Question No.	From	Proforma section	Criteria	Question	Date question asked	Date response required	Date received	Follow up to Question #	Confidential Y/N
1	CO	n/a	b) Value for money	Are any optimisation algorithms available and, if not, will they be developed as part of this project? Will the scope of the optimisation be focussed on specific applications or will it be generalised to all network topologies and applications?	22 August 2017	24 August 2017	24 August 2017		
2	CO	5	g) Robust methodology/ready to implement	The project builds on various other Tier 1 and NIA/NIC projects as shown in Fig. 5.1. Has the learning from these projects been used to identify the project risks and what mitigation has been proposed?	22 August 2017	24 August 2017	24 August 2017		
3	CO	n/a	g) Robust methodology/ready to implement	Have the safety implications of using these devices in the system been considered in full and have bodies such as the HSE been consulted?	22 August 2017	24 August 2017	24 August 2017		
4	NC	Appendix 10.1 Benefits Tables	a) Enviro+consumer bens	Please can you provide an updated version of the Benefits Tables showing the total benefits for both methods.	22 August 2017	24 August 2017	24 August 2017		
5	NC	n/a	a) Enviro+consumer bens	Your submission shows the financial benefits of the proposed trial method versus conventional reinforcement. Please explain why conventional reinforcement is the most efficient method in use today. Have you considered other methods to address the problem, eg ANM or DSR. Within the Poyry report (which accompanied the Innovation Review) you contributed data to indicates 37% of the methods trialled under the LCN Fund are ready for use in business as usual and a further 41% are ready for use in the right circumstances. This would imply that there are more efficient methods available to licensees than traditional reinforcement.	24 August 2017	29 August 2017	29 August 2017		
6	NC	n/a	g) Robust methodology/ready to implement	The FUN-LV project had intended to deliver SOPs for use on the network, it did not manage to do this. Please explain why you expect to succeed in developing the technology to this point now when this was not possible through the earlier project.	31 August 2017	05 September 2017	05 September 2017		
7	HM	10.4.3 Active Response Technologies	g) Robust methodology/ready to implement	On page 73 you state that "Network data will be provided via existing measurement systems and from new locations required to give the level of detail required to perform the optimisation." Can you please provide more details as to what network data this will be, what measurement systems are being used to collect it and how obtaining this data from new locations is to be funded?	31 August 2017	05 September 2017	05 September 2017		
8	EP	n/a	d) Is innovative	Please explain how the learning generated by this project will generate network learning that is different to that created by the Fun LV project?	05 September 2017	07 September 2017	07 September 2017		
9	EP	n/a	b) Value for money	Please explain whether the project will look to create new standalone software instead of a 'bolt-on' to existing network control software?	05 September 2017	07 September 2017	07 September 2017		
10	EP	n/a	Multiple	Which Silicon Carbide devices are you going to be using within the trial?	05 September 2017	07 September 2017	07 September 2017		
11	EP	n/a	g) Robust methodology/ready to implement	Please clarify whether the Soft Power Bridge will work in a series or shunt configuration?	05 September 2017	07 September 2017	07 September 2017		
12	EP	n/a	g) Robust methodology/ready to implement	Please could you provide a clear written specification for the software required to control the technological solutions	12 September 2017	14 September 2017	14 September 2017		
13	EP	n/a	b) Value for money	Please outline how the CPS & CGI contributions were calculated? How have you ensured this amount offers good value to network customers?	12 September 2017	14 September 2017	14 September 2017		
14	EP	n/a	a) Enviro+consumer bens	Please can you confirm whether the carbon benefits only include CO2? If not please explain how the final figure was built up.	12 September 2017	14 September 2017	14 September 2017		
15	EP	n/a	a) Enviro+consumer bens	Please confirm whether there are any additional environmental impacts of using Silicon Carbide instead when compared to the components found within the technology available today.	12 September 2017	14 September 2017	14 September 2017		
16	EP	n/a	g) Robust methodology/ready to implement	Why do you have grounds to believe the use of Silicon Carbide will resolve the issues of acoustic harmonic problems experienced during Fun LV?	12 September 2017	14 September 2017	14 September 2017		
17	EP	n/a	g) Robust methodology/ready to implement	Please confirm whether the decision to withdraw the IRM submission will have an impact on the NIC bid, ie you state that if your IRM application was succesful you would make an additional contirbution to the NIC of £665k? Will this work now be delivered by the project?	12 September 2017	14 September 2017	14 September 2017		
18	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number one is appropriate.	14 September 2017	19 September 2017	19 September 2017		
19	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number three is appropriate.	14 September 2017	19 September 2017	19 September 2017		
20	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number four is appropriate.	14 September 2017	19 September 2017	19 September 2017		
21	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number five is appropriate.	14 September 2017	19 September 2017	19 September 2017		
22	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number six is appropriate.	14 September 2017	19 September 2017	19 September 2017		
23	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number eight is appropriate.	14 September 2017	19 September 2017	19 September 2017		
24	NC	9	Mulitple	Please provide a justification that the proposed percentage of funding associated with deliverable reference number nine is appropriate.	14 September 2017	19 September 2017	19 September 2017		
25	EP	n/a	a) Enviro+consumer bens	Please explain why your submission does not include any attempt to estimate the carbon benefits of capacity released, but is confined to estimates of the embedded carbon effects.	21 September 2017	26 September 2017	26 September 2017		
26	EP	n/a	b) Value for money	Please provide clarification of whether the GE device is designed to over or under determine the network data it measures.	05 October 2017	10 October 2017	10 October 2017		

