PPA energy

Planning Energy
for a Sustainable World

Ofgem Electricity NIC Year 1 Evaluations

Visualisation of Real Time System Dynamics using Enhanced Monitoring (VISOR)

Final Report with Addendum

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Explanatory Note

This report, including the "traffic light" indicators that reflect issues of concern identified during the evaluation process, (other than Section 10) is based on:-

- the original full submissions that were received from SPT in August 2013;
- subsequent question responses through the formal written question process;
- discussions held at meetings between SPT and the Expert Panel and/or PPA Energy; and
- factual corrections provided by SPT.

In October 2013 SPT was given an opportunity to submit revised proposals. The traffic light indicators and the metrics shown in Sections 1 to 9 have not been changed to reflect any changes made by SPT in these revised submissions.

Section 10 of this report contains an addendum, which summarises changes made between the original and revised submissions, and the impact this has on the evaluation of the project against the criteria. Any significant changes to figures/metrics are noted in this addendum.

Project Summary

Full name:	Visualisation of Real Time System Dynamics using Enhanced Monitoring	Short name:	VISOR
		Total cost (£000):	£7,437
Network Licensees group:	Scottish Power Transmission Ltd (SPT)	NIC funding request (£000):	£6,550
The Problem(s):	Monitoring in the GB transmission system is currently based on unsynchronised measurements retrieved from substations and displayed in the control room. SPT claims that the increasing amount of new technology connected to the grid (such as wind generation, HVDC, and series compensation) may put the reliability of the network at risk through the occurrence of Sub-Synchronous power Oscillation (SSO), of which the UK currently has "very limited visibility" which may, if not addressed, impair the ability to plan investment in a timely and effective manner. SPT claims that savings can be made through improved visibility of the network using synchronised measurements to enable stability margins to become enhanced and dynamic, particularly at the B6 boundary connecting Scotland to England which has constraint costs ranging between £80m-£130m per annum.		
The Method(s):	To implement a suite of applications and supporting infrastructure of Phasor Measurement Units (PMU) and Sub-Synchronous Oscillation (SSO) Measurement Units to: • Develop a better understanding of the national dynamic performance of the Grid, including investigation into SSO activity; • Enhance and validate existing power system models using time-synchronised measurement data.		
The Trial(s):	The project will: • Install new PMUs and SSO devices at locations throughout GB		

	covering all three transmission operator (TO) regions; • Establish a centralised Wide Area Monitoring System (WAMS) server to collect data from all three TOs, as well as installing a WAMS server in the Scottish Hydro transmission area (SHE); • Conduct phasor data analysis and model validation simulations using PMU data, led by the University of Manchester (UoM); and • Trial a hybrid state estimator that integrates PMU data with the SCADA (System Control and Data Acquisition) system.
The Solution(s):	SPT claims that the tools demonstrated in VISOR will enhance control-room monitoring to provide: • Better understanding of the state of the network by reducing model and measurement uncertainty; and • Better visualisation for control operators and network planners with more accurate models and historical data. SPT also assert that, as a consequence, VISOR will: • Improve network efficiencies through released network capacity as a result of system constraint enhancements (£4m per annum saved in operational costs at B6); and • Reduce and defer investment costs through more informed knowledge of dynamic performance and stability limits (avoided investment benefit of £45m for every 100MW capacity released).
Key strengths and weaknesses against the criteria	Strengths: • Enhances existing modelling tools through the provision of more accurate network data. • Better understanding of stability margins leading to more

	efficient use of constrained circuits. • Reduction in constraint payments relating to B6 boundary. • Investigates the early warning signs of SSO of which there is currently limited visibility. Weaknesses • Cost benefits are speculative based on estimated capacity release. • There is a substantial project management overhead introduced through the complex interactions of the TOs and the Great Britain System Operator (GBSO – a role undertaken by National Grid (NGET)) in the project, the need for which requires review. • There is insufficient evidence of a formal commitment by the University of Manchester to provide staff to support the project. • The risk mitigation activity around the investigation of SSO borders on a business-as-usual activity for a prudent system operator.

1 Summary of Assessment against Evaluation Criteria

Criteria	Overall Assessment	
(a) Low carbon and benefits		The project has the potential to contribute significantly to the development of the low carbon energy sector, by demonstrating technology that can be applied to increase the capacity that can be utilised across constrained interconnectors in the transmission system. This is particularly relevant for the Scotland-England interconnection, given the concentration of offshore wind generation connecting to the network in Scotland. The scale of the financial benefits claimed in the transient stability related part of the project is reasonable, based around a £4m reduction in the annual constraint costs on the B6 Scotland-England boundary (currently running at around £130m per year), and avoided costs of £28.4m per 100MW of extra transmission capacity. Linking the project directly to a potential saving of the £30bn estimated cost of a system shutdown that may arise in the event of unmitigated dynamic instability is less credible however. A key issue concerning the realisation of the benefits arises from the fact that the VISOR project is not going to be integrated into the operation of the GBSO during the project lifecycle. The constraint related benefits to be demonstrated will remain at the theoretical level, until such time as SO business processes are changed to accommodate the techniques being demonstrated in the project.
(b) Value for money		The benefits of the project clearly flow to users of the transmission network in the form of potential reductions in use of system costs, arising from reduced investment requirements and lower constraint costs.

		The level of project management and support resources required in the project appears excessive, at 17 person-years of input, and the need for full-time equivalent project managers from each of SPT, SHE and NGET is highly questionable. The extent to which this is the result of the project being led by a TO rather than the GBSO has been questioned and the consortium has responded with a detailed explanation of the clear need for significant interaction between the three organisations irrespective of which company leads the project. Concerns remain about the efficiency of the project leadership structure, however, and the clarity of roles and responsibilities of the Project Lead and the Project Co-leads. Potentially inefficient communication within the GBSO has been cited as a part of the justification for a full-time coordinator being dedicated to the project from the GBSO. The need for a full-time knowledge dissemination co-ordinator has been justified by the consortium on a bottom-up basis and then rounded upwards. In some areas the time allocations appear generous, and given the level of knowledge already in the public domain regarding the application of PMUs and WAMS at the transmission level, the consortium should ensure that knowledge dissemination activity is focused on the learning that is specific to the outcomes of this project. Reasonable procedures appear to have been adopted for deriving project costs, although there are significant areas of uncertainty in final hardware costs associated with IT which should be tied down more accurately.
(c) Generates knowledge		The project aims to collect phasor measurements from all three TOs and use this information to validate and improve existing power system modelling tools, providing the TOs with better understanding of stability limits and dynamic

		behaviour, and more accurate network models. VISOR has the potential to generate knowledge that can be used by network licensees to better inform the Services Capability Specification (the requirement of "The System Operator Transmission Owner Code" under which TOs submit information about asset capability to the GBSO). This would be assisted by the development of more accurate system models, data and parameters enabling network utilisation to be maximised and consequently reduce constraint costs. The requirement for a full time Knowledge Dissemination Coordinator is somewhat questionable, since there is a limited amount of novel technological development being undertaken in the project on a continuous basis. Significant knowledge will be generated by the academic partner, responsible for testing, validating and improving the models, through a 'closed-loop' operation using a Real Time Simulator but concerns have been raised regarding the robustness of the University of Manchester's resource commitments.
(d) Is innovative		The complexity of this project presents a challenge in assessing its innovative merit. VISOR contains elements of innovation yet involves a certain degree of business as usual, trialling a combination of commercially available products and additional functionality developed as part of the project into a unified system to explore and demonstrate the operational and commercial benefits to the GBSO and TOs. The heart of the innovation of this project is in demonstrating the applications of phasor and SSO measurements within system operation and planning but the benefits are somewhat speculative given the technical complexity of assessing the likely improvements in system

