Call for Innovation Ideas
Dec 2014
UK Power Networks
Call for Innovation Ideas
UK Power Networks Innovation Portfolio Development

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1. Background

Innovation Strategy
UK Power Networks (Operations) Limited (UKPN) is committed to both technical and commercial innovation in order to deliver value and continuous improvement benefits for our customers. In order to have a proactive, healthy and well-balanced innovation portfolio, we seek ideas from all UK Power Networks business units and at the same time also keep abreast of industry technology developments.

Network Innovation Allowance (NIA)
Innovation is a key element of the new RIIO (Revenue = Incentives + Innovation + Outputs) model for price controls. The RIIO framework provides strong incentives for Network Licensees to innovate as part of normal business. However, certain Research, Development, and Demonstration Projects are speculative in nature and yield uncertain commercial returns. The NIA is available to UK Power Networks to fund eligible projects that will deliver benefits to customers (more information on the NIA and the eligibility criteria can be found here).

Why UK Power Networks is issuing this call
Following the identification of key innovation topics from each business unit, UK Power Networks is putting in place a process to provide more visibility of our needs, and receive innovation ideas from interested parties. The Call for Innovation Ideas is open to all vendors, and is the proposed approach taken by UK Power Networks for Request for Information. The innovation ideas provided by the vendors must comply with all the “Call Participation Requirements” outlined in this document (Section 4).

Why should suppliers be interested in this call and the benefits to the supplier?
The main benefits to suppliers could be the availability of funding to further develop a product, solution or idea a practical demonstration on a DNO network, or an increased profile within the DNO community.

Our commitments to suppliers
Whilst we cannot guarantee that a project idea will be taken forward, we will endeavour to provide feedback. The information provided to UK Power Networks will be treated as confidential, and will not be shared with any third party unless approval to do so has been given.

2. Key Innovation Topics

A brief description of all the Key Innovation topics that UK Power Networks is focusing on for this Call for Innovation Ideas can be found in Appendix 2. For each topic, a description of the issues has been outlined as well as the specific capabilities we are aiming to develop in order to address these issues.

Before replying to this call, please ensure that your ideas address at least one of the key innovation topics and align with the capabilities to be developed.

3. Engagement Process

The process for this call is as follows:
1. Suppliers to respond to this call for innovation ideas by 17:00pm GMT on 20th January 2015. Suppliers may respond to one or more of the innovation topics listed in Appendix 2.
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2. Please complete the response template (Appendix 1) electronically and send the entire document to the following email address: enquiries@energyinnovationcentre.com. Please do not copy and paste the template on a separate document.

3. UK Power Networks’ Future Networks team will lead the review of the ideas and provide feedback to all.

4. UK Power Networks may initiate a formal procurement process before ideas are progressed.

4. Call Participation Requirements

- The innovation idea complies with the NIA eligibility criteria / is eligible for NIA funding (please refer to Response Template for all NIA eligibility criteria).
- The innovation idea is a close match to at least one of the Innovation Topics outlined in Appendix 2, i.e. suggests a clear solution to the issues outlined in this Call and/or matches closely the description of UK Power Networks’ innovation topics and capability defined in this document.
- The innovation idea does not lead to unnecessary duplication, i.e. has not been trialled or implemented by any other UK DNO/TNO (See ENA Smarter Network Portal for existing industry projects).
- The idea will demonstrate at least Incremental Innovation (e.g. improvements to existing equipment, designs or processes).
- The deployment of the proposed project/solution will deliver clear financial benefits to UK Power Networks and the end consumers.
- The supplier is able to provide all the required information in the Response Template.
- The supplier has previous experience in the field relating to the Innovation Topic.
- The supplier will be expected to comply with UK Power Networks Health, Safety and Environmental policies.

If a supplier wishes to respond to more than one innovation topics listed in Appendix 2, a completed Appendix 1 is to be provided for each innovation topic.

5. Additional relevant information

You may wish to re-submit an idea that you have discussed with us in the past on one of these topics. In this case, please mark it as a ‘resubmission’ and give an update on the last contact that was made with UKPN and the development in the idea since then.

A response containing only a supplier or a product brochure will not meet the requirements of this call for innovation ideas.
Appendix 1: Response Template

<table>
<thead>
<tr>
<th>Contact Name</th>
<th>Company Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Address</td>
<td>Contact Number</td>
</tr>
<tr>
<td>Email</td>
<td>Company Registration No</td>
</tr>
</tbody>
</table>

Network Innovation Allowance (NIA) Eligibility Criteria

Is the project eligible for NIA Funding? (Yes/No/possibly)

To be eligible for NIA funding a project must have the potential to have a Direct Impact on a Network Licensee’s network or the operations of the System Operator must meet one of the following criteria:

