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Date: 29 June 2023

Dear Scottish Southern Electricity Networks Transmission Plc,

**SIF Project Direction ref: SHE/Network DC/SIFWholeSystem/Rd1 Beta**

Scottish Southern Electricity Networks Transmission Plc submitted Network-DC (the Project) to be considered for funding through the Beta Phase of the Strategic Innovation Fund (SIF). As explained in greater detail below, this Project previously received SIF Funding and completed a Discovery Phase and Alpha Phase for round 1 of the SIF. In our<sup>1</sup> SIF funding decision which is finalised and will be issued on 18 July 2023, we selected the Project<sup>2</sup> for conditional funding and as a result we are now issuing this SIF Project Direction to implement that decision.

Scottish Southern Electricity Networks Transmission Plc must comply with the conditions contained in this SIF Project Direction as a condition of the Project receiving funding through the SIF. These conditions can be found in the Schedule to this document.

**Progression through SIF Phases**

The SIF consists of a multi-phase approach for Projects in order to mitigate the risk associated with innovations. The Discovery Phase focuses on feasibility, the Alpha Phase on experimental development, and the Beta Phase on deployment and demonstration.

The Project previously received SIF Funding for the Discovery Phase<sup>3</sup> and Alpha Phase<sup>4</sup> of round 1, and submitted an Application for the Project to be considered for SIF Funding

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<sup>1</sup> The terms 'we', 'us', 'our' refer to the Gas and Electricity Markets Authority. Ofgem is the office of the Authority.

<sup>2</sup> Unless otherwise specified, defined terms in this SIF Project Direction have the meaning given to them in Appendix 1 of the SIF Governance Document.

<sup>3</sup> The Project Directions for round 1 of the Discovery Phase are available at:  
<https://www.ofgem.gov.uk/publications/strategic-innovation-fund-discovery-projects-approved-funding>.

<sup>4</sup> The Project Directions for round 1 of the Alpha Phase are available at:  
<https://www.ofgem.gov.uk/publications/strategic-innovation-fund-round-1-alpha-projects-approved-funding>.

through the Beta Phase of round 1 of the SIF. As stated above, the Project has been selected to receive SIF Funding for the Beta Phase of round 1.

### **Role of UK Research & Innovation (UKRI)**

As per Chapter 1 of the SIF Governance Document<sup>5</sup> the role of UKRI is to deliver the SIF in line with the SIF Governance Document - administering the funding programme, monitoring the delivery of Projects, collating data from Projects on benefits, making recommendations to Ofgem on operational matters, supporting third-party innovators and, where possible, successful Projects to become 'business as usual' activities. To support the success of the Projects and the SIF programme, we expect that the Funding Party and Project Partners collaborate with Ofgem and UKRI.

### **SIF Project Direction**

Paragraph 5.14 of the SIF Governance Document states that a SIF Project Direction will:

- Set out the Project-specific conditions, to which the Funding Party is committing in accepting SIF Funding.<sup>6</sup>
- Require the Funding Party to undertake the Project in accordance with the commitments made in the Application. Where appropriate, the SIF Project Direction may therefore include extracts from the Application or refer to specific sections of the SIF Application.<sup>7</sup>
- Where applicable, set out conditions (such as Project stage gates) linked to milestones and deliverables, which Projects must meet.<sup>8</sup>
- Set out the SIF Approved Amount for the Project, that will form part of the calculation contained in the SIF Funding Direction issued by the Authority under chapter 7 of the SIF Governance Document.<sup>9</sup>
- Set out the Project budget that the Funding Party must report against and how variations in the Project budget will be reported.<sup>10</sup>
- Where applicable, set out special information sharing requirements applicable to the Project.<sup>11</sup>
- Set out the mechanism for the Funding Party receiving the SIF Approved Amount as set out in the SIF Funding Direction.<sup>12</sup>

<sup>5</sup> <https://www.ofgem.gov.uk/publications/sif-governance-document>

<sup>6</sup> 'Project specific conditions' detailed under Point 3 – 'Condition President' of this SIF Project Direction.

<sup>7</sup> 'Project specific conditions' detailed under Point 3 – 'Condition President' of this SIF Project Direction.

<sup>8</sup> 'Project specific conditions' detailed under Point 3 – 'Condition President' of this SIF Project Direction.

<sup>9</sup> 'SIF Funding Amount' detailed under Point 5 – 'Condition President' of this SIF Project Direction.

<sup>10</sup> 'Annex 1 – Project Budget.

<sup>11</sup> 'Project specific conditions' detailed under Point 3 – 'Condition President' of this SIF Project Direction.

<sup>12</sup> 'SIF Funding Amount' detailed under Point 5 – 'Condition President' of this SIF Project Direction.