		performance that could be achieved ahead of conducting the trial itself. This is particularly true in the case of SSO detection, where it is only by deploying measuring equipment that the potential existence of SSO can be determined. Whilst there is considered to be sufficient risk associated with the achievement of the network benefits suggested by the project to warrant a demonstration project being implemented, the innovation in the project arises primarily from the application of relatively established technology to the GB system. New techniques will, however, be developed for assessing boundary capacities using PMU data and seeking to identify the location of SSO sources.
(e) Partners and Funding		The involvement of UK transmission and system operators is a necessity given the nature of the VISOR project. Whilst letters of support are included from SPT, SHE and NGET in its capacity as a TO and an SO, there is concern that there is no financial contribution explicitly stated from the project partners other than SPT. Whilst in-kind contributions totaling £274k are reported by the consortium, these relate to pre-project tendering support from SHE and NGET, and post-project support and hosting of a testing platform by the University of Manchester. SPT has also stated that in-kind support will be sought from the WAMS supplier, with a stated target of £0.5m of funding. There are concerns regarding the lack of evidence surrounding any formal agreement of the University of Manchester to provide a suitable research associate to carry out the required analytical work. The consortium demonstrates a strong level of engagement with equipment suppliers and service providers active in the field of WAMS.

(f) Relevance and timing		The project can potentially make a significant contribution to overcoming obstacles to a future low carbon economy, particularly through the reduction in transmission constraints. The wider significance of the scheme in overcoming low carbon barriers will depend on the geographical location of significant new renewable generation installations in relation to constrained parts of the transmission network, although SPT has identified two potential regions with significant network constraints that could be targets for the further roll-out of the solution. A combination of the application of series capacitors on the network in 2014/15, the introduction of the Western HVDC link and the rate of change of the generation mix on the GB network support the timing of the project. The techniques demonstrated in the project are broadly applicable to giving an increased understanding of the performance of the transmission network, and not solely dependent on the uptake of renewable generation sources.
(g) Methodology		The project is technically feasible and has measures in place to address the complex technical tasks to be undertaken. The key challenges within the project relate to the detection and analysis of the phenomena which are vital to enabling system performance to be improved. The main risks identified in the project arise from the complexity of the stakeholder interactions required and the project management effort needed. This has converted into a very high budget allocation for project management time, however, which threatens the value for money of the project as a whole. Other risks exist in the form of potential delays to the project and cost over-runs. SPT appears to have adequate measures in mind for addressing these. The risk that the University of Manchester may be unable to recruit and retain

		the required Post-Doctoral Research Associate is noted, however reasonable evidence has been supplied that a pool of appropriate technical expertise exists within the university to support the project. The project management structure appears adequate, albeit with a very high level of resources involved, but the project management plan requires a higher level of definition.
Successful Delivery Reward Criteria (SDRC)		The SDRCs are generally appropriate and the evidence required is in each case linked to a specific Work Package and month of delivery.

The "traffic light" system used in the table above gives an indication of PPA Energy's assessment of the information provided by the Network Licensee in support of the project in respect of its detail, alignment with the NIC evaluation criteria as specified in the Electricity NIC governance document, identification and management of project risks and other aspects for each of the criteria. This is not intended to suggest whether projects should be funded or not but to point out those areas which PPA Energy believes merit particular scrutiny or consideration. Thus:-

	• Seems to be generally in line with the objectives and requirements of the NIC evaluation criteria, • Whilst there are some areas where additional information would be useful, that provided is generally comprehensive and provides no immediate cause for concern.
	• Some indication that the project is in line with the objectives and requirements of the NIC evaluation criteria. However, further scrutiny is required to ensure this, • There are some gaps in the information provided, • Further assurance is needed to confirm that the project is viable and that risks are appropriately managed.
	• Significantly more assurance is required that the project is in line with the objectives and requirements of the NIC evaluation criteria, • There are some major gaps in the information provided, • Considerable scrutiny is needed to confirm that that the project is viable and that risks are appropriately managed,

	• Potential major risks to the viability of the project.

In the following evaluations against the criteria, if the project is addressing various problems and/or trialling several methods and solutions, separate analysis of metrics and sub-criteria will be provided, if appropriate, for relevant criteria.

2 Criterion (a) Low Carbon and Benefits

Criterion:	Accelerates the development of the low carbon energy sector and/or delivers environmental benefits whilst having the potential to deliver net financial benefits to future and/or existing Customers.
Overall assessment:	The project has the potential to contribute significantly to the development of the low carbon energy sector, by demonstrating technology that can be applied to increase the capacity that can be utilised across constrained interconnectors in the transmission system. This is particularly relevant for the Scotland-England interconnection, given the concentration of offshore wind generation connecting to the network in Scotland. The scale of the financial benefits claimed in the transient stability related part of the project is reasonable, based around a £4m reduction in the annual constraint costs on the B6 Scotland-England boundary (currently running at around £130m per year), and avoided costs of £28.4m per 100MW of extra transmission capacity. Linking the project directly to a potential saving of the £30bn estimated cost of a system shutdown that may arise in the event of unmitigated dynamic instability is less credible however. A key issue concerning the realisation of the benefits arises from the fact that the VISOR project is not going to be integrated into the operation of the GBSO during the project lifecycle. The benefits to be demonstrated will remain at the theoretical level, until such time as SO business processes and SCADA equipment are changed to accommodate the techniques being demonstrated in the project.
Metrics (where available):	
Net financial benefit (£)[1]:	£18,700,000

[1] The financial benefit of each method (at the trial scale) compared to the most efficient existing method; **Net financial benefit = Base case costs** (the lowest cost of delivering the Solution (on the scale outlined as part of

Carbon benefits (for example in £/tCO2) [2]:	Not specifically calculated for the project.
Network capacity released (kW)[3]:	50,000
Base case time to release capacity (months)[4]:	30
Method time to release capacity (months)[5]:	18
Potential for replication[6]:	2 boundaries (up to 2020)_

Sub-criteria	**Assessment**
Carbon claims (including quantitative analysis,	The carbon benefits associated with the project are described largely in terms of the generic benefits that result from the ability for larger quantities of renewable generation (principally offshore wind) to be accommodated by the

the project) which has been proven on the GB Transmission Systems) – **Method costs** (the costs of replicating the method at the trial scale once it has been proven successful)

2 The Carbon benefits that have been claimed by the application of each Method.

3 The network capacity released by each method (the additional headroom released on the transmission system following implementation of the Method)

4 The time it would take in months to deliver the capacity shown in "Network capacity released" under the Base Case

5 The time it would take in months to deliver the capacity shown in "Network capacity released" using the replicated Method

