Notes on Completion: Please refer to the appropriate NIA Governance Document to assist in the completion of this form. The full completed submission should not exceed 6 pages in total.

NIA Project Registration and PEA Document

Date of Submission

Dec 2021

Project Reference Number

NIA2_NGET0007

Project Registration

Project Title

EPRI Research Collaboration on Electric & Magnetic Fields Health & Safety (P60) 2021-25

Project Reference Number

NIA2_NGET0007

Project Licensee(s)

National Grid Electricity Transmission

Project Start

December 2021

Project Duration

4 years and 1 month

Nominated Project Contact(s)

Anusha Arva (Box.NG.ETInnovation@nationalgrid.com)

Project Budget

£1,886,480.00

Summary

Electric and magnetic fields (EMF) are present whenever and wherever electricity is generated, transmitted, and used. Radiofrequency (RF) emissions are prevalent due to the adoption of wireless communication devices, smart meters, inverters, etc. Understanding and concerns around potential environmental health and safety impacts related to these EMF and RF exposures are evolving as the need for electrification and grid resiliency increases. Through this project, National Grid Electricity Transmission (NGET) will collaborate with Electric Power Research Institute (EPRI) to carry out fundamental research to assess the uncertainties and potential impact of EMFs and RFs on human and non-human biota, develop models and characterization for EMFs and RFs, and synthesise global developments in the field, for use in the UK energy industry.

Preceding Projects

NIA_NGET0208 - EPRI Research Collaboration on Electric & Magnetic Fields Health & Safety (P60) 2017 -2021

Third Party Collaborators

Electric Power Research Institute

Nominated Contact Email Address(es)

box.NG.ETInnovation@nationalgrid.com

Problem Being Solved

Electric and magnetic fields (EMF) are present whenever and wherever electricity is generated, transmitted, and used. Radiofrequency (RF) emissions are prevalent due to the adoption of wireless communication devices, smart meters, inverters associated with renewable sources, etc. Scientific debate on whether EMF and RF exposures impact potentially impact environmental health and safety is inconclusive so far, while the need for electrification and grid resiliency is increasing. Utilities like NGET are

responsible to address stakeholder concerns as part of managing a robust public health and worker safety program and ensuring timely development and application of a more modern grid. Utilities also have a responsibility to provide stakeholders with most up-to-date, credible, consistent, and timely information regarding EMF exposures and potential health impacts.

Method(s)

NGET recognise that the challenges faced by the electricity industry can be more efficiently and cost-effectively addressed when approached through international collaboration initiatives. It is particularly useful when addressing challenges where the solutions require statistically diverse data sets and/or significant trialling and testing in different environments, under various conditions and/or diverse ways.

EPRI, with its wide international membership, is one of the routes through which these initiatives can be delivered, thereby maximising stakeholder value. The approach of managing collaborative projects within an internationally driven research and development initiative is beneficial to NGET and consumers alike, because it provides valuable information, learning and knowledge that would be considerably more expensive if approached on an individual basis.

The question of whether EMFs are linked in any way to ill-health in human and non-human biome is a long-standing debate for which there is no scientifically conclusive answer and extensive research is in progress. As a responsible business, NGET ensure effective management of EMF issues through an EMF management strategy that is informed by cutting edge medical research on potential health impacts on from EMF and RF exposures. Continued access to high quality research regarding EMF and RF exposures is central to ensuring that electricity assets can be operated effectively and safely. To facilitate this, NGET have been closely involved in Program 60 (P60): Electric and Magnetic Fields and Radio-Frequency Health Assessment and Safety, carried out by EPRI. There are two strands in this program, each with multiple research tasks:

- 60A – Health Studies and Risk Communication
- 60B – Exposure Characterization and Management

Data Quality Statement (DQS):