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	1
Question date	22/08/2017	Answer date	24/08/2017
Submission section question relates to	n/a		
Topic	b) Value for money		
Question	Are any optimisation algorithms available and, if not, will they be developed as part of this project? Will the scope of the optimisation be focussed on specific applications or will it be generalised to all network topologies and applications?		
Notes on question			
Answer	Our aim within Active Response is to develop and demonstrate a solution that is applicable as widely as possible, for different devices and topologies. This is demonstrated by our partnership with Scottish Power Energy Networks. We are aware that there are some existing optimiser solutions within different software applications, however we do not believe that these have been deployed on a UK distribution network for increasing capacity at LV and HV. Automatic reconfiguration solutions are deployed for reconnecting customers after networks faults. We are finalising the procurement approach for a software platform but the quote value in the bid includes the development of an optimiser and the new requirement to integrate soft open points and other smart network devices. An off the self solution will be used if it meets the specification which will be developed at the beginning of the project. Our current view is that the IT system integration challenge is a higher cost activity than the specific development of the opti-misation algorithm. The solution chosen will be in the best interests of increasing available capacity in the HV and LV network. We are looking to balance the solution cost, capacity released and		

	reinforcement costs deferred to ensure best value to customers from Active Response. The trial areas are to be confirmed in the project, with the intention of two areas of different network topologies for the Active LV, Network Optimise and Active Response trials. We are looking to balance the cost of developing additional trial areas against additional learning to provide best value from the project.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	2
Question date	22/08/2017	Answer date	24/08/2017
Submission section question relates to	Proforma section 5		
Topic	g) Robust methodology/ready to implement		
Question	The project builds on various other Tier 1 and NIA/NIC projects as shown in Fig. 5.1. Has the learning from these projects been used to identify the project risks and what mitigation has been proposed?		
Notes on question			
Answer	Our own internal project learning reviews and relevant close-down reports from previous Tier 1 and NIA/NIC projects from other DNOs were reviewed and the learning was used to identify project risks and appropriate mitigation. For example: 1. Risk 11: "A partner/supplier may withdraw from the project" was identified from FUN-LV where Alstom were not able to deliver the dual-terminal soft-open-point (SOP) and pulled out of the project. TPS who had been selected through the procurement process for the delivery of the multi-terminal SOP, were quickly able to design and deliver the dual-terminal SOP. The dual-terminal and multi-terminal SOP were two of the three methods trialled in FUN-LV. Having multiple suppliers for the hardware enabled redudency and mitigated this risk for FUN-LV. This risk is being mitigated in Active Response by induding the SPB and SOP hardware supplier as a partner in the project. 2. Risk 12: "Suitable sites for demonstration of solution are not available" was identified from FUN-LV where Westminster council		

	declined permission to install the dual-terminal SOP in several locations. Alternative sites were identified from previous site-identification work. 3. Risk 20: “The communications system is not adequate for the transfer of the required volumes of data” was identified from SSEPD NIC project, My Electric Avenue where reliability issues from the communications link between the substation and EV caused technical issues in the project. The risk register is a live document, continually reviewed through the project. Engagement with other DNOs will ensure further learning is incorporated into Active Response.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	3
Question date	22/08/2017	Answer date	24/08/2017
Submission section question relates to	n/a		
Topic	g) Robust methodology/ready to implement		
Question	Have the safety implications of using these devices in the system been considered in full and have bodies such as the HSE been consulted?		
Notes on question			
Answer	UK Power Networks has an outstanding safety record and is proudly the safest DNO in Great Britain. The safety implications of both the novel hardware and software systems have been considered. For example interlocks, secure covers separating the signal and control wiring from the live terminals inside the cabinets and generator cables which cover live terminals when disconnected were examples of safety technologies used during FUN-LV and will again be implemented during Actve Response. During the project the device specification, design and testing will draw on the expertise of both our Asset Engineers and those at Scottish Power Energy Networks. Their input will ensure the safety of the novel power electronic devices, as they do for all other equipment installed on our networks. The power electronics devices are very different from the Fault Limiting Circuit Breaker developed in Powerful-CB, as they inherently limit fault current and are not connected where other equipment would be overstressed were they not to operate correctly. As such we have not consulted the HSE at this stage, however we would not hesitate to do so if any queries arose during the course of the bid or the project. The software system raises some operational safety questions that we have discussed with our Health and Safety team. We will answer these during the		