6 The estimated number of sites or % of the GB Transmission System where the method could be rolled out, up to 2040

if provided)	network. This will offset electricity production from fossil-fuelled sources, assuming that sufficient transmission capacity exists to transfer the energy generated southwards across the constrained Scotland/England transmission boundary. The only quantitative analysis provided compares estimates by the Scottish Government and Scottish Renewables of the saving in carbon production achieved from a 134MW windfarm[7] and the carbon production of the Longannet thermal power station. These calculations are somewhat generic and are not specifically tied to the estimated transmission capacity improvement achievable on the Scotland-England transmission boundary. SPT presents a graph from the Electricity Network Strategy Group (ENSG) Update Report on the B6 Boundary from February 2012 which demonstrates the significant need for additional transmission capacity on the Scotland-England border to enable greater quantities of renewable generation to be connected. The ability to increase the transfer capacity on this border by improving the accuracy with which stability margins can be assessed and enabling additional output from renewable generation without incurring significant construction of new transmission assets will undoubtedly make a positive contribution to the speed with which carbon reduction can be achieved.
Environmental benefits	No explicit reference is made to any environmental benefits associated with the project.
Robustness of financial benefits	The Business As Usual case is based on a top down calculation of the cost of the capacity released by the Western HVDC link project. Whilst HVDC has a significantly higher cost per MW than conventional AC transmission schemes, this comparison is reasonable across the boundary in question. HVDC cable projects have been identified as the most economic conventional means of increasing the boundary capacity given planning constraints that restrict new transmission line construction and the anticipated volume of offshore renewable generation that can be expected over the next decade.

[7] http://www.scotland.gov.uk/Publications/2008/06/25114657/15

	The cost of an HVDC scheme to release 100MW of capacity is calculated as £44.4m. This compares with a cost estimate of £16m assumed for a VISOR implementation capable of releasing 100MW, which is a scaling of the £8m project cost for a 50MW capacity release (see below). It can be argued therefore that the avoided investment cost for 100MW capacity release is more accurately the difference between the HVDC cost and the VISOR cost, which gives £28.4m per 100MW. The robustness of this estimate is highly dependent on VISOR achieving a 50MW improvement in transfer capacity on the existing link; SPT considers this to be a conservative estimate for the improved transient stability margin that is achievable with more accurate network information. Whilst there is some evidence present from international literature to support this claim, the case is reasonably made that exploring this issue further can only be achieved by means of making measurements on the system in the project itself. The financial case for pursuing the sub-synchronous oscillation element of the work is less clear. SPT builds the case for the SSO element of the project on the basis of risk mitigation, citing the contribution that SSO makes to the risk of system collapse leading to a black start situation, and avoided investment in active damping equipment. A high-level calculation is presented showing an economic impact to Great Britain of £30bn in the event of system collapse, based on the value of lost load calculated in a recent study for Ofgem and DECC. Whilst this may theoretically be true, caution is required in allocating the saving of a three-day full system collapse to the VISOR project. The "insurance" aspect of understanding a potential major technical contributor to a system collapse is recognised, however it is recommended that the £30bn benefit is disregarded for the purposes of evaluating the project. Other financial benefits stated include maintaining utility reputation avoiding negative impacts on share prices, reducing customer bills by reducing constraint costs (a potential reduction of £4m in the cost of the constraint mitigation on the B6/Cheviot boundary is quoted), reduced internal labour costs for post-disturbance analysis, and opportunity cost reductions for generators in the event that precautionary reductions in plant output in the absence of detailed information about SSO

	problems can be avoided. The potential benefits can be summarised as follows. Those to the TO (which flow to customers eventually through lower system charges) are avoided investment cost through provision of incremental capacity and the risk mitigation of unstable system oscillations whilst benefits to the GBSO and to customers are reduced constraint costs.
Capacity released (if applicable)	The project is aimed at resolving the significant transmission constraint on the B6 boundary (between Scotland and England). The techniques proposed have the potential to contribute to constraint relief elsewhere. However the ability to replicate the approach has yet to be fully explored. SPT claims that 50MW of capacity on the Scotland-England border will be released by the method, and notes that it believes this to be a conservative estimate. It is further stated that an assumption that this is applicable for 50% of the time leads to a financial saving of £4m per annum. The basis for this calculation has been reviewed, and this is considered robust and relatively conservative. The 50MW figure is compared by SPT to the overall capacity of the B6 boundary, indicating that it represents a 1% improvement in the transfer capacity. This arises primarily from the potential ability to run the system closer to the transient stability margin through improved visibility and understanding of the operating point of the network and its physical constraints than is currently the case. SPT reasonably makes the case that to quantify this 1% improvement with greater confidence would require considerable network modelling activity. Achieving in excess of a 1% improvement in measurement accuracy is cited as possible in other reference literature. It should be noted however that this capacity release is only going to be demonstrated as a theoretical possibility by this project. The VISOR project performance and outputs will not be incorporated in the operating practices of the GBSO during the trial period.
Replication	The potential for replication of the project is closely linked to

	the location of key constrained transmission routes and the placement of PMUs in strategic locations to enable the stability margin across the relevant constraints to be assessed. The need for replication also depends on the extent to which in the initial deployment the WAMS will capture information from across the transmission network in a manner that makes the assessment of other constrained areas of the network possible. SPT have indicated that GB-wide measurements of the existence of SSO will be possible using the proposed trial, although more equipment would need to be deployed to give a comprehensive capability to locate the source of SSO. Specific additional deployments would be necessary to facilitate monitoring the transient stability situation across the network in the southern half of England. SPT have indicated that one additional replication is conceivable across a second network boundary over the period to 2020.

3 Criterion (b) Value for Money

Criterion:	Provides value for money to electricity transmission customers
Overall assessment:	The benefits of the project clearly flow to users of the transmission network in the form of potential reductions in use of system costs, arising from reduced investment requirements and lower constraint costs. The level of project management and support resources required in the project appears excessive, at 17 person-years of input, and the need for full-time equivalent project managers from each of SPT, SHE and NGET is highly questionable. The extent to which this is the result of the project being led by a TO rather than the GBSO has been questioned and the consortium has responded with a detailed explanation of the need for significant interaction between the three organisations irrespective of which company leads the project. Concerns remain about the efficiency of the project leadership structure, however, and the clarity of roles and responsibilities of the Project Lead and the Project Co-leads. Potentially inefficient communication within the GBSO has been cited as a part of the justification for a full-time coordinator being dedicated to the project from the GBSO. The need for a full-time knowledge dissemination co-ordinator has been justified by the consortium on a bottom-up basis and then rounded upwards. In some areas the time allocations appear generous, and given the level of knowledge already in the public domain regarding the application of PMUs and WAMS at the transmission level, the consortium should ensure that knowledge dissemination activity is focused on the learning that is specific to the specific application of the technology in this project. Reasonable procedures appear to have been adopted for deriving project costs, although there are significant areas of uncertainty in final hardware costs associated with IT which should be tied down more accurately.
Metrics (where available):	

Size of benefits to transmission system[8]	A £4m reduction in constraint costs per annum is quoted by SPT, arising from an estimated 50MW improvement in the transfer capacity on the B6 Scotland-England boundary.