All SIF Project Direction requirements are detailed in the Schedule to this SIF Project Direction.

### **Decision**

Provided the Funding Party complies with the SIF Governance Document and with the Schedule to this SIF Project Direction, the Project is deemed to be an Eligible SIF Project<sup>13</sup>.

This SIF Project Direction constitutes notice pursuant to section 49A (Reasons for decisions) of the Electricity Act 1989.

**Marzia Zafar**

**Deputy Director, Decentralisation & Digitalisation**

**For and on behalf of the Authority**

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<sup>13</sup> The meaning 'Eligible SIF Project' is described in Chapter 2 of the SIF Governance Document.

## Schedule to SIF Project Direction

### 1. PROJECT DETAILS

SIF Project Direction reference: SHE/Network\_DC/SIFWholeSystem/Rd1\_Beta

Application number: 10067854

Project title: Network-DC

Innovation Challenge/Project Phase: Whole system integration / Beta Phase round 1

Project start date: 01 July 2023

Project end date: 24 December 2026

SIF Approved Amount for SIF Funding: £5,486,794.00

### 2. PREAMBLE

This SIF Project Direction is issued by the Gas and Electricity Markets Authority (the "Authority") to Scottish Southern Electricity Networks Transmission Plc (the "Funding Party") pursuant to the SIF Governance Document issued pursuant to Special Condition 9.19 of the Electricity Transmission Licence (the "Licence"). It sets out the conditions to be complied with in relation to Network-DC (the "Project") as a condition of it being funded under the SIF Funding Mechanism.<sup>14</sup>

Unless otherwise specified, defined terms in this SIF Project Direction have the meaning given to them in the Licence or Appendix 1 of the SIF Governance Document.

References to specific sections of the Funding Party's Application in this SIF Project Direction are, for ease of reference, made by referring to the section number in the Funding Party's Application.

### 3. PROJECT SPECIFIC CONDITIONS

In accepting funding for the Project, the Funding Party is subject to the following Project-specific condition(s):

#### **Condition 1**

The Funding Party must not spend any SIF Funding until contracts are signed with the Project Partners named in Table 1 for the purpose of completing the Project.

**Table 1. Project Partners**

UNIVERSITY OF EDINBURGH
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<sup>14</sup> The SIF Funding Return Mechanism is defined in the SIF Governance Document.

CARBON TRUST ADVISORY LIMITED NATIONAL GRID ELECTRICITY SYSTEM OPERATOR SUPERGRID INSTITUTE
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### ***Condition 2 – Financial contribution***

The Funding Party must report on the financial contributions made to the Project as set out in its Application. Any financial contributions made over and above that stated in its Application should also be reported and included within the Project costs template.

### ***Condition 3 – Meeting arrangements***

The Funding Party must participate in all meetings related to the Project that they are invited to by Ofgem, UKRI and DESNZ during and after the Beta Phase.

### ***Condition 4 – Stage gate scoping***

The Funding Party must, with support from Innovate UK/UKRI and, where applicable Ofgem, scope the requirements and success criteria for each stage gate within a Project at the quarterly reporting meetings ahead of any stage gate. These will be used to determine what criteria a Project must meet in order to pass a stage gate, and whether any additional information, such as a report, must be produced as part of the stage gate.

### ***Condition 5 – Dissemination of annual progress report(s)***

Each of the annual progress reports that the Funding Party publishes in the Beta Phase must, at a minimum, be uploaded to the ENA's Smarter Networks Portal. We also strongly encourage wider dissemination of the annual progress report(s) and support from all Project Partners in ensuring it reaches a wide audience.

### ***Condition 6 – Impact monitoring***

As part of the end of Project Phase report, the Funding Party must produce a Project Impact Monitoring and Evaluation Plan. This plan must outline how the Project plans to monitor and evaluate the delivery of benefits outlined in the Beta Phase Application following the end of the Beta Phase. The plan must also include the methodology that will be utilised for quantifying and qualifying benefits realisation and how the Funding Party plans to report this to Ofgem 1, 3, 5 & 10 years post-Beta Phase completion. Further details on how to approach the development of this plan may be provided by Ofgem or IUK.

### ***Condition 7 – SIF Community Forums***

The Funding Party and all Project Partners must make reasonable attempts to attend, participate and/or contribute at SIF Community Forum events occurring during the Project delivery. We anticipate there being approximately one event per year.