- The project will be delivered under the NIA framework in line with OFGEM, ENA and NGET internal policy. Data produced as part of this project will be subject to quality assurance to ensure that the information produced with each deliverable is accurate to the best of our knowledge and sources of information are appropriately documented. All deliverables and project outputs will be stored on our internal SharePoint platform ensuring access control, backup and version management. Deliverables will be shared with other network licensees through following channels:
  - Executive summaries of EPRI reports through the EPRI website
  - Closedown reports on the Smarter Networks Portal.
  - Journals and paper publications
  - UK wide conference organised by NGET and EPRI annually
  - Posts on public-facing website www.emfs.info
  - ENA's EMF Strategy Committee proceedings

Measurement Quality Statement (MQS):

- The methodology used in this project will be subject to supplier's own quality assurance regime. Quality assurance processes and the source of data, measurement processes and equipment as well as data processing will be clearly documented and verifiable. The measurements, designs and economic assessments will also be clearly documented in the relevant deliverables and final project report and will be made available for review.

In line with the ENA's ENIP document, the risk rating is scored Low.

TRL Steps = 1 (2 TRL steps)

Cost = 3 (£1.886m)

Suppliers = 1 (1 supplier)

Data Assumption = 1 (Assumptions and principles are well defined as this is the continuation of the research carried out in NIA_NGET0208)

Scope

EPRI research programs contain multiple strands which span multiple years. Research objectives are revised every year based on the

most recent outcomes. Scope of the two strands within P60, for the next 2 years are outlined as follows:

PS60A: Health Studies and Risk Communication: This strand investigates health outcomes from EMF and RF exposures by:

- Conducting novel scientific research to help resolve key uncertainties related to residential EMF exposure and health outcomes. This may include conducting high-quality epidemiology studies and/or synthesis of health research. This will be carried out through:
  - TransExpo, which is an international, multi-year study of Childhood Leukaemia (CL) focusing on populations living in apartment buildings with built-in transformers
  - CL and EMF Pooled Analysis, which is a pooled analysis of 14 new epidemiology studies on CL risks that have been published since 2000 to validate a meta-analysis outcome that risk of CL is reducing
  - Alternative Hypothesis for CL and Transmission Lines, which explores an alternative hypothesis for CL that could be associated with transmission line rights-of-way but is not EMF related such as pesticides, population demographics, etc.
- Conducting research on emerging health and environmental concerns from application of technologies such as HVDC lines, 5G, hybrid lines etc. This will be carried out through:
  - Evaluation of the Scientific Literature on Potential Health Effects on Humans and Animals from High Voltage Direct Current (HVDC) and Hybrid Lines, a study on health impacts from the generation of air ions near electricity assets on humans and animals
- Developing research summaries and information using the latest available science to inform member risk communication plans. This will be carried out through:
  - Electrohypersensitivity (EHS) Information Sheet, which is a technical brief answering most common questions around EHS, a condition where people regularly experience a range of symptoms which could be caused by exposure to (EMF) usually well below established exposure limit values
  - 5G Information Sheet, a technical brief that will provide answers to the most commonly asked questions and/or misunderstandings about 5G that members may use to inform their risk communication plans
  - Developing EMF Training Modules to aid knowledge transfer in the industry

PS60B Exposure Characterization and Management: This strand addresses the electric utility industry's occupational concerns regarding exposure to EMF and RF emissions by:

- Developing source measurement methods, calculational tools, and industry exposure databases to assist in characterizing the EMF and RF fields. This will be carried out through:
  - EMF Occupational Database 1.0, an innovative exposure database that EPRI members can use to help inform their characterization and assessment of magnetic fields for typical equipment and tasks in the electric power industry
  - Updates to EMF Management Reference Book Second Edition
  - 5G Exposure Measurements, that looks into developing a measurement protocol to practically assess the potential exposures to workers and members of the pubic from the deployment of 5G equipment
  - Assessment of RF exposures from Smart Home and Smart City technologies
- Investigating exposure mitigation options and approaches
- Developing exposure management practices and guidance
  - Electrical Vehicle (EV) Charging Measurements, looking into characterization measurements during vehicle charging for a representative sample
  - Factors Affecting Extra Low Frequency (ELF) Immunity Limits for Implantable Medical Devices, a study investigating effects and implications of ELF EMF on operational staff with medically implanted devices
- Integrating aspects of at-pace learning for new occupational EMF issue managers and other stakeholders for knowledge transfer