<table>
<thead>
<tr>
<th>Yes/ No</th>
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<tbody>
<tr>
<td>A specific piece of new (i.e. unproven in GB, or where a Method has been trialled outside GB the Network Licensee must justify repeating it as part of a Project) equipment (including control and communications systems and software)</td>
</tr>
<tr>
<td>Please briefly explain in the box provided below:</td>
</tr>
<tr>
<td>What is the device?</td>
</tr>
<tr>
<td>To what extent has the equipment been trialled abroad?</td>
</tr>
<tr>
<td>A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)</td>
</tr>
<tr>
<td>Please briefly explain in the box provided below:</td>
</tr>
<tr>
<td>What is the ‘arrangement or application’ you are proposing?</td>
</tr>
<tr>
<td>Why do you regard it as novel?</td>
</tr>
<tr>
<td>A specific novel operational practice directly related to the operation of the Network Licensees System</td>
</tr>
<tr>
<td>Please briefly explain in the box provided below:</td>
</tr>
<tr>
<td>What is the ‘operational practice’ you are proposing?</td>
</tr>
<tr>
<td>Why do you regard it as novel?</td>
</tr>
<tr>
<td>A specific novel commercial arrangement</td>
</tr>
<tr>
<td>Please briefly explain in the box provided below:</td>
</tr>
<tr>
<td>What is the ‘commercial arrangement’ you are proposing?</td>
</tr>
<tr>
<td>Why do you regard it as novel?</td>
</tr>
</tbody>
</table>

Please provide a brief answer to the questions above which correspond to the criteria your Innovation complies with. (300 characters max)
### An NIA project must also meet ALL of the requirements described below:

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Yes/ No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Has the potential to develop learning that can be applied by all Relevant Network Licensees Please explain in question 1 below</td>
<td></td>
</tr>
<tr>
<td>Has the potential to deliver net financial benefits to electricity Customers Please explain in question 7 below</td>
<td></td>
</tr>
<tr>
<td>Does not lead to unnecessary duplication i.e. The Innovation is not currently being trialled by another UK network operator</td>
<td></td>
</tr>
</tbody>
</table>

### Additional Call Participation Eligibility Criteria

(NOtte: To be able to participate in the call, suppliers need to comply with all the following)

Please tick the boxes to confirm that the proposed innovation meets the below criteria:

- [ ] The proposed solution once deployed will deliver benefits to the end consumer and UK Power Networks
- [ ] The proposed project/solution addresses UK Power Networks needs / matches closely at least one of the innovation topics outlined in the document
- [ ] To the supplier's knowledge, this proposed innovation (or similar) has not been trialled or used by any other UK DNOs/TNO
- [ ] The proposed project is at a TRL level equal to or higher than 2

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Proposed Innovation Solution

Please specify in the table below which “Key Innovation Topic” and “Capability to be developed” from Appendix 2 does the proposed solution relate to.

<table>
<thead>
<tr>
<th>Key Innovation Topic</th>
<th>Capability to be developed</th>
</tr>
</thead>
</table>

Please answer the following questions if your innovation meets all the eligibility criteria outlined above:

1. Executive summary: Please provide a succinct description of your proposed innovation, the method of implementation and the expected new learning. (1000 characters max)

2. Please provide a single sentence summary of the benefits to the end customer. (300 characters max)

3. Please provide sufficient evidence on how the proposed innovation/solution/project specifically matches the selected Key Innovation Topic and Capability to be developed. (500 characters max per text box below)
## Key Innovation Topic:

<table>
<thead>
<tr>
<th>Capability to be developed:</th>
</tr>
</thead>
<tbody>
<tr>
<td>4. Please provide cost estimates and timescales for the proposed innovation. (150 characters max)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>5. What are the specific tangible outputs of the above innovation? (1000 characters max)</th>
</tr>
</thead>
</table>
6. Why is the proposed innovation better than other solutions on the market or currently in use by network Operators? (500 characters max)

7. If possible, illustrate ways that might be used to calculate the cost benefits if the innovation was successfully developed and deployed by UK Power Networks? Please also include information on the expected cost of the commercial solution where applicable. (500 characters max)

8. In addition to the cost savings stated above, what other benefits would the deployment of the innovation bring? (500 characters max)

9. What is the current status of development of the innovation and estimated current TRL? (See key below, 200 characters max)

10. Please provide information on previous experience in the field relating to the Innovation Topic. (300 characters max)
11. Could this innovation (either on its own or combined with other ideas/technologies) be developed into a significant Network Innovation Competition demonstration? Please describe. (500 characters max)

12. Other relevant information. (500 characters max)

**TRL Key:**

- **TRL 2-3 (Research)** means activities undertaken to investigate the Problem based on observable facts.
- **TRL 4-6 (Development)** means activities on generating and testing solutions to the Problem.
- **TRL 7-8 (Demonstration)** means activities focussed on generating and testing solutions on the network that takes them to a stage where they can be transferred to business as usual.
# Appendix 2: Key Innovation / Description of issues and Capabilities to be developed