### ***Condition 8 – Policy, regulatory and standards barriers***

The Funding Party must provide verbal updates at each quarterly meeting on any regulatory, policy and standards barriers and any change requirements which may impact delivery of the Beta Phase activities. The Funding Party must also include as an attachment to each of its annual progress report an update on any regulatory, policy and standards barriers which may require derogations and articulation of any proposed regulatory, policy and standards changes which would be necessary in deployment. The Funding Party must also provide as an attachment to its end of Project Phase report a summary of the Project's findings on regulatory, policy and standards barriers, including any considerations for future work, and where applicable, where specific regulatory, policy and standards changes would be required for deployment.

### ***Condition 9 – Updated 60-second videos***

The Funding Party must provide within the first three months of the Project beginning (i.e. by 1 October 2023) an updated 60-second video. If the Project is greater than two years (longer than 24 months) in length, an updated video must also be provided at the Project's mid-point meeting. All Projects must also provide an updated 60-second video as part of their end of Project phase report. Innovate UK can share its guidance for 60-second videos with the Funding Party, if necessary.

### ***Condition 10 – Post-Beta Phase roadmap***

The Funding Party must provide to the monitoring officer within six months of the Project beginning (i.e. by 1 January 2024) a roadmap for activities post-Beta Phase. This can build on the Project's Application question (question 11) and must focus on how and when the proposed solution will become business as usual within your network and across the other GB gas or electricity networks.

As part of this, the Funding Party must include consideration for:

- I. any steps the Project will take to ensure its innovation has suitable business as usual adoption;

- II. the Funding Party's strategy for adoption of the innovation or proposed solution, giving consideration to potential investment, ongoing costs and third-party involvement and;
- III. any early indication of interest from other networks in adopting the innovation.

The Funding Party must provide an update on all the above at every two quarterly monitoring meetings (i.e. every six months) and must include a final update of this roadmap as attachment to its end of Project Phase report.

### ***Condition 11 – Commercialisation strategy***

The Funding Party must provide at every second quarterly monitoring meeting (i.e. every six months) an update on its commercialisation strategy. This can build on the Project's Application question (question 12) and must focus on what considerations have the Project consortium made for the commercialisation of the proposed solution or innovation, and how the Project provides support for non-network partners to move towards commercialisation. As part of this, the Funding Party may wish to include consideration for:

- I. who the primary customer segment is beyond the Funding Party; the customer value proposition;
- II. if identified, the outline of the route to market and potential new partnerships;
- III. any additional Project Partner capital requirements in order to commercialize the innovation and;
- IV. how this product, process or service could be scaled across the GB network and taken to new markets.

The Funding Party must also include a final update of its strategy as an attachment to its end of Project Phase report. Ofgem and/or Innovate UK may issue a template for the final update as part of the end of Project Phase report.

### ***Condition 12***

As part of the Project's stage gate 1, the Funding Party must submit to the Project's monitoring officer its plan to improve the competition between original equipment manufacturers (OEMs) in the Project to ensure the Project is maximising its potential value for money and that it does not undermine the development of competitive markets. In addition, the successful OEM(s) must provide a statement of either their intent to participate in a physical demonstration/deployment after the SIF Project completion and should the SIF Project successfully conclude the Beta Phase, or reasoned justification as to why they will not participate in a physical demonstration/deployment following the SIF Project completion and should the SIF Project successfully conclude the

Beta Phase. A statement must be in place by stage gate 1 for the Project to progress beyond this point.

### **Condition 13**

The Funding Party must provide to its monitoring officer ahead of or as part of stage gate 1 an outline of how its Project governance will ensure the Project will react appropriately in the event of change of assumptions (e.g. policy or regulatory changes) which may impact the Project's overall proposed value or proposed solution. This could include, for example, additional opportunities for stage gates or reviews.

### **Condition 14**

During the Project, the Funding Party must include greater consideration as to how the Project's proposed solution would feed into and influence global HVDC and DCCB standards. The Project must also provide an update on these efforts at each stage gate and must include as part of or as an attachment to its end of Phase report, including if the Project concludes or ends early, a summary report of these efforts and the outcomes.

### **Condition 15**

At each stage gate, the Funding Party must include considerations of the policy and regulatory risks to the Project and its proposed solution, and opportunities for it. We expect this activity to be an ongoing and iterative activity where an update is provided at each stage but the Project maintains this work as part of its activities.

### **Condition 16**

The Funding Party must provide as an attachment to each of its Beta Phase annual progress reports a summary of policy and regulator developments since the Project's inception, including updates from the involvement of Ofgem and DESNZ (formally BEIS) in the Project.

### **Condition 17**

The Funding Party must provide as an attachment to its year one annual progress report a summary of its plans to influence wider industry and EU standards on DC circuit breakers and how it plans to incorporate any current or pre-existing work done in the wider industry, including in the EU, on DC circuit breaker standards. In particular, the report must demonstrate consideration for how the Project's learnings and findings will



look to also be applicable in the EU. The summary must also be published on the ENA's Smarter Networks Portal to support dissemination of the Project's findings.