Objective(s)

The objectives of this project is to continue the work in NIA_NGET0208, to generate the following updated outputs:

- timely, reliable EMF and RF scientific research results, communication materials, relevant background information, and analysis of key external studies
- publicly accessible, up-to-date information on EMF and RF research, health risk evaluations, and regulatory actions
- experimental and epidemiologic research investigating high-priority residential and occupational EMF and RF health and safety questions
- EMF workstation software for modelling transmission and distribution infrastructure EMF in residential and occupational settings
- EMF and RF exposure characterisation research and exposure assessment software
- educational materials, including instructional EMF/RF DVDs, tutorials, and RF safety awareness training
- comprehensive assessment of the potential effects of EMF on aquatic life from submerged cables;
- investigation of potential EMF interaction with implanted medical devices

Consumer Vulnerability Impact Assessment (RIIO-2 Projects Only)

Financial distributional impact:

This project ensures that NGET and the UK energy industry are at the forefront of global developments in EMF research, enabling the industry to make decisions that are safe to workers as well as public, and are backed by research. With access to the latest in EMF research, NGET will be able to avoid additional costs required to put EMF mitigation measures in place on major infrastructure projects. These expensive EMF mitigation measures would result in an increase in consumer bills.

Furthermore, the leveraged funding mechanism in EPRI programs ensure that expensive research can be carried out at subsidised rates, thereby ensuring the best value for consumers' money.

Technical and wellbeing impact:

There is uncertainty in the science around whether EMF cause or contribute to ill health. This uncertainty relates to health conditions such as childhood leukaemia, neurodegenerative diseases and is associated with high residential magnetic field strengths and birth address in proximity to OHLs. Birth address and proximity to OHLs are related to socio economic status, such as social housing. This project carries out research to understand if this potential risk is real, and secondly if it is disproportionately affecting vulnerable customers.

There are also issues around secondary effects, such as microshocks and interactions with implantable devices which can impact occupational workers and members of the public in close proximity to OHLs, which again could disproportionately affect vulnerable customers. This needs further investigation to understand and protect those closest to our assets.

The outcomes from this research will inform and enable the energy industry to take appropriate measures in the best interest of consumers, particularly in the vulnerable category, as the world transitions to a Net Zero future.

Success Criteria

The overall project comprises multiple strands of work. Progress should be expected on each strand during each calendar year of the subscription, but not necessarily that each strand would be completed within the calendar year. The project will be considered successful if it generates rolling updates on the two strands (P60A and P60B) within the P60 program through EPRI's annual deliverables, during the duration of this project.

Project Partners and External Funding

Each strand facilitated by an EPRI P60 programme is funded through collaborators, including NGET, that contribute to the development of the project portfolio and then express interest in to be involved with a specific strand once the portfolio is decided.

The total contribution to P60 from all the EPRI members over the next five years is expected to be in the region of £7.5m (based on 2021 rates).

Potential for New Learning

Several studies and development activities scoped within the two strands: P60A and P60B in the program P60, will produce advanced knowledge, management tools, and programmatic guidance to address the evolving EMF landscape. The research results from this project will inform utility stakeholder dialogue with the public and regulators and help to inform EMF management strategy in the UK.

The research outcomes from this project will be disseminated through several high impact scientific publications and included on our external website www.emfs.info with over 20,000 visitors per month. Additionally, every year NGET and EPRI organise a conference in the United Kingdom to present and disseminate results and outcomes from all the programs that GB Network Licensees subscribe to. The conference is open to all transmission operators and Distribution Network Operators, irrespective of their involvement in the projects. Information from each project is made available to all relevant parties to ensure an open environment for learning to be shared.