	project with the full support of the safety team to ensure above all the safety of our employees, contractors and members of the public.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	4
Question date	22/08/2017	Answer date	24/08/2017
Submission section question relates to	Appendix 10.1 Benefits Tables		
Topic	a) Enviro+consumer bens		
Question	Please can you provide an updated version of the Benefits Tables showing the total benefits for both methods.		
Notes on question			
Answer	An extra line has been added to the benefits table which totals the benefits across the two methods. [Please note that the benefits tables were changed further as a result of Q25. The reader is directed to refer to Section 10.1 of the Full Submission Proforma which contains the finalised versions of the tables, containing the modifications as a result of both Question 4 and Question 25.]		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	5
Question date	24/08/2017	Answer date	29/08/2017
Submission section question relates to	n/a		
Topic	a) Enviro+consumer bens		
Question	Your submission shows the financial benefits of the proposed trial method versus conventional reinforcement. Please explain why conventional reinforcement is the most efficient method in use today. Have you considered other methods to address the problem, eg ANM or DSR. Within the Poyry report (which accompanied the Innovation Review) you contributed data to indicates 37% of the methods trialled under the LCN Fund are ready for use in business as usual and a further 41% are ready for use in the right circumstances. This would imply that there are more efficient methods available to licensees than traditional reinforcement.		
Notes on question			
Answer	The Poyry report which evaluated the LCNF projects considered them by a set of categorised initiatives and as observed 37% were identified as being ready for use now, with a further 41% for use once the LCT uptake required them. The breakdown per initiative is shown below: % of initiatives that have Business As Usual (BAU) potential now, or which should contribute to BAU when the energy landscape is ready: • Ancillary service 1% • Asset Rating 6% • DG Connection 11% • FACTS 1% • FL management 4% • Flexible Demand 17% • Large scale storage 3%		

	• Network configuration 9% • Small scale storage 1% • Visibility 34% • Voltage Control 13% Flexible demand (Demand Side Response, DSR) is the largest category at 17 % after the provision of network visibility at 34 %. The report observed that whilst commercial and industrial demand flexibility is ready for BAU now, trials of residential demand response require further work to achieve a significant effect. Section 10.4.2 of our submission details the previous initiatives as categorised in the evaluation report and considers those from previous LCNF and NIC projects. We identified that DSR, network monitoring (visibility) and meshing (network configuration) will make a significant contribution to the accommodation of EV demand on the network. To develop our business case and the sensitivities applied in our submission (Section 10.2) we have taken account of the findings of previous projects such as My Electric Avenue (SSEN), Low Carbon London (UKPN) and Customer-Led Network Revolution (NPG) in the smart solutions developed to assist with controlled EV charging and the required consumer behaviour. Analysis in the business case considered different After Diversity Maximum Demand (ADMD) impacts of EVs at 1 kW, 2 kW and 4 kW and different DSR uptake rates of 25 %, 50 % and 75 %. We modelled the impact of these on the required amount of substation reinforcement. Higher DSR uptake, (reducing the amount EV charging at peak times) resulted in fewer sites going above their firm capacity and therefore fewer deployments of the solutions. We calculated that DSR uptake of 25 % provides a project NPV of £320m. Conversely 75 % DSR uptake provides an NPV of £49m. In addressing other valuable initiatives identified above, we are planning on developing our network visibility by increasing the amount of monitoring installed. Also the methods demonstrated in this project will move the existing capability and learning in respect of network configuration forwards by considering meshing across boundaries. Most projects which have examined ANM have considered generation connected to the high voltage networks. Typically, deployments of ANM have only curtailed connected generation when there is a network constraint. Our Network Optimise algorithms will develop the ANM solutions deployed in distribution networks. By reconfiguring the network depending on loading conditions, through moving Normally Open Points and meshing, we aim to connect more load and generation at LV before traditional reinforcement of the HV network is required. We see the Active Response methods as being complementary to ANM, DSR, Solid State Transformers and other smart solutions within our toolbox to minimise network reinforcement costs. The learning in respect of network optimisation and the use of power electronics that this project will provide will be another significant tool in the smart toolbox available to network operators.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	6
Question date	31/08/2017	Answer date	05/09/17
Submission section question relates to	n/a		
Topic	g) Robust methodology/ready to implement		
Question	The FUN-LV project had intended to deliver SOPs for use on the network, it did not manage to do this. Please explain why you expect to succeed in developing the technology to this point now when this was not possible through the earlier project.		
Notes on question			
Answer	As reported in the FUN-LV close-down report, the three core objectives of the project were to (1) demonstrate the optimisation of capacity on the LV network closest to customers. (2) enable improvement in the connection offer process and (3) advance the sector debate on future network architecture. FUN-LV achieved these aims by (1) deploying power electronics in three different methods and evidenced in the FUN-LV SDRC 9.2 and SDRC 9.4. (2) if a customer requires a connection offer and there is capacity in an adjacent substation a SOP could be deployed in a shorter time as evidenced in SDRC 9.1. (3) The project evaluated the financial learning and benefits across a variety of different network architectures in the trials including enabling dialogue between the utilities and the Power Electronics community. The project produced and trialled a first generation of Power Electronic equipment on LV Distribution networks, a significant challenge. It demonstrated that power electronics could be used to share capacity, manage the voltage at the terminal of the SOP and prevent fault current passing through the SOP. The SOP was deployed in multiple locations demonstrating connection in radial networks, meshed network and across		