Sub-criteria	**Assessment**
Proportion of benefits attributable to transmission system (as opposed to elsewhere on supply chain)	The majority of the benefits of the project flow to users of the transmission system, in the form of: a) reduced transmission network use of system (TNUoS) charges due to more efficient use of transmission assets and a reduced requirement for network investment; and b) reduced constraint costs, which are recovered through the costs of the balancing mechanism and arise due to the need to run more expensive generation than would ideally be operated due to technical limitations on the transmission system. The ability to accelerate generation connections is also claimed, as a result of a reduced need for extensive studies of sub-synchronous oscillation problems. It is not entirely clear the extent to which these studies are incorporated into existing planning practice, but as the potential SSO problem grows, the potential for delaying generation connections to carry out the required analysis in the absence of measurements also increases. In addition, improved monitoring of system stability would enable transmission investment to focus on the most effective strategies for mitigating the effects of instability.
How learning relates to the transmission system	The learning developed in the project is directly related to the needs of both TOs and the GBSO. Transmission operators are responsible for accurately determining the limitations on the capacity of the transmission assets that they make available to the SO for operating the system. They are also responsible for decisions as to the appropriate assets to add in order to increase network capacity. These decisions are taken in conjunction

[8] Size of benefits attributable or applicable to the Transmission System versus elsewhere

	with the planning processes coordinated by the SO, to ensure that the requirements of transmission users are accurately predicted. The VISOR project has the potential to reduce significantly the investment costs associated with alleviating transmission constraints, by providing greater visibility of the stability margins that exist in transient conditions, and potentially visualising the effects of SSO on the system. Given the level of benefit that could accrue to transmission system users through the deployment of, particularly, the PMUs and the WAMS for monitoring system stability, and recognising that the core PMU technology is well established and deployed internationally, the question of why this project should not form "business as usual" for, particularly, the SO, arises. NGET has claimed that PMU-based investment was disallowed from its price control allowance during the RIIO-TI review process as being an area in which too much innovative work was required; however, the innovation at the heart of the VISOR project, which relates primarily to the drawing together and processing of synchrophasor information into a centralised system, is directly relevant to the provision of a safe and reliable transmission system, which is a core licence objective of the TO and the GBSO. A key requirement if this project is funded should be for the rapid implementation of decision-making within normal business processes based on the enhanced information that becomes available.
Approach to ensuring best value for money in delivering projects	There are concerns about the extent to which value for money is being achieved in the project, given the structure of the project and the complex interaction of the TOs and the GBSO that will be required within it. The amount of project management time devoted to the project has been raised as a concern, since it totals approximately 17 person years of input and includes a full time equivalent staff member from each of SPT, SHE and NGET engaged in project management and support. The consortium is understood to have debated an obvious issue, that of whether the GBSO is actually the most appropriate organisation to run the project. The interactions between the SO and the TOs are complicated and governed by the requirements of the System Operator Transmission Owner Code (STC). This places a range of obligations on the SO and TOs, and restricts the extent to

	which data obtained by the SO from generators and other parties can be shared with the TOs. Whilst it is recognised that whichever licensee leads the project, there would be significant interactions between the organisations required, the current level of resource devoted to project management appears excessive. The project partners have agreed to review this. The project will make use of the 16 PMUs that are currently installed on the GB system. A further 11 are to be added within the scope of the project. The project draws on recent experience in North America where large-scale WAMS projects have been implemented; whilst this raises questions about the extent to which the learning on the project is innovative, SPT stresses that it is in the bringing together of PMU and SSO monitoring data in an integrated platform, with the associated analysis, that the key innovation and therefore value lies. Anecdotal evidence suggests that there are challenges wherever PMUs are deployed in being able to process the information they provide in ways that leads to operational benefits. The role of the WAMS provider in providing software that will facilitate the analysis of measurements to draw meaningful conclusions about transient stability margins will therefore be crucial. A competitive tendering approach is to be used to identify this supplier, and a strong technical evaluation process will be required to ensure that an appropriately qualified organisation is appointed. The process by which the academic partner was selected has been suboptimal, in that there was little response from the academic community to a call for expressions of interest in the project initially. The University of Manchester was initially the only institution to respond to the call; whilst other universities became more interested later, the timing of the project formulation was such that they were too late to be considered. Whilst the University of Manchester appears well qualified for the required activity, the project may have benefitted from greater engagement of other institutions in the process.
Identify and review major cost items, examine justification for relevant costs, assess choice of	The major cost items in the project comprise the following: Partners' labour costs: [redacted] Contractor costs: [redacted] IT costs: [redacted] Equipment costs: [redacted]

discount rates	The partners' labour costs represent some 27 person-years of effort, and the contractor costs include the time for the WAMS supplier. Daily rates for labour on the project are charged as follows: WAMS Supplier = [redacted] day; TOs = [redacted] day; Academic = [redacted] per day. These rates are not unreasonable, given the specialist skills required. Of more concern is the total level of person-time included in the project. The partners have allocated a total of 17 person-years to project management, which, as noted above, is an issue in terms of value for money. Cost estimates appear to have been obtained via a rigorous process, and PMU equipment prices quoted by a supplier have been checked with public domain information. WAMS costs have been obtained from one supplier and checked against another, and other costs have been benchmarked against previous innovation projects and tendering processes. The contractor costs contain both time and equipment costs for the WAMS supplier and Academic Partner, and include a sum of [redacted] contractor costs associated with the implementation of a standalone hybrid state estimator separate from the existing operational Energy Management System. This is based on an estimate from a SCADA manufacturer that has been cross-checked with another supplier. An area of concern in relation to the capital costs relates to the required Phasor Data Concentrator equipment, the cost of which SPT notes ranges from [redacted] depending on the specifications and the IT implementation. The impact of this degree of price variation could be significant, however it is understood that the upper value has been incorporated into the project costings. The overall contingency allowance for the project, of 4%, is somewhat lower than may be expected given the uncertainty in some areas of project cost.

4 Criterion (c) Generates Knowledge

Criterion:	Generates knowledge that can be shared amongst all relevant Network Licensees.
Overall assessment:	The project aims to collect phasor measurements from all three TOs and use this information to validate and improve existing power system modelling tools, providing the TOs with better understanding of stability limits and more accurate network models. VISOR has the potential to generate knowledge that can be used by network licensees to better inform the Services Capability Specification (a requirement of "The System Operator Transmission Owner Code" under which TOs submit information about asset capability to the GBSO). This will be assisted by the development of more accurate system models, data and parameters enabling network utilisation to be maximised and consequently reduce constraint costs. The requirement for a full time Knowledge Dissemination Coordinator is somewhat questionable, since there is a limited amount of novel technological development being undertaken in the project on a continuous basis. Significant knowledge will be generated by the academic partner, responsible for testing, validating and improving the models, through a 'closed-loop' operation using a Real Time Simulator but concerns have been raised regarding the robustness of UoM's selection and its resource commitments.
Metrics (where available):	
Conforming to default IPR arrangements:	Yes