### **Condition 18**

Prior to formally beginning any work on the Project, the Funding Party must provide a report summarizing how the IPR arrangements which the Project may generate will be handled should the HVDC centre change ownership as part of the next price control. As part of this, the report must include an outline of any risks to the IPR generated from the Project and a proposed contingency plan for any of the risks.

## **4. COMPLIANCE**

The Funding Party must comply with Special Condition 9.19 of the Electricity Transmission Licence (the "Licence"), the SIF Governance Document and with this SIF Project Direction.

## **5. SIF APPROVED AMOUNT**

The SIF Approved amount of £5,486,794.00 (as detailed under Section 1: Project details of this Project Direction) will be recovered by National Grid Electricity System Operator from GB customers and transferred to the Funding Party. The Funding Party is responsible for notifying National Grid Electricity System Operator of the bank account details to which transfers must be made, in addition to completing Annex 2 of this SIF Project Direction. If a Funding Party is required to return funding to National Grid Electricity System Operator, the reverse applies. The Funding Party must provide bank account details to National Grid Electricity System Operator within two weeks of accepting this SIF Project Direction.

## **6. PROJECT BUDGET**

The Project Budget is set out in Annex 1 of this SIF Project Direction.

The Funding Party must report on expenditure against each line under the category total in the Project Budget and explain any projected variance against each line as part of its detailed report which will be provided, in accordance with Chapter 7 of the SIF Governance Document. The Funding Party must report variations in the Project budget as outlined in Chapter 6 of the SIF Governance Document.

## **7. PROJECT IMPLEMENTATION**

The Funding Party must undertake the Project in accordance with the commitments it has made in the Application and with the conditions of this SIF Project Direction. These include (but are not limited to) the following:

- (i) undertake the Project in accordance with its Application,
- (ii) complete the Project on or before the Project completion date as detailed under section 1 of the schedule of this SIF Project Direction, and
- (iii) disseminate the learning from the Project at least to the level described in chapter 3 of the SIF Governance Document. Dissemination of learning must be carried out whether the Project was concluded successfully or otherwise.

## **8. REPORTING**

Ofgem and UKRI may issue guidance (and amend it from time to time) about the structure and content of the Project reporting required by Chapter 6 of the SIF Governance Document. The Funding Party must follow this guidance in preparing the reports.

The Funding Party must submit an end of Project Phase report to UKRI monitoring officers for the Beta Phase. Within this report, the Funding Party must submit information related to questions on Project delivery as detailed in chapter 6, table 6 of the SIF Governance Document.

## **9. MONITORING**

The Funding Party must comply with any reasonable request for information by its monitoring officer at UKRI and related deadlines. Ofgem, with the support of UKRI, will together monitor Project delivery, impacts and benefits. Throughout the term of the Project, progress is monitored by UKRI through a monitoring officer. The monitoring officer is the first point of contact for official notifications, queries and correspondence with UKRI and the Authority, unless otherwise required by this SIF Project Direction.

As detailed in Chapter 6 of the SIF Governance Document, meetings with the monitoring officer will take place at regular intervals, as advised by Ofgem or the monitoring officer during the delivery of the Project, and at the end of each Project Phase.

## 10. EVALUATION

The Funding Party has acknowledged when it submitted its Application for this Project, that reporting information and data gathered during the Project's timescales (as detailed in Section 1 of this SIF Project Direction) will be used to evaluate Project performance. In addition, the Funding Party may be required to provide requested information outside of the Project timescales and, in particular, for the period from the Project end date to the end of the SIF Programme. Further data and reporting information may be requested (frequency and method based on requirement) outside of standard monitoring and reporting requirements as deemed necessary. Further data and information requirements must be complied with by the Funding Party and Project Partners.

## 11. DATA SHARING

As set out in Chapter 3 of the SIF Governance Document, the Funding Party must follow Data Best Practice Guidance with regards to all data gathered or created in the course of a Project. We expect the Funding Party to document any reasons, such as commercial sensitivities, for desensitising data. As defined by, and in accordance with, Data Best Practice Guidance, Funding Parties must have a data triage process. Where multiple Project Partners are collaborating on a Project, the consortium must adopt a consistent Open Triage Process for the data related to the Project. Ofgem may require that Project information and data is also shared with other specified parties, such as parties working on complementary innovation funding programmes (subject to redaction of sensitive data).