Scale of Project

This project is predominantly laboratory or desk based; as such there is no scope to reduce the scale of the project any further. Much of the value of the programme comes from its scale which includes funding from other utilities, allowing it to be run as a coordinated programme rather than a series of stand-alone projects.

Technology Readiness at Start

TRL2 Invention and Research

Technology Readiness at End

TRL4 Bench Scale Research

Geographical Area

The research undertaken in the EPRI P60 programme is predominantly carried out in the US, Canada, and various European countries, although the programme also reviews the latest research from across the world.

Revenue Allowed for the RIIO Settlement

Not Applicable

Indicative Total NIA Project Expenditure

£1,697,832 which is 90% of the total project cost, reclaimed through NIA in RIIO-2.

Project Eligibility Assessment Part 1

There are slightly differing requirements for RIIO-1 and RIIO-2 NIA projects. This is noted in each case, with the requirement numbers listed for both where they differ (shown as RIIO-2 / RIIO-1).

Requirement 1

Facilitate the energy system transition and/or benefit consumers in vulnerable situations (Please complete sections 3.1.1 and 3.1.2 for RIIO-2 projects only)

Please answer **at least one** of the following:

How the Project has the potential to facilitate the energy system transition:

This project aims to evaluate potential health impacts of existing as well as upcoming electricity technologies on human and non-human biomes. It includes development of modelling and characterisation of EMFs and RFs, which will aid the engineering decisions in electricity infrastructure projects. It aims to generate insights and information required for utilities, regulators, policy makers and the public. Having accurate and most up-to-date outcomes on these themes will ensure that we transition to Net Zero in a safe, reliable and equal way.

How the Project has potential to benefit consumer in vulnerable situations:

The scientific debate about whether certain adverse health effects may be linked to EMF and RF exposures are a cause for stakeholder concern which needs to be addressed by the energy industry. These concerns are more pronounced in certain locations of birth address and proximity to OHLs and are related to socio economic status of the neighbourhood. Not having access to latest developments in EMF research would increase consumer bills resulting from expensive EMF mitigation measures and this increase is more acute in case of consumers in vulnerable situations. The outcomes from this project will develop insights on the impact of EMF on workers and public, thereby enabling NGET as well the UK energy industry to ensure that the path to Net Zero is inclusive to all and vulnerable consumers (financially and health-wise) are not disproportionately disadvantaged by the transition.

Requirement 2 / 2b

Has the potential to deliver net benefits to consumers

Project must have the potential to deliver a Solution that delivers a net benefit to consumers of the Gas Transporter and/or Electricity Transmission or Electricity Distribution licensee, as the context requires. This could include delivering a Solution at a lower cost than the most efficient Method currently in use on the GB Gas Transportation System, the Gas Transporter's and/or Electricity Transmission or Electricity Distribution licensee's network, or wider benefits, such as social or environmental.

Please provide an estimate of the saving if the Problem is solved (RIIO-1 projects only)

Not applicable

Please provide a calculation of the expected benefits the Solution

Benefits will be achieved through the use of leveraged funding mechanism in EPRI P60 as opposed to conducting expensive EMF health research independently. The baseline method has been considered to include the costs involved in carrying out individual research projects and annual reviews to ensure the UK electricity industry is up to date with the latest outcomes on health impacts of EMF. The Innovation method includes the cost of subscribing to and extensively participating in P60 for a 5 year period. The CBA assessment indicates a net benefit of approximately £864k over a 5 year period to UK consumers.

In absence of latest outcomes from EMF research, other utilities have reported that 4-15% of total project costs is spent on EMF reduction techniques. These include measures such as undergrounding near residential and commercial properties, introducing corridors around overhead lines, compact tower usage, cable screening with metal tubes or passive loops and health screening of communities close to lines. If EMF and RF are not managed in the UK as effectively, given the scale of the program of works to achieve Net Zero, this would result in very high mitigation costs and delays in consenting.