Sub-criteria	Assessment
Potential for new/incremental learning to be generated by the project	Power oscillations pose a significant risk within an electricity network that can result in equipment damage and the loss of supply. With the increasing penetration of new technologies on the GB transmission network, such as series capacitors and power electronics, it is feasible, if not likely, that new oscillations arise between these complex technologies. SPT claims that there is a potential risk that new oscillations may arise at frequencies beyond the scope of existing PMU monitoring devices and would therefore go undetected without intervention. VISOR aims to trial SSO monitoring on the GB transmission network, intent on delivering the first implementation of SSO monitoring up to 45Hz. SPT states that this is the first solution of its kind, and as such should provide the industry with new learning that is globally applicable. Through the deployment of a GB-wide WAMS the project partners will gain new knowledge relating to: • design, testing and operation of the GB-WAMS along with its limitations; • validation and, where applicable, improvement of power system models; • establishing parameters for transient stability performance and network risk identification. Overall implementation of the GB-WAMS will ultimately build experience and confidence in the potential for employing phasor measurements as part of a tool for system planners and operators to improve understanding of the dynamics of the network and potentially increase effective utilisation and reduce risks.
Applicability of learning to other Network Licensees	The project involves participation of the three onshore network licensees which are expected to share the following knowledge outcomes: • Demonstration of applications for both TO and SO

	roles, including o Monitoring asset performance, particularly dynamic performance and compliance with technical standards; o Model validation and identifying locations of sources of deviations from modelled parameters; o Approaches to increasing asset utilisation. • Procedures and outcomes of base lining system performance and risk identification. The most probable and profitable learning points for the TOs will come from the modeling and analysis of the phasor data which, if successful, would demonstrate the possibility of increasing network efficiency and potentially delay reinforcement requirements. Applications successfully developed for the VISOR WAMS which facilitate better understanding of actual dynamic system performance and stability could be deployed on individual TO WAMS following the project conclusion, regardless of whether the GBSO adopts a national roll-out. SPT acknowledges that whilst the primary beneficiaries of VISOR are the TOs and GBSO, there are potential benefits for Offshore Transmission Owners (OFTOs). However, SPT does not demonstrate that the OFTOs have been consulted at this stage. In a global context, the findings of the SSO analysis could provide significant learning for the wider electricity community and a system capable of detecting and locating as yet unknown oscillations would have a potentially very large market.
Proposed IP management and any deviations from default IP principles	No foreground IPR is anticipated to be developed that will fall outside the default IPR requirements. SPT does however highlight that suppliers may wish to fully contribute certain Solution Development Costs (for example,

	the development of a new software application or extension of an existing one), in order to retain the resulting IPR.
Credibility of proposed methodology for capturing learning from the trial and plans for disseminating	The project has identified the transfer of knowledge amongst the project partners and the global community as an integral feature of VISOR and proposes a dedicated full-time Knowledge Dissemination Coordinator (KDC) assigned to the knowledge dissemination work package for the duration of the project. The knowledge dissemination work package involves internal and external dissemination, addressing policies and standards, and public engagement but the role of the KDC has only been described at a high-level. With regard to internal dissemination, the KDC is expected to liaise with related relevant TO projects. However, in regard to external dissemination, the academic partner is stated as being responsible for capturing real-time system knowledge and sharing this with the wider community, via academic papers and industrial reports. The role of the KDC in external dissemination is not fully described. Furthermore, it is unclear whether the KDC will be involved in assisting in reviewing technical reports, producing the project progress report (WP5.4), maintaining the online portal or organising workshops. When considering the degree of overall project management proposed in this project, as addressed in section B, there are concerns that the requirement for a full-time KDC may be overstated. The justification for this has been presented by the consortium on a bottom-up basis and rounded upwards from a task by task analysis. Some of the time estimates associated with reporting and workshop preparation appear generous, however, and the consortium should ensure that the inputs of the KDC are clearly focused on the learning from the specific outcomes of this project. The end objective of the project is to trial the operation of phasor measurements and integrated SSO monitoring and associated applications, and to demonstrate technical feasibility and business benefits to the System Operator before techniques

	can be fed into a National Roll-Out plan, speculated to be around 2020-2022. SPT has conveyed confidence and dedication to delivering satisfactory knowledge dissemination to the GBSO.

5 Criterion (d) Is Innovative

Criterion:	Is innovative (ie not business as usual) and has an unproven business case where the innovation risk warrants a limited Development or Demonstration Project to demonstrate its effectiveness.
Overall assessment:	The complexity of this project presents a challenge in assessing its innovative merit. VISOR contains elements of innovation yet involves a certain degree of business as usual, trialling a combination of commercially available products and additional functionality developed as part of the project into a unified system to explore and demonstrate the operational and commercial benefits to the GBSO and TOs. The heart of the innovation of this project is in demonstrating the applications of phasor and SSO measurements within system operation and planning but the benefits are somewhat speculative given the technical complexity of assessing the likely improvements in system performance that could be achieved ahead of conducting the trial itself. This is particularly true in the case of SSO detection, where it is only by deploying measuring equipment that the potential existence of SSO can be determined. Whilst there is considered to be sufficient risk associated with the achievement of the network benefits suggested by the project to warrant a demonstration project being implemented, the innovation in the project arises primarily from the application of relatively established technology to the GB system. New techniques will, however, be developed for assessing boundary capacities using PMU data and seeking to identify the location of SSO sources.

Sub-criteria	**Assessment**

Justification that the project is truly innovative	The project proposes two main technological developments: 1. Introduction of a centralised GB-wide Wide Area Monitoring System (WAMS), collecting PMU data from three TO WAMS, 2. Installations of novel SSO devices capable of analysing a broader frequency range (10-45Hz), locating the source of oscillation and communication of this information to the WAMS. However, SPT states that the main innovation in this project relates to the control room applications and analysis of the data collected by the centralised WAM server, rather than the hardware itself (excluding the associated IT equipment) which is mostly commercially available and only represents 5% of the total project cost. The GB-wide synchronised phasor measurements will be used for power system model validation of the B6 boundary, in particular to: • Validate and improve existing power system models, • Assess and improve dynamic stability limits, • Develop WAMS applications to demonstrate visualisation and alarming, • Inform a newly developed (as part of VISOR) hybrid state estimator. Conventional PMU data is already collected by the WAMS but the angular measurements are currently only used for accurate system measurements rather than the tasks of assessing stability margins to feed into a hybrid state estimator. Global examples of hybrid state estimator implementation are rare; however SPT has shown examples where they have been implemented to good effect. SPT claims that the use of PMU data in system operation is an innovative means of increasing transfer capacity as opposed to the conventional approach which is to invest in infrastructure.

	This is a reasonable assertion. The SSO monitoring will examine a frequency range beyond the scope of existing PMU devices and trial the integration of these devices into the network operation and planning process as a risk mitigation tool against potential new oscillations as a result of interactions between series compensation, wind generation and power electronics. Existing SSO devices operate only as local protection devices and do not process or communicate the SSO data in any way. VISOR includes the trial of enhanced SSO devices capable of detecting power oscillations between 10-45Hz, beyond the 0-10Hz scope of existing devices, and communicates this information to the WAMS server for further processing and oscillation source location. Oscillation source location is a new invention; it has been used off-line in consulting services with phasor measurements, but will be deployed in a real-time environment on VISOR to aid system-health monitoring. As such devices are not commercially available a technical functional specification of the desired SSO is included in the project proposal, the supply of which is to be tendered.
Justification that NIC funding is required and credibility of claims	SPT highlights that the conventional approach to accommodate new generation would involve investment in infrastructure but, with increasing volumes of wind generation causing more volatile power flow, an innovative approach has been proposed to accommodate the technological change. The alternative approach employs a centralised GB-wide WAMS to offer insights into the capability and dynamic performance of the transmission system. This is intended to demonstrate to the system operator the viability of utilising the full capacity of the network and provide the ability and confidence to do so. The claims that the network could be run at higher levels of performance if transient stability and the impact of SSO can be assessed more accurately appear reasonable, based on the international examples quoted and the technology that is proposed for investigation. The ability to predict accurately the