<table>
<thead>
<tr>
<th>CPV codes</th>
<th>Item Number</th>
<th>Business Area</th>
<th>Key Innovation Topics</th>
<th>Description of issues</th>
<th>Capabilities to be developed</th>
</tr>
</thead>
</table>
| 31321100  | A1          | Asset Management | EHV Conductors and Fittings (LOT 1) | Condition Assessment of EHV (voltages above 11kV) Overhead Line Conductors and Fittings:  
Overhead Lines are an essential part of UK Power Network’s network infrastructure and many were built prior to nationalisation and during the period of rapid electrification in the 1950’s/60’s. Most structures supporting these are over fifty years old, with some being more than eighty years old. In particular, UK Power Network owns the 132kV grid system that was transferred from the CEGB in 1981. The original conductors on these structures were predominately ACSR, but Hard Drawn Copper and Cadmium Copper conductors were also used.  
In the intervening period since construction, several Overhead Lines have been reconducted with ACSR on a like-for like basis (or where necessary and possible with larger conductors). Since the 1980’s AAAC conductors have also been used, as this material has greater capacity without the corresponding increase in weight. When reconductoring occurs, it is normal to replace the associated fittings (including insulators as well as spacers and dampers).  
Failure of ACSR conductor occurs when the supporting steel core deteriorates either through corrosion or is annealed. The steel core is protected by high temperature grease and some earlier conductors had a bitumen paste layer. Inspection of the steel core is difficult as it is surrounded by the conductive aluminium strands, so is impossible to see. In 1985, an electromagnetic device (Corman) was developed by CERC which could travel along a conductor and induce eddy currents into the conductor. These eddy currents were sensitive to strand corrosion which allowed the early | UK Power Networks is seeking to develop new technologies or methods that can detect or predict defects in overhead line conductors and fittings, including:  
Conductors (ACSR, ACCC, bare Cu, covered Cu):  
- Corrosion (caused by water ingress), especially ACSR steel cores, and underneath the sheath of non-water-blocked covered copper conductors  
- Surface oxidation (caused by pollution)  
- Metal fatigue (caused by vibration)  
- Annealing (caused by overheating)  
- Loss of grease (caused by overheating).  
Fittings  
- Loss of galvanising layer  
- Mechanical wear on attachment points (caused by vibration)  
- Corrosion  
- Water ingress  
- Dirty insulators (caused by pollution).  
All methods and technologies must be:  
- Non-intrusive  
- Non-destructive  
- Not require the line to be de-energised  
- Not require personnel to breach the working and access clearances defined in the UK Power Networks Distribution Safety Rules. |
stages of internal corrosion to be identified. UKPN has several of these Corman devices, but they are reaching the end of their life and need replacement.

HD and Cadmium copper conductors do not fail in the same way, but can suffer from fatigue fracture due to long term vibration. Long and/or exposed spans are particularly susceptible to this failure mode. In addition, covered conductors (particularly PVC coverings) which are not water blocked have suffered from chemical corrosion under the sheath resulting in early life failures. In the UK covered conductor has not generally been used above 33kV construction.

All Aluminium Alloy Conductor (AAAC) can deteriorate due to oxidation of the surfaces especially in polluted areas, annealing or fatigue fracture due to vibration. As with ACSR, the conductor is manufactured with high temperature protective grease. Most AAAC conductor is under thirty years old so is not considered to be at as high as risk of failure.

UK Power Networks currently visually inspects overhead line fittings and correlate it to a fitting condition based on lab tests. This is not a deterministic process.

Overhead Line Fittings are a mixture of:

- Porcelain or toughened Glass, which is generally very stable and does not suffer from aging or deterioration. However, it can physically break under impact or fail electrically when exposed to high voltages or if polluted. Under this later condition, the heat generated in the flashover has been known to melt the porcelain or glass surfaces. Galvanised steel, which will need replacement once

- Not require personnel to work at heights, e.g. climbing poles or towers
- (Ideally) Non-contact
- Able to assess hidden components e.g. ACSR steel cores, and metal pins cemented inside insulators.
- Cost-efficient
- Easy to deploy by two personnel.
<table>
<thead>
<tr>
<th>Asset Management</th>
<th>A2</th>
<th>Fluid Filled Cables (LOT 2)</th>
</tr>
</thead>
</table>

- Cement, which is used to secure the galvanised metal parts to the porcelain or toughened glass portion of insulators can deteriorate due to water ingress. Expansion of any ingressed water or corrosion jacking due to corrosion of the internal metal surfaces can exert sufficient pressure in the confined space to result in breakage of the surrounding porcelain or toughened glass.

UK Power Networks has a large population of fluid-filled cables (FFCs), which due to their age, have an increased risk of leaks. In the long term, leaks could be eliminated by replacing FFCs with modern XLPE cables, but is not feasible in the short or medium term.

FFC leaks cause a number of issues, including:

- **Time to locate and repair leaks:** Existing methods take a long time, and require the FFC to be de-energised, which reduces the network’s resilience for the duration of the work. This also requires engineering resources for lengthy periods, and increases labour costs.

- **Safety:** Although new leak location techniques such as the use of a Perfluorocarbon tracer have been introduced, conventional methods use liquid nitrogen to freeze a section of cable, which exposes our staff to the hazards of handling and using liquid nitrogen in the field.