	network boundaries. It also found that in some scenarios, and making assumptions about production costs, the devices had a business case for wider use. The evidence for the project aims are listed in Section 5 of the FUN-LV closed down report. The project overcame technical challenges such as the high level of neutral current found on LV networks, logistical requirements and establishing communications between remote network equipment which are valuable learning for future power electronic However, the demonstration in real world environments did also reveal that the first generation of devices did have limitations which meant the use of this design was not yet ready for wider use. These limitations are now understood and can be overcome through further development of the devices. Section 8 in the FUN-LV close-down report identifies that a second generation of the SOPs are required to alleviate performance issues and leave permanently installed on the network. The SOP and SPB power electronic devices are new designs using novel Silicon Carbide (SiC) semi-conductors devices which were not commercially viable during the design stage of FUN-LV. Their cost has significantly fallen meaning they are now viable. However, the new SiC devices are unproven on distribution networks. This presents significant innovation risk that should be tried and tested before wider roll-out. This project therefore aims to develop the SOP from a TRL of 6 to 8, such that the devices are suitable for adoption, by addressing the design issues identified in section 9 of the FUN-LV close-down report. The development of the Soft Power Bridge (SPB) will be accelerated as we can apply learning from the LV SOPs trials to these devices, mitigating many of the potential pitfalls. The SPB is a new architecture that presents significant benefits over traditional inverter solutions. The device uses partially rated components but is able to affect the connections full rated power. The novel design will allow a reduced physical size, reduced losses and reduced cost. Moreover, the project will demonstrate significant additional functionality above and beyond the hardware improvements such as the integration of the software automation system, and network hardware, with the proven safe systems of work that govern how we operate our network. Active Response will build on the lessons learnt in FUN-LV to develop devices that are ready for wide scale rollout.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	7
Question date	31/08/2017	Answer date	05/09/17
Submission section question relates to	10.4.3 Active Response Technologies		
Topic	g) Robust methodology/ready to implement		
Question	On page 73 you state that "Network data will be provided via existing measurement systems and from new locations required to give the level of detail required to perform the optimisation." Can you please provide more details as to what network data this will be, what measurement systems are being used to collect it and how obtaining this data from new locations is to be funded?		
Notes on question			
Answer	To provide the automated response to changing network conditions, the advanced automation and optimisation system will require visibility of the state and power flows at HV and LV on the trial networks. We anticipate that this will include: • Electrical quantities such as voltage, current and phase information, and also possibly include additional quantities such as levels of harmonic content, • Indications of switch positions and the number of operations, • Any other data identified during the specification, design and development phases of Work Streams 1 and 2 of the project. We believe much of this information can be provided by existing instrumentation systems such as are used by our operational control system, as provided by Remote Terminal Units (RTUs) at our secondary substation sites. Additional RTUs will be required in order to implement the Active Response Solution. Where the locations align with plans for existing installations of		

	additional monitoring these will be funded by allowances. Where further monitoring is required this will be funded by the project. As the trial networks are to be confirmed in the ”Detailed use case development, Site selection and Trial design” phase of WS3 (Project Planning, Trials and Analysis) of the project it is not possible to confirm exact numbers now, but an allowance was included in the project bid for 169 sites. This was derived by assessing two potential trial areas and the additional monitoring required within those areas.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	8
Question date	05/09/17	Answer date	07/09/17
Submission section question relates to	n/a		
Topic	d) Is innovative		
Question	Please explain how the learning generated by this project will generate network learning that is different to that created by the Fun LV project?		
Notes on question			
Answer	As set out in our answer to question 6, FUN-LV set out to meet three core objectives and one of the methods of demonstrating this was to prove that power electronics could be used in specific locations on the LV network to provide benefits. Active Response would like to demonstrate two methods: Network Optimise; and Primary Connect. Network Optimise will take a system view of both the HV and LV networks, and test the automated optimisation of both in a co-ordinated manner. This is new network learning. To demonstrate this will require the HV and LV networks to be controllable. At HV this is largely the case with existing ring main units, but to control the LV network will require LV CBs, link box switches and LV Soft Open Points (SOPs). In demonstrating this hardware there is some overlap in the network learning generated by FUN-LV. However it is intended to use second generation SOPs that use Silicon Carbide semi-conductors to overcome the limitations of the first generation FUN-LV SOPs. It is intended to investigate how the hardware can be co-ordinated where they overlap in area of network influence, something not considered in FUN-LV.		