	impact of the technology in the GB system and to assess its overall applicability is a key part of the learning on the project, and the points made by SPT in the clarification process regarding the difficulty of assessing the potential impact of the project analytically are reasonable.
Identification of project specific risks (including commercial, technical, operational or regulatory risks)	SPT has identified a key risk as the availability of the dynamic model data for use outside of NGET premises. SPT states that a 3rd party cannot receive a full GB model and the mitigating action would be for studies to be conducted on site at NGET. This risk arises through constraints imposed in the System Operator Transmission Owner Code. It is understood, however, that this issue has been addressed by the existing Non-disclosure Agreement between the University of Manchester and NGET. The largest risk to the project has been stated in discussions with the consortium to be the management of the complex range of stakeholder interactions and the overall project management of a challenging programme. SPT has identified a risk that it may be neither financially viable, nor a technical necessity, to stream SSO data from every location to the WAMS server, which in turn conducts the frequency analysis. This is referred to as the "continuous SSO" approach. SPT has identified a second approach referred to as "discontinuous SSO" that will enable low-cost use of existing disturbance recorders to provide widespread geographic coverage to supplement the continuous observability provided by the new dedicated "continuous SSO" devices. There is an underlying risk within the project that the ability to determine accurately the improvement in stability margins and to detect the existence and source of SSO will be limited. This is however a fundamental element of the project learning. As the project conducts an offline trial of technologies, no operational risks have been identified. The main regulatory risk arises from the constraints imposed by the System Operator Transmission Owner Code and the restrictions this places on information sharing. These are mitigated to some degree through the project organisational structure. However, as previously mentioned, this seems to require a substantial project

	management overhead.

6 Criterion (e) Partners and Funding

Criterion:	Involvement of other partners and external funding		
Overall assessment:	The involvement of UK transmission and system operators is a necessity given the nature of the VISOR project. Whilst letters of support are included from SPT, SHE and NGET in its capacity as a TO and an SO, there is concern that there is no financial contribution explicitly stated from the project partners other than SPT. Whilst in-kind contributions totaling £274k are reported by the consortium, these relate to pre-project tendering support from SHE and NGET, and post-project maintenance of a testing platform by the University of Manchester. SPT has also stated that in-kind support will be sought from the WAMS supplier, with a stated target of £0.5m of funding. There are concerns regarding the lack of evidence surrounding any formal agreement of the University of Manchester to provide a suitable research associate to carry out the required analytical work. The consortium demonstrates a strong level of engagement with equipment suppliers and service providers active in the field of WAMS.		
Metrics (where available):			
Total cost of project (£000):	£7,437	NIC support (£000):	£6,550 (£6,693 before adjustment for payment in the first year of the project)
Costs met by Network Licensee (£000):	£744	Costs met by others (£):	£0
NIC support (% of	90.0%	Costs met by Network Licensee	10%

total cost):		(% of total cost):	
Costs met by others (% of total cost):	0%	Number of consortium members:	3

Sub-criteria	Assessment
Appropriateness of collaborators (including experience, expertise and robustness of commitments)	Involvement of all three TOs is considered appropriate considering the proposed implementation of a GB-wide monitoring system. NGET is an appropriate collaborator as they share the B6 boundary with SPT and also since the project aims to provide evidence of VISOR viability to the GBSO before the SO can trial a roll-out into business as usual. SHE is an appropriate collaborator as they operate the region of the network with significant wind generation which is of particular interest to the model validation. The proposal includes a letter of support from SHE. SHE has been allocated a total of 540 person-days plus one further FTE in the detailed project tasks in the Project Evaluation Model which suggests they have been involved in the project proposal, although no representatives have been present at the meetings with the Expert Panel or Technical Consultants. UoM has been selected as an appropriate academic partner with sufficient experience in WAMs and has the important responsibility of carrying out an independent evaluation of equipment performance, end-to-end data exchange and knowledge dissemination. UoM are a suitable candidate considering the evidence supporting their expertise in the field of WAMS research. There are however concerns regarding the robustness of the commitments of UoM; SPT has indicated that there has been no contractual agreement entered into, but during the clarification process a letter of support from the University has been presented. The project team has acknowledged this issue but indicated no reason for concern as there is a good working

	relationship between NGET and UoM.
External funding (including level and security of external funding)	No external funding is provided in this project. Whilst in-kind contributions totaling £274k are reported by the consortium, these relate to pre-project tendering support from SHE and NGET, and post-project support of a testing platform by the University of Manchester. SPT has also stated that in-kind support will be sought from the WAMS supplier, with a stated target of £0.5m of funding.
Effectiveness of process for seeking and identifying new project partners and ideas	SPT states that the academic partner was selected on the basis that they have good experience in the field of WAMS and have a real-time simulator capable of running power system models. SPT did however state than they were the only institution to initially respond to a call for expressions of interest, which raises concerns regarding SPT's selection process. It is noted that following the VISOR selection process Brunel University and Imperial College, who also have expertise in the WAMS field, expressed interest in the project. It is unclear whether there will be opportunities for their future involvement. The project consortium has engaged with a significant number of suppliers of equipment and services relating to WAMS technology, and ran a Transmission Stakeholders Workshop to gauge interest in the project.

7 Criterion (f) Relevance and Timing

Criterion:	Relevance and timing		
Overall assessment:	The project can potentially make a significant contribution to overcoming obstacles to a future low carbon economy, particularly through the reduction in transmission constraints. The wider significance of the scheme in overcoming low carbon barriers will depend on the geographical location of significant new renewable generation installations in relation to constrained parts of the transmission network, although SPT has identified two potential regions with significant network constraints that could be targets for the further roll-out of the solution. A combination of the application of series capacitors on the network in 2014/15, the introduction of the Western HVDC link and the rate of change of the generation mix on the GB network support the timing of the project. The techniques demonstrated in the project are broadly applicable to giving an increased understanding of the performance of the transmission network, and not solely dependent on the uptake of renewable generation sources.		
Metrics (where available):			
Start date:	Dec-13	Project time scale:	3 years 4 months

Sub-criteria	**Assessment**
Significance of the project in: (a) overcoming current obstacles to a future low carbon economy	The project can potentially make a significant contribution to overcoming obstacles to a future low carbon economy, particularly through the reduction in transmission constraints that is offered by the ability to run closer to the transient stability margins on the network as a result of better visibility and accuracy of system measurements. This is particularly relevant in the case of the constrained boundary between the transmission systems in Scotland and England, given that the bulk of offshore wind generation will be connected to the Scottish network and requires increased export capacity to the

	south. At present the project is targeting a relatively modest 50MW increase in the transfer capacity across this border, although SPT reasonably claims that this may turn out to be a conservative assumption. The wider significance of the scheme in overcoming low carbon barriers will depend on the geographical location of significant new renewable generation installations in relation to constrained parts of the transmission network. SPT cites a second deployment, relating to a boundary in North Wales or elsewhere in the Scotland-England border, as being likely; beyond this, however, uncertainties around the evolution of the network make it hard to assess where else the VISOR solution could be deployed to have a major system impact from the transient stability perspective. Additional deployments would be required to give accurate locational information about the sources of SSO and to enable transient stability limits across additional boundaries to be assessed. SPT claims that the timing of the project is right because of (1) the installation of series capacitors in 2014/15 and the opportunity to observe the effect of these; (2) the Western HVDC link scheduled for 2016 and the opportunity to conduct system tests on commissioning the link; and (3) the rate at which general changes are taking place (e.g. changing generation mix) and the opportunity to record a "baseline" of dynamic performance. Given the complex nature of the sort of system interactions that may arise (as supported by references from other jurisdictions in the application) as a result of the introduction of HVDC and increasing quantities of wind generation, this comment about timing appears reasonable.
(b) trialling new technologies that could have a major low carbon impact	The significance of the project in trialling technologies that could have a low carbon impact is related to its contribution in two areas: the assessment of system transient stability more accurately than has hitherto been possible with the use of computer models, and the identification of incipient sub-synchronous oscillation problems which if unchecked could lead to a major network High Impact/Low Probability event. The technologies themselves are not “new”, in that PMUs and WAMS have been deployed in a number of other jurisdictions internationally. The extended application of the PMUs in the GB context and

