and incorporated in agreed TSO-DSO operating protocols, it is not possible to define the type and scope of system service contracts for distribution-connected generators.

6 Summary & Next Steps

The power system of Ireland and Northern Ireland is in a period of transition due to external factors which will result in a fundamental change in a number of power system components and operational characteristics. As a consequence of these changes, the TSOs have identified that a significant transformation in the composition and need for essential system services is required.

EirGrid and SONI are undertaking a fundamental review of the System Services for the power system and this paper is part of a multi-stage consultation process, within the DS3 Programme, which will ultimately lead to a decision on the way forward.

Building on earlier system studies for 2020 and consultations, the TSOs have identified that new System Services are required to facilitate the levels of renewable resources needed to meet the Governments' targets. This paper proposes new products associated with frequency control and voltage control for a power system with high levels of variable non-synchronous generation.

This paper also proposes an updated remuneration approach to system services. Providers will only be eligible to provide System Services where their capabilities meet (or exceed) the minimum Grid Code standards and remuneration should be based on three core aspects: capability, availability and performance reliability. The new approach places a significant increased focus on reliable delivery. The paper proposes bilateral contracts as the most appropriate contractual arrangement and outlines the TSOs views on eligibility of providers.

As part of the current consultation, an industry forum will be held (during the consultation period) where the new products and financial arrangements developed in this paper will be presented. The TSOs will then consider all responses received to the current paper and will develop proposed recommendations for the SEM Committee, which will be issued for consultation in Q3 2012. The third System Services consultation will provide a further opportunity for the industry to comment on the proposed products. It will also include details of the financial aspects and seek views on a range of possible remuneration levels to service providers and costs to consumers. Following a review of the responses to this third consultation, the TSOs will submit of a set of final recommendations to the SEM Committee; the SEM Committee has indicated its intent to publish a decision on these by end 2012 / early 2013.

7 Responding to the consultation

While views and comments are invited regarding all aspects of this document, the TSOs are particularly interested in your views on the proposed new products, the remuneration approach and contractual arrangements. A questionnaire template has been prepared to facilitate responses.

Responses should be sent to:

DS3@eirgrid.com or DS3@soni.ltd.uk by Friday 3rd August 2012

It would be helpful if responses are not confidential. If confidentiality is required, this should be made clear in the response. Please note that, in any event, all responses will be shared with the Regulatory Authorities.