	The Primary Connect method is expected to generate entirely new network learning, using a new device architecture and semiconductor material.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	9
Question date	05/09/17	Answer date	07/09/17
Submission section question relates to	n/a		
Topic	b) Value for Money		
Question	Please explain whether the project will look to create new standalone software instead of a 'bolt-on' to existing network control software?		
Notes on question			
Answer	The project will demonstrate the most appropriate software platform we can for this application, in terms of delivering value for money and replicability, whether this be a “bolt-on” or a standalone system. The project is currently investigating procurement options to ensure our requirements are met while delivering good value for money to customers. We are not intending to create a completely new system from scratch as we deem that this would be uneconomic and impractical. We know from the Power Potential platform procurement that much of the functionality we require is available in existing platforms. In order to meet our safety and IT security requirements the new software will have to closely interface with our existing network control software, which is also used by all but one of the other UK DNOs. This will be the case whether a standalone software system or “bolt-on” is used, allowing the benefit to be more easily transferred to customers on other DNOs.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	10
Question date	05/09/17	Answer date	07/09/17
Submission section question relates to	n/a		
Topic	Multiple		
Question	Which Silicon Carbide devices are you going to be using within the trial?		
Notes on question			
Answer	Both the LV SOPs and the HV Soft Power Bridge will utilise state-of-the art Silicon Carbide MOSFETs (Metal-Oxide-Semiconductor Field Effect Transistors) and Silicon Carbide Diodes arranged in a half-bridge module with nominal rating of 1.7kV and 300A. These packages are commercially available from various suppliers for industrial applications, and are fully characterised. They have also been trialled and fully verified by TPS in a different converter arrangement proposed for rail application.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	11
Question date	05/09/17	Answer date	07/09/17
Submission section question relates to	n/a		
Topic	g) Robust Methodology/ready to implement		
Question	Please clarify whether the Soft Power Bridge will work in a series or shunt configuration?		
Notes on question			
Answer	The Soft Power Bridge has both series and shunt elements, in a similar configuration to that of a Unified Power Flow Controller (UPFC).		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	12
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	g) Robust Methodology/ready to implement		
Question	Please could you provide a clear written specification for the software required to control the technological solutions		
Notes on question			
Answer	The following is a list of high level requirements for the Advanced Automation and Optimisation System: • Open and close switches and CBs at HV and LV • Ensure safe operation of the network is not compromised • Ensure customers supplies are not un-necessarily interrupted • Understand thermal, voltage and fault level constraints • Understand variable constraints (such as Real Time Thermal Ratings – RTTR) where relevant • Understand time based constraints such as impact of voltage transients from switching (Reference ER P28 flicker requirements) • Issue control set points (via PowerON) to UKPN owned flexible devices (storage / SOPs / etc) • Issue control set points to third party owned Distributed Energy Resourcess (if required, primarily via PowerON) • Interface with PowerON live diagram (HV and LV) to have full visibility of current network state • Be resilient to bad measurement points and identify these as potentially erroneous • Be resilient to incomplete measurements • (optional) send advisory instructions to get manual switching carried out where tele-control does not exist • Include forecasting module or interface to separate forecaster. Forecasting only required intra-day		

	• Have post fault supply restoration functionality equal to or in advance of PowerON APRS (Automatic Power Restoration System) • Interface with other UKPN platforms technical or commercial information (such as Power Potential platform or D-Plan / Digsilent modelling tools) • Have one touch safety override for control engineers • Have an intuitive human interface to enable easy adoption by control engineers • Have integrated update workflow to ensure it is updated with all network changes with minimal additional work • Have integrated workflow to allow planned outages to interface with automated changes in a safe and sensible manner • Include a “study mode” or offline/sandbox mode to enable “what if?” studies to be carried out • It must be scalable by design, to simplify / enable a roll out to the rest of UKPN / other DNOs if the project is successful • Be able to optimise (by voltage level or region, tbc) on the following parameters: o Network losses o Minimum customer demand (cf ENW work) o Voltage o Customers at risk of interruption, both by number of customers and level of risk o Cost to DNO of operation of flexible resources o Available capacity headroom o Multiple parameters simultaneously, sensible combinations only, not all at once
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	13
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	b) Value for money		
Question	Please outline how the TPS & CGI contributions were calculated? How have you ensured this amount offers good value to network customers?		
Notes on question			
Answer	TPS are the primary equipment manufacture for Active Response and view this project with high strategic importance, but acknowledge that there is a risk associated with the Smart Grid market not being fully developed and them not receiving a return on their investment. The DNO community, through the NIC funding, is developing the strategies and equipment required to meet the significant challenges ahead. TPS have an ambition of becoming a significant UK supplier to the emerging Smart Grid market, and in recognition of returning value, they have committed £808,322. This is a significant proportion of the project budget and therefore represents good value to network customers. TPS have a financial interest in the ultimate success of this project. Active Response is a significant proportion of their allocated R&D budget and equates to [redacted]% of their R&D spend in [redacted] accounting period. CGI are the primary systems integrator and have calculated their contribution of £260,000 by identifying their efforts required to deliver the main system integration and data tasks. This estimation is from their experience of delivering for other LCNI / NIC projects. CGI have discounted their personnel rates through their partnership with UK Power Networks and		

	supporting industry innovation. They will also be supplying a free licence for the use of the DPlan application for the Active Response Project. They have proposed an experienced team of Smart Grid experts who are familiar with the systems architecture and data structures of UK Power Networks. This familiarity will improve the efficiency of the project and therefore deliver more benefit to customers. Active Response takes forward and substantively further develops aspects of previous projects such as FUN-LV, where CGI supported, and in so doing enables cost effectiveness through knowledge transfer and re-use. In Active Response, CGI are focussed on the enabling integration and data tasks required and this does not include a plan to develop a specific additional software application that it will later try to gain a return from. We believe that both TPS and CGI offer good value for our customer's money.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	14
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	a) Enviro+consumer bens		
Question	Please can you confirm whether the carbon benefits only include CO_2? If not please explain how the final figure was built up.		
Notes on question			
Answer	The carbon benefits include only CO_2 except for the CO_2 for oil production and CO_2 for road building. These two used CO_2eq measurements due to the availability of information during the preparation of the FSP. The output of the modelling of the demand growth due to EV uptake determined the number of sites where either a Primary Connect solution or Network Optimise solution could be deployed. For Primary Connect the CO_2 emissions in manufacturing a SPB were compared to the emissions of manufacturing a primary transformer. For Network Optimise the CO_2 emissions of digging up the road, manufacturing and installing an 11 kV cable and finally resurfacing the road were assumed to be mitigated by being able to utilise existing equipment. The replacement of switchgear and communications equipment was assumed to be necessary for all solutions and not considered. We have carried out research to identify CO_2 emissions data which were used in the calucations. The materials required for each solution was estimated and detailed below.		