	the bringing together of data from PMU measurements into a single location for subsequent processing is the major area of project innovation. The level of impact that this will have on the GB system is highly dependent on the extent of the potential improvements in system performance that are to be identified in the trial, which are hard to predict. Given, however, that the technical justification for the project is based on a 1% improvement in the transfer capacity on the B6 boundary, or 50MW, then any increase in this in respect of key system boundaries has the potential to become significant in relation to the size of windfarm developments being installed.
(c) demonstrating new system approaches that could have widespread application	The project is demonstrating approaches that are new in their application to the GB transmission system, whilst not all necessarily being novel on a worldwide scale. The use of PMUs for accurate system measurements is described in the examples of California, Australia and Iceland that are included in the application, and further information has been provided regarding SSO issues in Texas where equipment damage resulted. The use of the PMU measurements to gain a more accurate knowledge of network technical parameters is a valuable component of the project and has widespread application for improving the modelling of the GB system as a whole. It could, however, be argued that because of the value of this activity to a wide range of system planning and operational assessments, this should be an activity being undertaken by the GBSO as part of "business as usual".
(d) The applicability of the project to future business plans, regardless of uptake of LCTs (Low carbon Technologies)	The project is reasonably applicable to the generic problem of understanding more about the operation of the transmission network in a range of operating scenarios, irrespective of the extent to which this involves an increased uptake of LCTs. The accurate measurement of stability margins and the detection of SSO have the potential to reduce investment requirements on the network in a range of planning and operating scenarios, and not only those related to renewables.

8 Criterion (g) Methodology

Criterion:	Demonstration of a robust methodology and that the project is ready to implement
Overall assessment:	The project is technically feasible and has measures in place to address the complex technical tasks to be undertaken. The key challenges within the project relate to the detection and analysis of the phenomena which are vital to enabling system performance to be improved. The main risks identified in the project arise from the complexity of the stakeholder interactions required and the project management effort needed. This has converted into a very high budget allocation for project management time, however, which threatens the value for money of the project as a whole. Other risks exist in the form of potential delays to the project and cost over-runs. SPT appears to have adequate measures in mind for addressing these. The risk that the University of Manchester may be unable to recruit and retain the required Post-Doctoral Research Associate is noted, however reasonable evidence has been supplied that a pool of appropriate technical expertise exists within the university to support the project. The project management structure appears adequate, albeit with a very high level of resources involved, and the project management plan has been developed with a reasonable degree of resolution.

Metrics (where available):

Requested level of protection against cost over runs (default 5%) (%):	5%	Requested level of protection against direct benefits (default 50%) (%):	50%
Level of resources committed to the project (person-months):	478 person months		

Sub-criteria	Assessment
Feasibility of project proposal	The project is based around the established technology for measuring network quantities with highly accurate time tagging. The PMU technology to be deployed is widely available, however the key challenges within the project are associated with the analysis of the measurements to be stored in the centralised WAMS server and the drawing of robust conclusions as to the extent to which stability margins can be reduced in the light of more accurate network measurements. In relation to SSO detection, SPT states improvement in operational safety margins can be achieved "provided that the SSO can be 'seen' if it materialises". There is therefore apparent uncertainty as to whether the measurement techniques and equipment proposed will achieve this objective. To some extent this is a reason why the trial is necessary, since SSO is very difficult to predict analytically.
All risks, including customer impact, exceeding forecast costs and missing delivery date	The biggest area of risk identified in the project, from discussions with the consortium, arises from the complexity of the project in terms of stakeholder interfaces and project management. In particular, the challenge of interfacing with the multiple different functions of the GBSO has been highlighted. This is mitigated by a clear approach to project management. However this comes at a significant cost in terms of resources allocated to the project. Significant areas of risk are identified by SPT associated with the late delivery of software, communications infrastructure inadequacy, and cost over-runs. In addition, the potential for delays in integrating the SSO detection function into the WAMS platform are highlighted. Mitigation measures are proposed in the form of contract conditions to be applied to suppliers, paying attention to lifetime costs in the tender adjudication process, and careful management of priorities in software development. Reasonable contingency plans for working around the integration of the SSO function are also proposed. The absence of generator dynamic data is highlighted as a major issue, as this cannot be shared outside National Grid in its capacity as the System Operator, under the terms of the System Operator Transmission Owner Code. There is a

	proposal to address this through the involvement of academic resources based in the National Grid offices. However it is noted that this is dependent on people with the appropriate skills being available. Other risks associated with the need to redefine constraints processes and the possible lack of co-ordination between VISOR and the National Grid Dynamic Security Assessment project are noted. These risks could significantly affect both the validity of the analysis that is performed on the overall system and the ability of the project outcomes to be fully integrated into the normal business processes of the GBSO. SPT has noted in a clarification response that the project is intended to "baseline the network and build evidences to prepare for any changes in the existing operational exercises" and has highlighted a number of business processes that will change after completion of the VISOR project to integrate its operation into business as usual. The integration risk is handled primarily by measures focused on developing the interfaces of VISOR with existing platforms and looking at offline alternatives. A relatively high area of residual risk in the project relates to the possible inability of the academic partner to find a suitably qualified Post-Doctoral Research Associate to work on the project. Whilst the lead researcher is well qualified and experienced in the field, it will be crucial to ensure that adequate resources are made available to support the required analytical work. Reasonable evidence has supplied that a pool of appropriate technical expertise exists within the university to support the project. The customer impact of the project will be minimal, since VISOR will be tested effectively off-line from overall system operation. Equipment installation will be handled by the TOs and should be achievable without compromising the security of the transmission network.
Whether items within project budget provide value for money	As noted under Criterion (c) above, the total level of person-time included in the project is the main area of concern in relation to value for money. The partners have allocated a total of 17 person-years to project management, which appears excessive, notwithstanding the undoubted complexity of the project and the need for multiple interactions between

	organisations and technologies to be managed.
Project methodology (including depth and robustness of project management plan)	The project methodology is clearly and comprehensively defined from a technical perspective. The project management structure is well defined, with robust arrangements proposed for knowledge dissemination and stakeholder management. The project management plan has been defined with a reasonable level of resolution for this stage in the project.
Appropriateness of Successful Delivery Award Criteria (SDRC)	See Section 9, below.