UK Power Networks is seeking to reduce the risks and cost of FFC leaks, by developing new technologies or methods that could help:

- Reduce or eliminate the root causes of leaks, which include:
  - Third party damage leading to rupture of the metallic sheath
  - Ageing/corrosion of metallic sheaths due to thermal stress, mechanical stress or vibration
  - Lead sheath crystallisation
  - Changes in the thermal resistance of the soil surrounding the cable
  - Degradation of terminations
  - Ground movement.

- Reduce the cost, time, safety risks, network reliability impact, and environmental impact of leaks that cannot
### Environmental impact:
Leaks can contaminate the surrounding ground, and may result in reportable environmental incidents.

### Network reliability:
Leaks cause the pressure inside the cable to drop, which can lead to a cable insulation fault. These faults can potentially interrupt supply to large numbers of customers.

be prevented, for example:
- Minimise the leakage rate
- Minimise the pressure drop, and/or the risk of insulation failure
- Reduce or eliminate the hazards associated with using liquid nitrogen
- Contain leaks, to limit the extent of ground contamination
- Reduce or eliminate the need to de-energise the cable to locate and repair leaks
- Reduce the time needed to locate and repair leaks.

<table>
<thead>
<tr>
<th>34928210</th>
<th>A3</th>
<th>Asset Management</th>
<th>Wood Poles (LOT 3)</th>
</tr>
</thead>
</table>

Wood poles have been used to support overhead lines at voltages from LV to 132kV trident construction. The wood poles used for this purpose are generally imported redwood (Pinus silvestris) treated with creosote under sufficient pressure to ensure complete impregnation of all the sapwood after the timber has been seasoned and all fabrication completed. In the past preservation treatment and seasoning requirements have varied resulting in poles having different susceptibility to decay.

During the pole’s life, additional chemical treatment such as Cobra (identified by labels and an aluminium sheet around the pole at ground level) or inserted rods / injections of Boron have been applied to poles in service to provide additional protection. These treatments are normally applied close to ground level.

Both internal and external wood pole decay usually occurs at or just below ground level, where both air and

UK Power Networks is seeking to developing new technologies or methods that can detect or predict defects in wood poles, including:

- Internal decay
- External decay
- Below-ground decay
- Other indicators of imminent failure.

All methods and technologies must be:

- Non-intrusive
- Non-destructive
- (Ideally) not require excavation to identify below-ground defects
- Cost-efficient
water are continuously present, but external decay can take place at any point along a pole especially where the wood has been damaged, for example by woodpeckers. Poles that have been fabricated or shortened on site (i.e. post treatment) are also more susceptible to both internal and external decay at this point.

The structural capability of poles enables them to be treated as cylinders, so external decay is more important than internal decay. The highest mechanical stress point for standard Line Poles (which are subject to cantilever loads) is at one third of the distance between ground level and the pole butt. This emphasises the need to test for decay below ground level. Angle and terminal poles are however subject to vertical crippling loads and therefore the thinnest section of pole, normally at a higher level (due to pole taper) is the most susceptible.

Historically pole decay has been detected by a cost effective hammer and auger method. This method is no longer used due to the resultant damage caused by the sample hole. A needle thin resistivity drill is preferred. Ultrasonics have been shown to detect decay and EA Technology produced the Pole Ultrasonic rot locator (PURL) in the 1990's.

The requirement is the development of a tool that can quickly and accurately detect wood pole decay, especially below ground level without the need for excavation.

<table>
<thead>
<tr>
<th>31214000</th>
<th>A4</th>
<th>Asset Management</th>
<th>Link Boxes (LOT 4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>UK Power Networks has over 110,000 link boxes across its network. Disruptive failures of these link boxes cause a number of issues including:</td>
<td>UK Power Networks is seeking to reduce the risks and cost of disruptive link box failures, by developing new technologies or methods that could, for example:</td>
</tr>
</tbody>
</table>

- Easy to deploy by two personnel
- Time-efficient.

UK Power Networks is also interested in techniques to enable faster pole replacement or pole renovation.


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- **Safety:** These failures are a safety hazard to our staff and to the public.
- **Network reliability:** These failures can potentially interrupt supply to large numbers of customers.

Investigations have shown the primary cause of failure of the bitumen-filled link boxes is water ingress due to corrosion of the cable glands, mechanical damage, or compacted dirt in the link box frame sealing groove. Excess load or poor electrical contact on the links is a secondary cause of failure.

For the cast resin filled link boxes, the primary cause of failure appears to be condensed water on the inner surface of the bell cover, which runs down and collects on top of the cast resin plastic phase covers.

UK Power Networks currently conducts visual inspection of link boxes which are used as an input to the link box asset replacement priority model. The results from this model determine the priority of link box replacement programme.

- **Reduce or eliminate water ingress**
- **Detect or measure water ingress**
- **Identify incipient link box failures and enable targeted interventions.**

Technologies or methods must be:
- **Reliable**
- **Rapidly deployable across our entire network**
- **Cost efficient**
- **Be easily retrofitted to existing link boxes**
- **Ideally the manufacture of a sturdier link box that can withstand the forces currently experienced by link boxes.**

UK Power Networks is also interested in novel battery-powered communications technologies that can help. Sensors and their communications must be able to communicate through a link box cover without opening the link box, and when the inspector is present. Technologies used in tyre pressure monitoring and Near-Field Communications are of interest.