Please provide an estimate of how replicable the Method is across GB

Electric and magnetic fields will be present at any existing or newly built overhead lines, underground cables or substations throughout the transmission and distribution networks.

Please provide an outline of the costs of rolling out the Method across GB.

The direct cost of making a policy or procedure change following significant EMF research could range from as little as ten thousand to hundreds of thousands of pounds depending on the complexity of the change implications. The wider cost implications arising from such changes will be dependent on the specific outcomes generated from the project and typically will be subject to further stages of demonstration prior to roll out. Further information regarding roll out costs can be provided prior to demonstration stage.

Requirement 3 / 1

Involve Research, Development or Demonstration

A RIIO-1 NIA Project must have the potential to have a Direct Impact on a Network Licensee's network or the operations of the System Operator and involve the Research, Development, or Demonstration of at least one of the following (please tick which applies):

☐ 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 system software).

☐ A specific novel arrangement or application of existing licensee equipment (including control and/or communications systems and/or software)

☐ A specific novel operational practice directly related to the operation of the Network Licensees system

☐ A specific novel commercial arrangement

RIIO-2 Projects

☐ A specific piece of new equipment (including monitoring, control and communications systems and software)

☐ A specific piece of new technology (including analysis and modelling systems or software), in relation to which the Method is unproven

☐ A new methodology (including the identification of specific new procedures or techniques used to identify, select, process, and analyse information)

☐ A specific novel arrangement or application of existing gas transportation, electricity transmission or electricity distribution equipment, technology or methodology

☑ A specific novel operational practice directly related to the operation of the GB Gas Transportation System, electricity transmission or electricity distribution

☐ A specific novel commercial arrangement

Specific Requirements 4 / 2a

Please explain how the learning that will be generated could be used by the relevant Network Licensees

Outcomes from this project will be disseminated through various channels such as:

- Executive summaries of EPRI reports through the EPRI website
- Closedown reports on the Smarter Networks Portal.
- Journals and paper publications
- UK wide conference organised by NGET and EPRI annually
- Posts on public-facing website www.emfs.info
- ENA's EMF Strategy Committee proceedings

Relevant Network Licensees will be alerted to the most up-to-date learnings generated which can then be used by the licensees to review their EMF management strategies, feed into stakeholder engagement on upcoming works, etc.

Or, please describe what specific challenge identified in the Network Licensee's innovation strategy that is being addressed by the project (RIIO-1 only)

Not applicable

Is the default IPR position being applied?

☐ Yes

Please demonstrate how the learning from the project can be successfully disseminated to Network Licensees and other interested parties.

In addition to the publication of research outcomes and summary reports described above, every year NGET and EPRI organise a conference in the United Kingdom to present and disseminate results and outcomes from the project that GB Network Licensees subscribe to. The conference is open to all GB transmission operators and distribution network operators, irrespective of their involvement in the project. Information from each project is made available to all relevant parties to ensure an open environment for learning to be shared. Industry coordination on EMFs is organised through ENA's EMF Strategy Committee, on which all ENA members are entitled to representation. Network Licencees are alerted to significant learning from this project through the papers for those meetings and an update on research is a standing item on the agenda. NGET maintains a public-facing website www.emfs.info. This already includes listings of publications from the EPRI EMF Project and further information on some of the research is being progressively added.

Please describe how many potential constraints or costs caused, or resulting from the imposed IPR arrangements.<

Due to the high proportion of third party funding leveraged from sources, other than the NIA, that the alternative IPR arrangements for EPRI projects does not lead to consumers incurring excessive costs due to the relevant projects deviating from the default IPR arrangements. Other transmission and distribution network licensees have the option of obtaining access to the learning on commercial terms and, as descried above, some leaning is available to interested parties.