9 Successful Delivery Reward Criteria

Criterion:	Review:
Overall assessment:	The SDRCs are generally appropriate and the evidence required is in each case linked to a specific Work Package and month of delivery.
9.1	**Successful delivery of Sub-Synchronous Oscillation (SSO) monitoring prior to start of Series Compensation commissioning.**
	This is an important criterion in that it links the delivery of a key element of the project to the commencement of the series compensation commissioning. This is due to take place in 2015, so the target date of December 2014 for achieving this key project milestone is appropriate and relevant.
9.2	**Enhanced stability tools delivered, including Oscillation Source Location and Disturbance Impact.**
	The delivery of Oscillation Source Location is a key component of the project, and this is therefore an appropriate milestone.
9.3	**Successful model validation activity completion.**
	This SDRC relates to work that will involve the academic partner, and is therefore relevant to ensuring the performance of the University of Manchester as part of the project.
9.4	**Successful improvement options for management of transient stability constraints.**
	No comments.
9.5	**Successful deployment of the supporting infrastructure of the VISOR project.**
	There is a key date missing for the coming into operation of the central VISOR server and inter-TO data exchanges, which are important elements of the overall project delivery.

9.6	**Successful dissemination of knowledge generated from VISOR project.**	
	No comments.	

10 Addendum: Changes made in resubmission

10.1 Summary of Changes

The key changes made by SPT in their resubmission are noted below.

The overall NIC Funding request has reduced slightly, from £6.550m to £6.492m. This is the result of modest reductions in the time allocated for project management inputs by the TOs and the GBSO, and a small reduction in the inputs provided by the University of Manchester.

In response to concerns raised in the clarification process and in meetings with the Expert Panel, SPT has also sought to provide further reassurance regarding the level of support being provided by NGET as the GBSO and the commitment of the University of Manchester.

10.1.1 Project Management resources

Following the concerns expressed about the significant amount of project management time included in the project, the Consortium has reviewed the level of inputs provided by SHE and NGET to the Project Leader roles that have been identified in each organisation. These have been reduced from 1 Full Time Equivalent (FTE) Project Leader from both companies for 40 months to:

- 1 FTE for 16 months;
- 0.8 FTE for 12 months; and
- 0.85 FTE for 12 months.

for both organisations. This averages to 0.9 FTE Project Leaders for each company, and introduces savings of £79,300 in the project budget. Whilst this is a welcome, if small, reduction, it does not address the issue of the efficiency of the overall project management approach raised by the Expert Panel. The VISOR Consortium will need to focus on ensuring that reporting lines and responsibilities are clear within the project as a whole.

10.1.2 University of Manchester resources

SPT has reviewed the overall resources in the project “to ensure that dedicated resources required from the NIC funding application were kept to a minimum, so as to achieve the best value for money.” As a result, some 50 person-days have been removed from activities being undertaken by the University of Manchester in the development and application of an algorithm to optimise the placement of monitoring equipment on the network.

It is unclear why this modification is considered appropriate, given that a key concern expressed in the review process has been to ensure the commitment of the University of Manchester to being able to cover its areas of responsibility. It will be important to ensure that the University remains confident in its ability to deliver with this reduced level of input. A financial saving of £27,500 results from this change.

10.1.3 Contingency costs

Concern was expressed in the clarification process regarding the relatively low level of contingency allowance in the project as a whole. In addition to providing reassurances regarding the basis on which key equipment costs have been estimated within the clarifications, in their resubmission SPT has increased the contingency cost for project management to £39,700. This represents a 14% increase in the contingency allowance, taking this to 4.5% of the project as a whole, from 4.0%. This is an acceptable increase, assuming that the contingency will be drawn upon for any purpose within the project and not restricted to project management, in view of the concerns already expressed regarding the level of project management resources in the project.

10.1.4 Diagram of business case benefits

An additional diagram has been included in the application indicating a summary of the business case information presented in the text.

10.1.5 Letter of commitment from NGET

Following concerns expressed by the Expert Panel regarding the level of commitment to the project that would be assured by NGET, SPT has submitted a letter from Chris Train, who is Director of Market Operation in National Grid, stating that "the System Operator would be pleased to, following the advice from the innovation project, put in place those systems and business procedures that will provide benefits for customers." The letter also confirms that the Transmission Network Service Director, Mike Calviou, is championing the project across National Grid. These statements give reasonable confidence that National Grid is indeed committed to pursuing the potential benefits of the project for network users.

10.1.6 Letter of commitment from the University of Manchester

SPT has included a letter of support for the project from Prof. A K Brown, Head of School in the School of Electrical and Electronic Engineering. This letter was submitted during the clarification process, but, as described in Section 6 of the main report, does not constitute a commitment to retain the required expertise for the duration of the project. The letter commits to the provision of in-kind support of up to £150,000. The letter does not therefore materially change the assessment of this issue provided in the main report.

10.2 Impact on LCN Funding Application

The key changes identified in the VISOR resubmission are:

- a saving of 0.1 FTE inputs in project management over the 40 month project programme, by reducing the time input for the Project Leads from NGET and SHE;
- a reduction of 50 person-days in the input of the University of Manchester to the project;
- a 14% increase in the contingency allowance in the project budget; and
- confirmation of NGET's intention to draw on the results of the project in delivering benefits to customers.

The net result of this is a £67,100 (0.9%) decrease in the total project budget, and a £58,300 (0.9%) reduction in the NIC funding request.

The impacts of the changes made by SPT to their submission are considered for each evaluation criterion below.

10.2.1 Criterion (a) Low Carbon and Benefits

The performance of the project in terms of low carbon and benefits is unchanged by the modifications to the project described in the resubmission.

10.2.2 Criterion (b) Value for Money

The small reductions in the amount of time allocated to project management make a marginal improvement to the project's value for money assessment, however these are insufficient to result in a change to the overall conclusion on this criterion.

10.2.3 Criterion (c) Generates Knowledge

The project's ability to generate knowledge remains strong. The reduced input of the University of Manchester in developing an algorithm for optimising monitor placement could marginally reduce knowledge generation.

10.2.4 Criterion (d) Is Innovative

No changes have been made to the project that affect the conclusion that it offers a reasonable level of innovation, arising from the application of established measurement techniques in a new context and using the results to gain potentially significant insights into ways of assessing stability and sub-synchronous oscillation.

10.2.5 Criterion (e) Partners and Funding

No changes to the project partners or funding arrangements are proposed, however evidence has been provided of a strong commitment to utilising the outcomes of the project from NGET in their capacity as GBSO. There is no material change to the level of commitment shown by the University of Manchester in the resubmission, however information provided during the clarification process indicates that the UoM has a reasonable pool of suitably qualified academics to support the project. These changes improve the assessment of the project under this criterion overall.

10.2.6 Criterion (f) Relevance and Timing

The relevance and timing of the project are unchanged by the resubmission and remain strong aspects of the application.

10.2.7 Criterion (g) Methodology

The technical content of the project is clearly defined and the methodology is robust. The main concerns raised with this aspect of the application related to the project management arrangements, and the large amount of resource dedicated to this. SPT has made a nominal reduction in this input, however concerns remain as to whether the project is organised in the most efficient way to deliver the desired results. The reporting lines and accountabilities between the three project leads will need to be clearly defined to ensure that decision making is effective. The Consortium should ensure that the reduced inputs from the University of Manchester in the area of optimising monitor placement will not materially impact the project. There is no change to the overall assessment of the project under this criterion.

10.2.8 Successful Delivery Reward Criteria (SDRC)

No changes are proposed to the SDRC, which are well defined and are clearly related to the project programme.

10.3 RAG (Red Amber Green) Analysis

In the light of the above assessment of the resubmission, no changes are proposed to the red/amber/green assessment of the project against the criteria recorded in the main report.