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<table>
<thead>
<tr>
<th>LOT</th>
<th>Company</th>
<th>Contact</th>
<th>Product Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>31320000</td>
<td>A5</td>
<td>Asset Management</td>
<td>High Voltage Underground Cables (LOT 5)</td>
<td>UK Power Networks owns approximately 140,000 km of underground cables ranging from LV to 132kV. Faults are occurring more frequently as the cables age.</td>
</tr>
<tr>
<td>31321210</td>
<td>A5</td>
<td>Asset Management</td>
<td>High Voltage Underground Cables (LOT 5)</td>
<td>The primary causes of underground HV cable faults are:</td>
</tr>
<tr>
<td>31321220</td>
<td>A5</td>
<td>Asset Management</td>
<td>High Voltage Underground Cables (LOT 5)</td>
<td>1- Age deterioration</td>
</tr>
<tr>
<td>31321300</td>
<td>A5</td>
<td>Asset Management</td>
<td>High Voltage Underground Cables (LOT 5)</td>
<td>2- Third party damage</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>3- Condition of the cables</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td>4- Environmental condition</td>
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<tr>
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<td>UK Power Networks intends to develop a proactive approach to asset management and replacement of underground cables. To enable this, we are seeking to:</td>
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<td><strong>Develop an asset degradation model for all of our underground cable assets.</strong> The outputs from the model could include, for example:</td>
</tr>
<tr>
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<td>- A health index and criticality index for each cable asset</td>
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<td></td>
<td></td>
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<td></td>
<td>- Estimate of remaining economic service life for</td>
</tr>
</tbody>
</table>
The issues to be resolved include:

- **Visibility of asset condition.** We have installed on-line partial discharge monitoring systems on approximately 1000 HV cable circuits, however apart from these, our view of asset condition and replacement priority is based mostly on age profiling, and anecdotal evidence such as fault trends.

- **Relationship between Partial Discharge (PD) activity and time to failure.** Whilst the existing generation of monitoring equipment and processing algorithms can effectively identify genuine PD and display trends, time to failure is difficult to predict as the presence of PD alone is not considered to be an indicator of an imminent failure.

- **Asset data management.** Information about our underground cable assets exists, but needs to be collated and verified before it could be used to inform a proactive asset management approach.

- Probabilistic estimate of CIs and CMLs that each cable asset will cause, and the CI/CML improvement that could be achieved by replacing the asset

- Ranking of cable assets for replacement priority

- Cost estimate to replace each cable asset.

- **Develop methods or technologies that will enable us to efficiently capture, verify, and manage the input data to the model.** Inputs to this model could include, for example:
  
  - Physical data: e.g. location, length, type, size, installation conditions, joints, etc.
  
  - Service history: e.g. commissioning date, loading history, fault records, repair records
  
  - Condition information: e.g. commissioning and post-repair test results, partial discharge measurements, distributed temperature sensing.

In addition, we are also seeking to develop methods or technologies that could, for example:

- Reduce the risk of third-party damage to underground cables

- Novel, cost-efficient, easy-to-retrofit, on-line measurement techniques to monitor underground cables’ condition, and detect and locate incipient faults

- Maximise the use of our existing online partial
<table>
<thead>
<tr>
<th>Project Code</th>
<th>Lot</th>
<th>Department</th>
<th>Description</th>
<th>Innovation Objectives</th>
</tr>
</thead>
</table>
| 35111500 | A6 | Asset Management (Civils) | Fire Suppression Systems (LOT 6) | UK Power Networks has a large number of existing CO₂ fire suppression systems. The issues to be addressed include: 
- **Cost of maintenance**: Gaseous fire suppression systems require frequent testing and maintenance; for example, gas cylinders must be pressure tested and replaced every 10 years. 
- **Safety**: CO₂ fire suppression systems expose our staff to a serious risk of injury or death by toxicity or asphyxiation. CO₂ inhalation incidents are especially likely during maintenance on or around the CO₂ fire suppression system itself. 
- **Environmental Impact**: Discharge and leakage from CO₂ and HFC fire suppression systems contribute to our greenhouse gas emissions. | UK Power Networks is seeking to address these issues by developing new technologies or methods that could, for example: 
- Reduce the maintenance requirements for existing gaseous fire suppression systems, without compromising safety or reliability. 
- Reduce the risk of unwanted gas discharge (i.e. false operation of fire suppression systems). 
- Reduce gas leakage during normal service, maintenance, and decommissioning. 
- Improve the safety of existing CO₂ fire suppression systems. 
- Minimise the cost of replacing existing CO₂ fire suppression systems with modern alternatives. 
- Eliminate the need for pressure vessels (gas cylinders). 
- Eliminate the need for existing fire suppression systems. 
- Novel automatic fire suppression methods that are not yet proven in a GB DNO substation environment. |
| 48461000 | A7 | Asset Management (Civils) | Preventative Maintenance of Civil Assets (LOT 7) | Civil assets such as substation buildings and cable tunnels degrade over time due to age, exposure to various and sometimes harsh environmental conditions etc. Therefore, inspections of all civil assets are required in order to ensure that their condition is fit for purpose. However, the optimal frequency of civil assets inspections is difficult to achieve. The more frequent the inspections, the higher the associated cost. The less frequent the inspections, the lower the associated cost. | The development of an advanced condition monitoring, modelling and reporting tool for Civil assets will assist in sustaining a well-maintained and safe distribution network at a lower cost. The tool should include most of the following functionalities: |
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<table>
<thead>
<tr>
<th>31200000</th>
<th>A8</th>
<th>Asset Management (Distributed Generation)</th>
<th>Management of small-scale distributed generation (LOT 8)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>UK Power Networks has experienced unprecedented growth in connection of distributed generation over the last three years in the Eastern and South Eastern parts of its networks. The growth has given rise to upstream thermal constraints (thermal capacity of grid and supergrid transformers) which can pose significant barriers to further connection of further distributed generation, including small-scale distributed generators (typically G59 generators smaller than 200kW).</td>
</tr>
</tbody>
</table>