	For Primary Connect, the amount of materials and the transportation of the manufactured devices to site was considered. The SPB was assumed to consist of (weights approximate): • SiC (6 kg) • Copper (24 kg) • Steel (1,016 kg) • Aluminium (747 kg) • Transportation (200 miles @ 10 mpg of diesel) Resulting in a CO_2 emission of 3.788 tCO_2. A transformer replacement considered as the alternative method to installing an SPB consisted of: • Steel (15,000 kg) • Oil production (8,000 kg) • Transportation (200 miles @ 10 mpg of diesel) Resulting in a CO_2 emission of 40.5 tCO_2 per 33 kV to 11 kV transformer. For Network Optimise the replacement of 1 km of 11 kV cable was considered and consisted of: • Aluminium for the conductors (10,726 kg) • Equipment for excavating the road • Materials for paving the road Resulting in a total CO_2 emission of 10.81 tCO_2 per 1 km of 11 kV cable. The CO_2 emission from the equipment required to implement Network Optimise was considered the same as the new switchgear required to protect the reinforced 11 kV feeder. We are carrying out further research following the discussion in the Bilatteral meeting and will revise our CO_2 emmissions of the proposed solutions if more suitable references are identified.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	15
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	a) Enviro+consumer bens		
Question	Please confirm whether there are any additional environmental impacts of using Silicon Carbide instead when compared to the components found within the technology available today.		
Notes on question			
Answer	We are not aware of any specific environmental impacts of using Silicon Carbide (SiC) instead of other Silicon (Si) technologies. As Silicon Carbide is a relatively new material to the electronics industry it is more prone to defects during manufacturing process resulting in lower yields than Silicon. This increases the cost, reduces the manufacturing efficiency and increases the CO_2 emitted for each working device. As manufacturing techniques improve the CO_2 intensity to manufacture a SiC device should reduce. We have as yet been unable to find sufficient data to quantify this and revise our carbon benefits estimates. Due to the ability of Silicon Carbide devices to operate at higher efficiency than Silicon we anticipate with the information currently available to us that the lifetime environmental impact will be lower.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	16
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	g) Robust methodology/ready to implement		
Question	Why do you have grounds to believe the use of Silicon Carbide will resolve the issues of acoustic harmonic problems experienced during Fun LV?		
Notes on question			
Answer	The findings of FUN-LV demonstrated that acoustic noise from SOPs in substations or as street furniture needs to be reduced to achieve a business as usual deployable product. There are two sources of noise in power electronic converters. Air flow noise is generated from any cooling system deployed to dissipate the heat generated from electrical losses of the power electronics. Tonal noise is created by the switching frequency of the semiconductor devices. The converters used in the FUN-LV project used standard Silicon (Si) devices. They had tonal noise issues relating to the switching frequency at 5kHz and required a cooling system to remove the heat generated by the Si devices. The designs of both the second generation SOPs and the Soft Power Bridge (SBP) have considered the findings of FUN-LV and propose the use of Silicon Carbide (SiC) devices as a solution to the identified noise issues. The use of SiC, which unlike when the FUN-LV project started is now readily available for high current systems, will address both elements of noise. SiC devices have ten times the dielectric breakdown field strength, three times the bandgap, and three times the thermal conductivity than tradition Silicon devices. SiC Power Devices offer lower switching losses, lower ON resistance, and higher temperature operation. These features result in a lower power loss, the ability to operate at a higher switching frequency and		