## 12. CYBER SECURITY

It is the responsibility of the Funding Party and all Project Partners to implement and maintain appropriate security measures to protect personal data in accordance with The GDPR (General Data Protection Regulation)<sup>15</sup> and DPA (Data Protection Act) 2018<sup>16</sup>. Protection of computer systems from unauthorised access or being otherwise damaged or made inaccessible must be in place alongside effective working practices. These must be maintained in line with the Funding Party's IT Management Strategies and policies.

## 13. PROJECT MILESTONES

The Funding Party must submit its end of Project Phase report to its monitoring officer that verifies the Project milestones have been achieved or explains why they have not.

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<sup>15</sup> [https://ec.europa.eu/info/law/law-topic/data-protection/data-protection-eu\\_en](https://ec.europa.eu/info/law/law-topic/data-protection/data-protection-eu_en)

<sup>16</sup> <https://www.legislation.gov.uk/ukpga/2018/12/contents/enacted>

Project milestones are outlined below in Table 3, based upon details contained within Question 7 and Appendix Question 9 in the Funding Party's.

**Table 3. Project milestone<sup>17</sup>**

Reference	Project milestone	Deadline	Overall objectives and key tasks	Summary of Milestones and Success Criteria	SIF Funding Request (100%)
Milestone 1	Work package 1: Appoint OEMs	24 December 2026	<p>Overall work package objectives: One or more OEMs has been appointed, managing a balance between incumbent and emerging suppliers, and European, Japanese and Chinese suppliers</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>• Re-confirm rules of engagement with Chinese OEMs with The Department of Energy (TBC) industrial policy team</li> <li>• Develop evaluation criteria for OEMs</li> <li>• Develop a lotting structure or a clear statement of how the</li> </ul>	<p>M1: Finalise evaluation criteria and issue tender: Tender documents issued. (£60,381.00)</p> <p>M2: Tender return period: Returned. (£10,292.00)</p> <p>M3: Evaluate responses and appoint OEM(s): OEM(s) have been appointed. (£30,084.00)</p>	£100,757.00 (2%)

<sup>17</sup> As outlined in in the Application or Project Plan appendix.

			<p>highest-scoring bidder, next-highest scoring bidder will be treated to maintain a balance between incumbent and emerging suppliers, and European, Japanese and Chinese suppliers to ensure a diversity of OEM technologies.</p> <ul style="list-style-type: none"> <li>• Develop tender pack and instructions to tenderers, based on the commercial terms sheet and scope of work issued for consultation in Alpha phase</li> <li>• Issue tender, support clarifications and carry out evaluation</li> <li>• Secure internal SSEN-T procurement approval to appoint</li> <li>• Negotiate and sign contract with OEM(s)</li> </ul>		
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Milestone 2	Work package 2: Design of a scheme-wide control & protection philosophy	24 December 2026	<p>Overall work package objectives:</p> <p>Develop the design of a scheme-wide control philosophy, protection philosophy and arrangement of DCCBs</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>• OEM(s) support SSEN-T, The National HVDC Centre and SuperGrid Institute to design the C&amp;P scheme for the DC Grid and its integration with the C&amp;P system supplied with the Protection IEDs and DCCBs.</li> <li>• Conduct studies to define minimal functional and technical requirements for DCCBs and limiting DC reactors respecting the main constraints according to the selected C&amp;P philosophy.</li> <li>• Conduct studies to define minimal functional specifications</li> </ul>	<p>M1: Establish confidentiality arrangements with OEMs and National Grid ESO: Confidentially agreements signed. (£5,519.00)</p> <p>M2: Develop the design of a scheme-wide control philosophy, protection philosophy and arrangement of DCCBs: Summary report setting out the scheme. (£426,126.00)</p> <p>M3: Support the design of a scheme-wide control philosophy, protection philosophy and arrangement of DCCBs: OEM's confirm understanding of arrangements. (£208,587.00)</p> <p>M4: Summary report: Summary report issued. (£0)</p>	£640,232.00 (12%)
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			<p>for protection IEDs (Intelligent Electronic Devices).</p> <ul style="list-style-type: none"> <li>• Production of design documents detailing the in-principle protection and control arrangement that enables the retrofit of DCCBs to a DCSS including: <ul style="list-style-type: none"> <li>o list of intact, credible post-fault and planned outage running arrangements;</li> <li>o statement of the most onerous fault type (whether in terms of breaking current or difficulty for the protection to detect the fault) and fault location in each running arrangement;</li> <li>o type of protection scheme, Protection IEDs and measurement points required at different parts of the DC Grid ((near converters,</li> </ul> </li> </ul>		
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			<p>near DCSS or near DCCBs) to detect the fault and localise each of the most onerous faults;</p> <p>o primary protection timeline for each of the most onerous faults in each running arrangement;</p> <p>o protection Matrix identifying converter's behaviour in accordance with CENELEC CLC/TS 50654-1 ;</p> <p>o protection scheme settings for each converter and DCCB in each post-fault running scenario.</p> <ul style="list-style-type: none"> <li>• Validation or amendment to Minimum Functional Specification from Alpha</li> </ul>		
Milestone 3	Work package 3: Design of DCCBs	24 December 2026	Overall work package objectives: OEMs design or re-design their DCCB design to meet the Minimum Functional Specification.	M1: OEMs design or re-design their DCCB design to meet the Minimum Functional Specification: DCCB designs received. (£436,060.00)	£809,269.00 (15%)