- Assess the current condition of civil assets
- Identify civil assets that are degrading faster compared to similar civil asset types by taking into account environmental conditions, current and past asset conditions etc.
- Indicate which assets could last longer with minor interventions
- Prioritise asset refurbishment and/or replacement
- Assess the impact of delaying the refurbishment/replacement

UK Power Networks is currently rolling out flexible DG connections for larger generators and is looking to develop capabilities to:

- Assess the risk to the security of the network from additional small-scale generation in areas where the capacity has diminished using a mixture of deterministic and “probabilistic” approaches.
- Safely curtail or disconnect small-scale generators for upstream constraints (132kV in instances) under contingency (N-1,N-2) scenarios. This is likely to involve some form of aggregation of small-scale generation in order to deliver the expected benefit, particularly at secondary /primary substation level.
- Use small-scale generation to provide local reactive power support to lower voltage network in situations where UK Power Networks identifies the need (e.g. high/low volts, losses strategy). The business case for this approach should be favourable and interactions.
Call for Innovation Ideas
UK Power Networks Innovation Portfolio Development

<table>
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<tr>
<th>Ref</th>
<th>Lot</th>
<th>Description</th>
<th>Details</th>
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</table>
| 7160000 | A9 | Asset Management (Power Quality Management) (LOT 9) | The impact of harmonics on the DNO’s network are largely unknown and further understanding of their impact is required. Several areas exist where existing understanding can be furthered which includes identifying how harmonics affect particular types of equipment, and the limits that harmonics can be taken to before damage to equipment is experienced.  
  
The ultimate aim will be to consider existing G5/4 limits and identify whether they are still valid or whether equipment immunity has progressed since the limits were first suggested. Further areas to be considered include accurate measurement of higher order harmonics and effectively modelling harmonic behaviours once background harmonic levels are known. |

With existing voltage control strategies accounted for.

The control approaches / systems proposed will need to consider suitable robust communications if required and be cost-effective even at the lower levels of the range (below 50kW). The trade-off between the cost of such systems and level of complexity of the control actions UK Power Networks needs to be considered.

The approach needs to be repeatable, scalable and safe.

UK Power Networks is seeking to better understand the following:
- Impact of harmonics on various equipment.
- Identify under what conditions (and where) harmonic issues could potentially occur by modelling a susceptible network, and verifying the modelling with physical measurements on a real distribution network.
- How typical connection arrangements (e.g. type, frequency response, and placements of CTs and VTs) impacts the accuracy of conventional harmonic measurement equipment.
- Show how dynamic monitoring and display of network harmonic conditions can allow the active management of harmonic issues.
- Understand the impact of harmonics on network losses.
- How the data from a network of fixed power quality monitoring devices can be used in a modelling environment for system coordination and analysis.

Multiple power quality recording points on the same network has not been used in modelling to date.
UK Power Networks is also interested in innovative technologies to mitigate against breaches of harmonic limits.