	smaller module size. They also allow designers to use fewer components, further reducing design complexity and the total volume of the device. The switching frequency of the SOP and SPB devices are expected to operate at is [redacted] kHz. This is beyond the human audible range of around 20 kHz and will remove the tonal noise that can be heard when operating the FUN-LV units. The use of the higher switching frequency also enables the reduction of the size of the inductors used in the device. This will reduce the electrical loss, reduce the weight and reduce the volume of the SOPs and SPBs. In reducing the losses of the device associated with the inductors and power electronic devices, the size of the cooling fans is greatly reduced. From prelimary calculations the fan used on the proposed liquid cooling heat exchange system for the Soft Power Bridge is expected to produce noise of the order of 43 dBA. This results in a lower generated acoustic noise from the cooling system.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	17
Question date	12/09/17	Answer date	14/09/17
Submission section question relates to	n/a		
Topic	g) Robust methodology/ready to implement		
Question	Please confirm whether the decision to withdraw the IRM submission will have an impact on the NIC bid, ie you state that if your IRM application was succesful you would make an additional contirbution to the NIC of £665k? Will this work now be delivered by the project?		
Notes on question			
Answer	We can confirm that the decision to withdraw our IRM submission will have no impact on the NIC bid. Installtion of RTUs and monitoring in trials areas which do not already have monitoring or control installed, will be delivered by the project, which was the position assumption made in the FSP meaning there are no changes to the finances as a result of this decision.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	18
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number one is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 1 is a “High Level Design Specification of Advanced Automation Solution” and has been allocated 1% of the NIC funding request. As such the costs associated with the production of this specification are Time and Expenses costs from UK Power Networks, CGI and Ricardo to derive, develop and document the specification. Time for Scottish Power Energy Networks to review and comment on drafts of the document is also included.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	19
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number three is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 3 is a report detailing “Learning from Hardware factory tests” and has been allocated 23% of the NIC funding request. As such the costs incurred in order to be able to produce this report include: • TPS costs for design and build of Soft Open Point and Soft Power Bridge devices; • Ricardo and UK Power Networks engineering support and acceptance testing time and expenses costs; • Costs for use of a suitable test facility; and • Scottish Power Energy Networks engineering time for review of report.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	20
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number four is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 4 is a report detailing “Learning from Commissioning and Operation of Active Response Software Solution tools” and has been allocated 34% of the NIC funding request. As such the costs incurred in order to be able to produce this report include: • Costs for the build of the trial network software models; • The development and trialling of the Advanced Automation and Optimisation software tool; • CGI development costs for the network modelling tool; • Ricardo and UK Power Networks engineering support and acceptance testing time and expenses costs; and • Scottish Power Energy Networks engineering time for review of report		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	21
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number five is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 5 is a report detailing "Initial Learning from the Installation and Commissioning of Active Response Hardware" and has been allocated 19% of the NIC funding request. As such the costs incurred in order to be able to produce this report include: • Trial location additional equipment costs, such as HV Ring Main Units, and Remote Control LV Link Box Switches and Circuit Breakers ; • UK Power Networks and TPS installation costs for trial network equpiment; • Ricardo and UK Power Networks engineering support time and expenses costs; and • Scottish Power Energy Networks engineering time for review of report.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	22
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number six is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 6 is a "Project technology handover, rollout and adoption into BaU plan" and has been allocated 3% of the NIC funding request. As such the costs incurred in order to be able to produce this plan include: • UK Power Networks Communications team time; • UK Power Networks Training team costs; • The three academic research areas; • Learning Event and Conference costs; • Ricardo workstream management and delivery time; and • Scottish Power Energy Networks engineering time.		
Attachments			

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	23
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number eight is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 8 is "Presentation of findings from the project trials" and has been allocated 5% of the NIC funding request. As such the costs incurred in order to be able to produce this include: • UK Power Networks trial support time from Network Planning and Operations teams; • Solution support from TPS and CGI; • A performance bonus reward payment for TPS, • Time and expenses costs associated with Ricardo's data collection, analysis and reporting on findings; and • Scottish Power Energy Networks engineering time for review of findings. Please note that since submission of the FSP we have reviewed the TPS costs associated with this deliverable. In order to ensure continued engagement and commitment to the project we had allocated a significant proportion of their costs to this deliverable. However in discussion with TPS following		

	submission we believe a smaller amount would be sufficient, and we intend to reallocate some of these costs to Deliverable 3 in our resubmission.
Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	24
Question date	14/09/17	Answer date	19/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please provide a justification that the proposed percentage of funding associated with deliverable reference number nine is appropriate.		
Notes on question			
Answer	We have allocated costs to each deliverable in proportion to the costs associated with its development. We are happy to discuss this if you have an alternative methodology you would like to propose. Deliverable 9 is "Review of solution applications and project business case" and has been allocated 13% of the NIC funding request. As such the costs incurred in order to be able to produce this report include: • Ricardo time and expenses to perform the review; • Scottish Power Energy Networks engineering time for review of findings; • UK Power Networks Project management costs for the entire project; • Ricardo Project management support costs for the entire project; • Project Contingency allowance; and • The independent audit of all deliverables. Please note that since submission of the FSP we have reviewed our approach to the allocation of project management and contingency costs. In order to reduce the risk associated with only receiving project funding for these significant elements at the end of the project, we intend to redistribute some of these costs to earlier deliverables, in our resubmission.		

Attachments	

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	25
Question date	21/09/17	Answer date	26/09/17
Submission section question relates to	9		
Topic	Multiple		
Question	Please explain why your submission does not include any attempt to estimate the carbon benefits of capacity released, but is confined to estimates of the embedded carbon effects.		
Notes on question			
Answer	Our submission considers the Carbon Benefits of the Active Response methods in terms of Direct and Indirect Benefits. We have considered Direct Benefits to be those released by methods through the deferral of conventional reinforcement. As such we are able to estimate these benefits, using the same assumptions inherent throughout the model in terms of number of deployments etc., and data on carbon released from the various constituent elements of the base case solution and the project methods. These benefits are stated in the Full Submission document in section 3.5, Appendix 10.1 and 10.2. The project methods also release capacity that could be used for the connection of Low Carbon Technologies. We have considerd these to be Indirect Benefits, as these benefits are dependant on network customers using alternative technologies. It is possible to translate the calculated capacity benefits of the project into carbon benefits. We did not include these in our Full Submission in order to present a conservative figure, with a high confidence of achievement. If the expert panel require us to include indirect carbon benefits in our resubmission to present an optimistic potential total we would be happy to do so, as per the below derivation.		