			<p>Key tasks:</p> <ul style="list-style-type: none"> <li>• OEM(s) design or modify an existing design of a DCCB which meets the Minimum Functional Specification. To adhere to the eligibility criteria of the Strategic Innovation Fund, the design shall utilise the Supplier's existing valve firing firmware and software.</li> <li>• OEM(s) provide (as confidential information) a design document including the principle of operation; the control and protection systems supplied with the DCCB; a Failure Modes Effects Analysis (FMEA); the footprint, height and weight.</li> <li>• OEM(s) propose how they will provide a replica for testing at The National HVDC Centre</li> </ul>	<p>M2: OEMs provide design principles, Failure Mode &amp; Effects Analysis report: Report from OEM's received. (£169,804.00)</p> <p>M3: Review design principles &amp; FMEA report for suitability against Good Industry Practice: Stage Gate 2: Design principles and FMEA sufficient to be reliable. (£20,060.00)</p> <p>M4: OEMs propose how to provision a Hardware-in-the-Loop or Software-in-the-Loop replica: Proposal received and reviewed. (£169,804.00)</p> <p>M5: Review of proposals for HIL or SIL replicas: Proposals are reviewed and agreed so that project can progress. (£13,541.00)</p>	
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			<ul style="list-style-type: none"> <li>• Relevant teams within SSEN-T and NG ESO review the proposals for prudent utility practice (e.g. redundancy of internal components, mechanisms which ensure DCCBs fail open not fail closed).</li> <li>• The National HVDC Centre reviews and agrees the replica proposal is feasible and will deliver meaningful value over and above desk-based software simulations.</li> </ul>		
Milestone 4	Work package 4: Use OEM's proprietary equivalent models to validate the DCCB parameters	24 December 2026	<p>Overall work package objectives: Use OEM's proprietary equivalent models to validate the DCCB parameters.</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>• OEM(s) provide a software model of their DCCB design proposed in WBS 3.0</li> </ul>	<p>M1: OEMs provide sufficient software model of their revised DCCB design: Model supplied and functioning. (£23,584.00)</p> <p>M2: Carry out desk-based software simulations of the scheme-wide control &amp; protection scheme: Completion of desk based simulations. (£141,720.00)</p>	<p>£745,349.00 (14%)</p>

			<ul style="list-style-type: none"> <li>• Re-run simulations from the Alpha and early Beta phase which had to use generic models of DCCBs, replacing the generic model with the Supplier's more accurate representation of its design.</li> <li>• Continue to develop and refine open source models of DCCBs from the literature and from non-confidential conversations with the OEM(s)</li> <li>• Review results of simulations with the OEM(s) to validate that the control &amp; protection philosophy for the DCSS developed in WBS 2.0 is feasible</li> <li>• Review results of simulations and refine the Minimum Functional Specification if required, in time to be reflected in the OEM's replica</li> </ul>	<p>M3: Develop open source models of DCCBs: Open source models created and made available. (£565,642.00)</p> <p>M4: Summary report: Stage Gate 3: Desktop simulations re-confirm the Minimum Functional Specification. (£14,403.00)</p>	
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			<ul style="list-style-type: none"> <li>Summarise findings in a technical report</li> </ul>		
Milestone 5	Work package 5: Establish a replica	24 December 2026	<p>Overall work package objectives:</p> <p>Creation of Replica Models.</p> <p>Installation and configuration of hardware and/or software and EMT models at the National HVDC Centre, to replicate the behaviour of up to 2 DCCBs, of which at least one shall be a full HIL or SIL replica.</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>The National HVDC Centre and OEM(s) progress and elaborate the OEM's proposal for a replica provided in WBS 3.0</li> <li>OEM(s) identify and justify the measurements necessary for operation of the DCCB and its embedded/stand-alone Control &amp;</li> </ul>	<p>M1: OEMs specify the signals required: Specification received and documented. (£50,723.00)</p> <p>M2: Program the Supplier's C&amp;P hardware/software and carry out Factory System Tests (FSTs): Factory tests completed. (£488,829.00)</p> <p>M3: Provision the test environment at the National HVDC Centre: Test environment set up and ready for simulation. (£807,052.00)</p> <p>M4: Supply, install, and configure the Supplier's replica at the National HVDC Centre: Replica installed at the HVDC Centre. (£250,072.00)</p> <p>M5: Reliability models associated with open-source models of DCCBs and based on FMEA provided by OEMs delivery end of project:</p>	£1,938,687.00 (35%)