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<tr>
<th>LOT</th>
<th>Category</th>
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<tbody>
<tr>
<td>72210000</td>
<td>S1</td>
<td>Safety Induced Voltages (LOT 10)</td>
<td>UK Power Networks is interested in innovative technologies to mitigate against breaches of harmonic limits.</td>
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<tr>
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<td>Induced voltages can be hazardous if no mitigation measures are utilised when working on a de-energised circuit in the vicinity of a live cable or overhead line. The UK Power Network current practice for assessing the hazard associated with induced voltages involves referring to a relevant National Grid standard. The standard does not provide any guidance on induced voltages calculations and safety thresholds.</td>
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<tr>
<td>71600000</td>
<td>S2</td>
<td>Safety Working at height (LOT 11)</td>
<td>UK Power Networks is seeking technological solutions that will remove the need for working at height by being able to conduct inspections of poles and various equipment from the ground. The technology solution shall be cost efficient and easy to deploy with existing equipment (i.e. requires at most two people to deploy the solution on site).</td>
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<td>National statistics for 2012/13 reveal that there were 5382 reported incidents of falls from height, 47.8% leading to major injuries. Specifically, for work at height undertaken by utility companies, the percentage of accidents for last year was 3.58% with statistics for this year showing an increase to 4.3% so far. (1)</td>
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<td>A number of activities undertaken by a Distribution Network Operator (e.g. pole and equipment inspections and repairs) require working at height. Although safety measures are in place and adhered to, UK Power Networks is seeking to further reduce this safety risk by eliminating the need to work at heights through technology innovation.</td>
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<td>Project Code</td>
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<tr>
<td>73000000</td>
<td>S3</td>
<td>Safety</td>
<td>Live Line working (LOT 12)</td>
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<tr>
<td>90742000</td>
<td>S4</td>
<td>Safety</td>
<td>Noise Impact (LOT 13)</td>
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<td>71300000</td>
<td>S5</td>
<td>Safety</td>
<td>EMF (LOT 14)</td>
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<td>71600000</td>
<td>S6</td>
<td>Safety</td>
<td>Asset disposal (LOT 15)</td>
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<tr>
<td>31200000</td>
<td>S7</td>
<td>Safety</td>
<td>Earthing of mobile generators (LOT 16)</td>
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## Call for Innovation Ideas
### UK Power Networks Innovation Portfolio Development

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| effective earthing of the generator which is crucial for the safety of UK Power Networks personnel and third parties. In certain areas such as city centres, these generators cannot be earthed easily using the conventional method of staking an earth rod in the ground. Current methods of addressing the problem vary depending on the location, but could involve:  
- Earthing the frame of the generator using an earth at a customer’s premise (e.g. metal fence of a garden). This requires getting the customer’s consent.  
- Drilling a hole in the concrete ground, stake an earth rod and cover the hole afterwards. This causes public disruption, increases operational costs and time on site.  |
| and touch safety hazards that may arise at the customer’s premises due to the earthing arrangement of the mobile generator. |

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<tr>
<th>44110000</th>
<th>C1</th>
<th>Capital Programme</th>
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</table>
| Alternative Construction Materials (LOT 17) | Traditional construction materials have a proven overall performance (e.g. durability, strength, thermal performance, etc.). However, they can have a number of disadvantages:  
- They can be costly and constitute a significant proportion of construction cost.  
- The construction timescales using these materials can be lengthy which increases cost and health and safety risks for personnel on-site during construction.  
- High carbon footprint.  |
| UK Power Networks is seeking alternative construction materials for high value items such as building materials, equipment footings and transformer bunds. The alternative materials should have the following properties:  
- Similar or better performance compared to traditional materials, with an emphasis on longevity/durability and structural strength.  
- Enable lower construction cost. (For example, faster curing times of the materials could lead to the reduction of construction time and hence any associated cost. Savings could also come from materials that could offer the same performance and strength as conventional materials.) |
## Call for Innovation Ideas

**UK Power Networks Innovation Portfolio Development**

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<tr>
<th>capital programme</th>
<th>Design and Construction – Build off site (LOT 18)</th>
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<tbody>
<tr>
<td>44210000 C2</td>
<td>Load growth and a growing number of distributed generation connection requests are increasing the need for new build and network reinforcement. DNOs are facing increasing pressures to be more cost efficient with meeting these needs.</td>
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<tr>
<td>45000000</td>
<td>Traditional new build and reinforcement building techniques have the following disadvantages:</td>
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<td>- They can be costly and time consuming as a larger construction site is required.</td>
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<td>- Bespoke designs and components cause difficulties in future expansion and replacement when faults occur. In addition, they are usually more expensive to produce than standardised components.</td>
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<td>- They can lead to an increase in safety risk, as</td>
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UK Power Networks is looking to develop and use novel build off-site techniques which can reduce the construction time, and therefore minimise the cost of construction projects.

The build off-site techniques entail pre-fabricated components which are delivered and assembled on site. An example of an existing off-site building technique is pre-cast concrete building walls. Note that existing techniques utilised in the UK DNO industry are excluded from this call for innovation ideas.

The alternative methods/techniques developed should meet the following requirements:

- Be scalable for small and large build for different types of assets (e.g. from switch houses to transformer...

The following materials are excluded from the alternative construction materials UK Power Networks is seeking:

- Glass-reinforced plastic (GRP) unless referring to a type with superior durability compared to the conventional types of GRP.
- Flammable materials, such as wood etc.
### Call for Innovation Ideas
**UK Power Networks Innovation Portfolio Development**

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<th>C3</th>
<th>Capital Programme</th>
<th>Design and Construction - Containerisation (LOT 19)</th>
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<td>44210000 45000000</td>
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Load growth and a growing number of distributed generation connection requests are increasing the need for new build and network reinforcement. DNOs are facing increasing pressures to be more cost efficient with meeting these needs.