Please justify why the proposed IPR arrangements provide value for money for customers.

EPRI is a membership organisation which uses funds from a number of sources to carry out R&D of common interest to funders. The majority of the funding for its projects comes from third party organisations and NGET will have access to, and the ability to use, all IPR generated by the projects it has participated in (not just the learning and IPR NGET directly funds). This means that the learning NGET, network operators, and other interested parties receive will be valuable relative to the cost of obtaining it. We consider that, on balance, the IPR arrangement with EPRI provides appropriate value for money for customers.

Project Eligibility Assessment Part 2

Not lead to unnecessary duplication

A Project must not lead to unnecessary duplication of any other Project, including but not limited to IFI, LCNF, NIA, NIC or SIF projects already registered, being carried out or completed.

Please demonstrate below that no unnecessary duplication will occur as a result of the Project.

This project will enable NGET and the UK energy industry to keep a watching eye on the latest global developments in EMF research, helping to identify and facilitate opportunities for EMF research and avoid unnecessary duplication of research effort both within the UK and internationally.

If applicable, justify why you are undertaking a Project similar to those being carried out by any other Network Licensees.

Not applicable

Additional Governance And Document Upload

Please identify why the project is innovative and has not been tried before

Strands within EPRI P60 focus on carrying out and synthesising high quality novel research in the field of EMF health research. This includes several activities such as epidemiology studies, summarising the latest developments on global scale, developing tools and methodologies to characterize EMF and RF exposures, developing training material and information sheets that help in dialogue with utility stakeholders, etc. All these activities are directed towards progressing novel fundamental research in the field which involves innovative elements that haven't been explored before.

Relevant Foreground IPR

The foreground IPR generated in this project are research outcomes in the form of new and/or updates to existing technical reports, training materials, occupational EMF databases, information sheets, etc.

This project does not comply with the default IPR position, the Foreground IPR remains the property of EPRI, with only member

companies granted full access to the information. This IPR position is approved by Ofgem as per the 'Non Default Intellectual Property Rights (IPR) Arrangements for Electric Power Research Institute (EPRI) Projects' letter dated 8th February 2017.

Data Access Details

Data for this project and all other projects funded under the Network Innovation Allowance (NIA), Network Innovation Competition (NIC) or the new Strategic Innovation Fund (SIF) can be found or requested in a number of ways:

- A request for information via the Smarter Networks Portal at https://smarter.energynetworks.org, to contact select a project and click 'Contact Lead Network'. NGET already publishes much of the data arising from our innovation projects here so you may wish to check this website before making an application.
- Via our Innovation website at https://www.nationalgrid.com/uk/electricity-transmission/innovation
- Via our managed mailbox box.NG.ETInnovation@nationalgrid.com

Please identify why the Network Licensees will not fund the project as apart of it's business and usual activities

Several elements of scope of this project involve addressing novel questions that require long term research. Such elements are associated with high risk and often on the lower end of TRL. Carrying out this research as part of business as usual activities would require several projects conducted in silo, resulting in risk of repetition of research and not having the watchful eye on latest in the field that EPRI P60 would provide.

Please identify why the project can only be undertaken with the support of the NIA, including reference to the specific risks(e.g. commercial, technical, operational or regulatory) associated with the project

EMF and RF assessments form an important part of consultations and stakeholder engagement in electricity infrastructure projects. Having up-to-date and credible information on EMF research is imperative to ensure we communicate effectively with public, regulator and decision makers. Planning and consultation activities on live schemes run on specific schedules to meet the Earliest In Service Date (EISD), leaving very little time or budget to carry out fundamental research. Carrying out EMF research through NIA will enable NGET and the UK electricity industry to obtain latest information about the domain in a timely and extensive manner and facilitate stakeholder dialogues as well as policy reviews.

This project has been approved by a senior member of staff

☑ Yes