			<p>Protection (C&amp;P) system within the DC Grid</p> <ul style="list-style-type: none"> <li>• The National HVDC Centre provisions the interfaces, and the physical space for the replica</li> <li>• OEM(s) programs its existing, proven C&amp;P hardware/software to align with the overall DC Grid C&amp;P scheme and carry out Factory System Tests (FSTs) by preparing configuration files; and/or making hardware/software revisions; and/or making firmware revisions;</li> <li>• OEM(s) develop models to emulate the performance of the remaining sub-components within each DCCB (such as electronic modules, MV and HV plant) which are not provided as physical hardware replicas. These models shall as a minimum meet the requirements of a "Simplified</li> </ul>	<p>Replica supplied and ready for testing. (£342,011.00)</p>	
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			<p>equivalent models (Type 4)” with a preference for “Detailed equivalent models” as defined in Section 5.2 of CIGRE Technical Brochure 873</p> <ul style="list-style-type: none"> <li>• OEM(s) ship equipment and install the equipment and accompanying models on-site at the National HVDC Centre</li> <li>• The National HVDC Centre and OEM(s) co-operate to carry out System Acceptance Tests and confirm the replica is ready for use in simulations</li> </ul>		
Milestone 6	Work package 6: Use the replica to demonstrate performance in the GB network	24 December 2026	<p>Overall work package objectives: For up to 2 DCCBs: Use the replica to demonstrate performance in the GB network.</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>• Agree with OEM(s) simulation cases from WBS4.0 which will be</li> </ul>	<p>M1: Simulate scheme-wide C&amp;P scheme using the HIL or SIL replica: Simulation complete and results documented. (£177,808.00)</p> <p>M2: Support simulations to demonstrate the performance of the Supplier’s replica:</p>	<p>£401,214.00 (7%)</p>

			<p>re-run, using the previous desk-based or software-based results as a benchmark</p> <ul style="list-style-type: none"> <li>• Agree with OEM(s) additional simulations cases to run, exploiting the additional detail in the Hardware in the Loop (HIL) or Software in the Loop (SIL) replica</li> <li>• Simulations shall be based upon a series of reduced networks. One reduced network shall be generated for each running arrangement identified in WBS2.0. In each case the reduced network shall comprise: <ul style="list-style-type: none"> <li>o A HIL or SIL representation of the HVDC converter(s) directly feeding into the faulted section (or which itself faults)</li> <li>o The DCCB(s) intended to open as the primary protection</li> </ul> </li> </ul>	<p>Performance of supplier documented. (£206,266.00)</p> <p>M3: Assess variance from desktop model results: Review and analyse desktop results and results documented. (£17,140.00)</p>	
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			<p>o A suitable equivalent of the remaining converters and cable sections connected to the DCSS.</p> <ul style="list-style-type: none"> <li>• Discuss results with OEM(s) and clarify any points, amending and re-running as necessary</li> <li>• Analyse variances to the previous desk-based or software-based results in WBS4.0</li> <li>• Identify any points at which the Minimum Functional Specification could be relaxed or tightened and discuss the impact with OEM(s)</li> <li>• Write summary report</li> </ul>		
Milestone 7	Work package 7: Regulatory barriers and Cost Benefit Analysis	24 December 2026	<p>Overall work package objectives: Regulatory barriers and Cost Benefit Analysis</p> <p>Key tasks:</p>	<p>M1: (at the Supplier's discretion as an optional extension) Conduct hardware testing of the design: Optional for supplier to test design. (£45,107.00)</p> <p>M2: Develop a more detailed cost-benefit framework including capacity factor of</p>	<p>£537,718.00 (10%)</p>