We have calculated that the combined project methods will release the following capacity at GB rollout scale. Using the following assumptions, the following carbon benefits can be derived if all of that capacity is used to charge Electric Vehicles (EVs):

- 7kW Electric Vehicle Charging,
- an average EV produces 74g/km[1] against 130g/km from a typical conventional car in tax band D[2], and
- that average annual distance covered in vehicles is 12,714km per year[3], and that this figure is the same for both conventional and Electric vehicles:

Year	Capacity released (MVA)	Equivalent Number of Electric Vehicles	Potential Carbon Benefits (tCO_2e)
2030	4,228	604,000	428,663
2040	9,394	1,342,000	952,426
2050	6,962	994,571	705,853

If this indirect benefit is included with the carbon benefits stated in the Full Submission (in section 3.5, Appendix 10.1 and 10.2.) the total benefit from both methods at GB rollout scale would read as follows:

Year	Direct Carbon Benefits (tCO_2e)	Indirect Carbon Benefits (tCO_2e)	Total Carbon Benefits (tCO_2e)
2030	19,592	428,663	448,255
2040	47,806	952,426	1,000,232
2050	40,727	705,853	746,580

However the project methods themselves only make the network capacity available, it is the users themselves that may use this to provide carbon benefits. As such, in preparing our submission, we felt it was more appropriate to present a conservative view of the project benefits for which this project was fully accountable if successful.

Attachments	

[1] Based on a 0.211kWh/km average EV energy usage (http://shrinkthatfootprint.com/wp-content/uploads/2013/02/Shades-of-Green-Full-Report.pdf) and a 2017 UK Grid Emission Factor of 351.56 gCO2e/kWh (https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2017).

[2] Note that EV carbon emmissions per km will reduce with time assuming the UK generation mix continues to decarbonise, so the carbon benefits from EVs may be greater than stated here.

[3] http://www.bbc.co.uk/news/uk-england-28546589

Electricity Network Innovation Competition Full Submission

Supplementary Answer Form

Project: Active Response

Tick if this answer has been provided verbally: ☐

Project code	UKPNEN02	Question Number	26
Question date	05/10/17	Answer date	10/10/17
Submission section question relates to	n/a		
Topic	b) Value for money		
Question	Please provide clarification of whether the GE device is designed to over or under determine the network data it measures.		
Notes on question			
Answer	The vast majority of our LV and HV networks do not have realtime analogue measurement equipment installed. As such discussions with potential suppliers have centred around being able to estimate accurately or otherwise allocate with a minimum error the load flowing on the distribution network. From this other parameters can be calculated. This requires an under-determined approach to distribution state estimation to be carried out which we believe will also be more robust than over-determined to future challenges. This is the approach taken in the module GE have proposed for this function (please see end note). In London we have highly monitored networks at 132kV, EHV (and for some of the 11kV network) where an over-determined approach might be more appropriate due to the higher volume of data but this is not what we are looking to test within Active Response. [end note: as discussed in the bilateral meeting the supplier for the Advanced Automation and Optimisation System has not been determined. This will be decided following procurement discussions to ensure technical		

	suitability and value for money for customers – GE is just one such supplier.]
Attachments	

Intervention	After Diversity Peak reduction (kW)	Gross Peak Reduction (kW)	Assumed running hours/year	kWh/year reduction	£/kWh benefit (retail electricity price if we are considering the reduction on customer energy bills)	£/ year benefit (on customer energy bills)	£/kWh benefit (40% of retail electricity price [i.e. the cost of generating electricity] if we are considering the avoided cost of generation)	£/ year benefit (avoided cost of generation)	Life of measure years (appliance life)	£ benefit over life of measure (on customer energy bills)	£ benefit over life of measure (avoided cost of generaiton)	Cost of measure (Appliance cost)(£)	£/year saving in distribution UoS costs	£/year savings in DNO's network reinforcement costs (from deployment of EE measure)	£/year savings in DNO's network reinforcement costs (over lifetime of EE measure)
Appliances	0.14	0.212	627	133	£ 0.14	£ 19.11	£ 0.057	£ 7.64	10	£ 191.12	£ 76.45	£ 345.00	£ 1.91	£ 1,858.00	£ 186.00
Heating	0.385	0.453	542	983	£ 0.14	£ 141.26	£ 0.057	£ 56.50	20	£ 2,825.14	£ 1,130.06	£ 750.00	£ 14.13	£ 5,110.00	£ 255.00
Lighting	0.27	0.54	185	100	£ 0.14	£ 14.37	£ 0.057	£ 5.75	30	£ 431.10	£ 172.44	£ 50.00	£ 1.44	£ 3,583.00	£ 119.00
Behaviour	0.072	0.085	N/A	50	£ 0.14	£ 7.19	£ 0.057	£ 2.87	5	£ 35.93	£ 14.37	£ 70.00	£ 0.72	£ 956.00	£ 191.00
Solar PV	18.75	37.5	425	15938	£ 0.14	£ 2,290.22	£ 0.057	£ 916.09	30	£ -	£ 27,482.63	£ 23,756.25	£ 229.02	£ 610,000.00	£ 20,333.33
Combined Measures	0.357	0.51	549	280	£ 0.14	£ 40.24	£ 0.057	£ 16.09	10	£ 402.36	£ 160.94	£ 425.00	£ 4.02	£ 4,738.00	£ 474.00