Traditional new build and reinforcement building techniques have the following disadvantages:

- They can be costly and time consuming as a larger construction site is required.
- Bespoke designs and components cause difficulties in future expansion and replacement when faults occur. In addition, they are usually more expensive to produce than standardised components.
- They can lead to an increase in safety risk, as personnel need to be on site for longer periods of time.
- Generates a significant amount of construction materials waste.

UK Power Networks is seeking to develop a novel approach to containerisation of DNO assets, which will reduce construction time and the associated costs.

Ideally the novel approach will expand containerisation capabilities to include and be suitable for the construction of more types of assets (currently limited to switch houses).

New types of materials should offer good performance and durability.

The approach should also accommodate for the standardisation of containerised assemblies, which will offer greater flexibility in meeting future reinforcement/expansion needs. The standardisation of containerised assemblies will also reduce the cost of construction, since the manufacturing of bespoke parts is more costly than serialised production.

Last but not least, the containerisation approach developed (e.g. new type of containerisation, new materials used or combination of both etc.) should be less intrusive and allow for potential decrease of the construction’s carbon footprint.
<table>
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<tr>
<th>71500000 90710000</th>
<th>C4</th>
<th>Capital Programme</th>
<th>Improvement of construction related Carbon Footprint (LOT 20)</th>
</tr>
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<tr>
<td>Containerisation entails the construction and fit out of the container off site. The container with its housed equipment is then transported to site and fixed to its corresponding foundation on site. No assembling of parts occurs on site. Containerisation addresses most of the disadvantages mentioned above. However, the materials currently used for containerisation do not have a proven durability compared to conventional materials. The technology has only been applied to a small set of DNO-related assets.</td>
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<th>38431300</th>
<th>N1</th>
<th>Network Operations</th>
<th>LV Underground Cable Faults (LOT 21)</th>
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<td>Carbon footprint is the overall amount of greenhouse gas emissions, consisting primarily of carbon dioxide, associated with an organisation, event or production. It is one of the most common measures of the effects of an individual, community, industry, or country on the environment. National and international legislation is currently setting drivers for the UK to reduce its carbon footprint (reduce CO2 emissions by 80% below 1990 levels by 2050) in an attempt to help prevent the further exacerbation of environmental problems, such as global warming and climate change. In relation to the built environment in particular, the Green Construction Board have developed a Low Carbon Route map for the Built Environment to help meet UK’s 2050 targets.</td>
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In order to reduce its carbon footprint and be more proactive, UK Power Networks is seeking to develop a carbon calculation tool with the following capability:

- Identification of ways to improve the CO2 footprint for all UK Power Networks related activities, and at a reduced or equivalent cost compared to traditional techniques.

The LPN LV network is predominantly underground. Analysis of the fault data for the LPN network from 2002 to date shows that LV network faults contribute approximately 90%, 30% and 60% to LPN fault count, customer interruption (CI) and customer minute lost.

UK Power Networks is seeking a cost efficient technological innovation that will satisfy the following needs:

- Improve the existing accuracy of locating LV cable faults
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UK Power Networks Innovation Portfolio Development

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<th>72230000</th>
<th>N2</th>
<th>Network Operations</th>
<th>Storm Response (LOT 22)</th>
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</table>

(CML) figures respectively. Intermittent single phase to earth faults (i.e. the fuse is replaced without the fault being found) account for at least 50% of the LV faults.

Cable faults have the following negative impact:

- Weakens cable insulation
- Electrostatic stresses on the busbar of the faulted cable due to induced voltage on health phases by the single phase to earth fault
- Increased fault count, CIs and CMLs figures.

The timely and accurate identification and repair of LV faults will have a positive impact on the LV network fault count, CIs and CMLs. This will improve the overall network performance.

The technology currently used by UK Power Networks for the location of intermittent faults does not provide sufficient accuracy. It is accurate to within +/-50 metres of the actual fault location. It may require several fuse operations before the fault location can be established. The more accurate gadgets available in the market can only be connected to the network at Normally open points and this limits its application to radial networks only.

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<tr>
<th>72200000</th>
<th>Adverse weather conditions (high speed winds, snow etc.) can cause widespread overhead line (OHL) faults and bring down OHL which will have a negative impact on the network performance.</th>
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</table>

It is not economically astute to construct networks that can withstand all conceivable adverse weather conditions.

UK Power Networks is seeking to develop technologies or solutions to be more efficient during storm conditions. An example is more accurate estimated time to restoration taking into account weather condition and the level of available resources.

- Requires less time to locate the fault
- Be more flexible with installation location in the network (i.e. can be installed at locations other than normally open points)
- Easily deployed across the LV network.
conditions. The feasible solution is to respond quickly to faults. This requires resources to be available for deployment in the event of such an event. It is crucial to optimise the scheduling of resources to balance costs and response time.

Excluded from the capabilities to be developed are:

- The determination of the spatial distribution of faults in relation to weather conditions.
- The determination and optimisation of resource levels for fault repair within acceptable fault restoration time.