			<ul style="list-style-type: none"> <li>• OEM(s) indicate their interest and secure internal funding to proceed with High-Voltage testing</li> <li>• OEM(s) carrying out High-Voltage testing of the design proposed in WBS 3.0 in its own or third-party facilities, or by carrying out other activities it identifies to increase deployment readiness.</li> <li>• Work-plan developed to address the 17 highest priority recommendations</li> <li>• Time series for typical neighbouring offshore wind farms sourced or simulated and cost-benefit approach updated to account for capacity factors of offshore wind farms, and capacity released</li> </ul>	<p>connecting wind farms and load factor of DCSS: Detailed cost benefit model reviewed and finalised. (£65,599.00)</p> <p>M3: Develop and share a non-binding cost estimate for supply of the DCCB: OEMs have shared costs and populated costs template. (£18,375.00)</p> <p>M4: Update cost-benefit analysis report: Revised cost benefit report and OGA template completed. (£299,059.00)</p> <p>M5: Develop and consult on an method to address the highest priority recommendations relating to regulatory and commercial barriers: Recommendation for regulatory reforms. (£109,578.00).</p>	
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			<ul style="list-style-type: none"> <li>• OEM(s) provide an updated, parameterised cost estimate for supply of a DCCB meeting the Minimum Functional Specification</li> <li>• Cost-benefit analysis re-calculated and results summarised in a report</li> <li>• Consultation materials prepared, and consultation carried out on specifications, ownership models and compensations for HVDC Switching Stations</li> </ul>		
Milestone 8	Work package 8: Innovation roll-out and scale-up	24 December 2026	<p>Overall work package objectives: Innovation roll-out and scale-up</p> <p>Key tasks:</p> <ul style="list-style-type: none"> <li>• Re-assess the supply chain, recognising potential for changes in the market since the Network-DC Beta phase tender was</li> </ul>	<p>M1: Update assessment of the supply chain: Updated supply chain report. (£35,376.00)</p> <p>M2: Engineering policy: Agreed approach for a sufficient representation of a DCCB in FEED and detailed design: Detailed design of DCCB document delivered. (£81,549.00)</p> <p>M3: Models curated in an independent environment (HVDC Centre) for benefit of all TNOs and NG ESO: Models curated and</p>	£313,568.00

		<p>completed in 2023 by work package 1.</p> <ul style="list-style-type: none"> <li>• Establish stakeholder group across the three Transmission Owners (TOs) representing Asset Management, System Planning, Connections and Capital Projects delivery teams</li> <li>• Develop and consult internally on common engineering policies and Minimum Functional Specifications, to ENA Technical Specification (TS) or Engineering Recommendation (EREC) level of detail and maturity</li> <li>• Raise and support a modification request to the Security and Quality of Supply Standard (SQSS)</li> <li>• Prepare for removal of the replicas from the HVDC Centre</li> </ul>	<p>made available for use by others. (£82,091.00)</p> <p>M4: Engineering policy: Recommended network configurations for use of DCCBs, accounting for cost and reliability: Recommendations report delivered. (£24,211.00)</p> <p>M5: Connections policy: Reliability estimates, cost information, cost allocation and failure mode information available for all stakeholders: Connections policy developed and documented. (£32,649.00)</p> <p>M6: Agree needs case and implement timetable for changes to NETS, SQSS, Grid Code or SO TO Code to facilitate utilisation: SQSS study group formed. (£25,235.00)</p> <p>M7: Knowledge dissemination workshop: Workshop held with key stakeholders. (£32,457.00)</p>	
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			<p>(unless OEMs are willing to leave them in situ) by finalising a sufficient desk-based, software-only representation of DCCBs for use by The National HVDC Centre supporting System Planners in the TNOs sponsoring the National HVDC Centre.</p> <ul style="list-style-type: none"><li>• Secure agreement from OEMs and curate models in this sufficient representation at the National HVDC Centre, for the benefit of all TNOs and NG ESO</li></ul>		
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#### **14. USE OF LOGO**

The Funding Party and the Project Partners, External Funders and Project Supporters or subcontractors<sup>18</sup> must not use the Innovate UK/UKRI and/or Ofgem logo for purposes associated with the Project in any circumstances.

As an alternative for use of both Ofgem and UKRI logos, all external Project communications must include the following standard form of wording:

- (i) "this project is funded by network users and consumers under the Strategic Innovation Fund, an Ofgem programme managed in partnership with UKRI."

For additional guidance, refer to the communications and media guidelines for competition winners, detailed as part of your delivery pack. These guidelines are designed to help with some suggestions and encourage you to take a proactive approach to communicating about your Project.

#### **15. SHARING OF LESSONS LEARNED**

The Funding Party is required to ensure that the sharing of lessons learned and the facilitation of knowledge transfer is conducted as effectively as possible, to ensure that all parties, and therefore all consumers including future consumers, can benefit from Projects.

As contained within Chapter 3 of the SIF Governance Document, we require the Funding Party to work collaboratively to maintain the ENA Smarter Networks Portal so that all reporting and dissemination of learnings on Projects (as required by chapter 6 of the SIF Governance Document) is available via the ENA Smarter Networks Portal.

#### **16. COLLABORATION**

The Funding Party must collaborate with third-party innovators as Project Partners, as well as work closely with other parties in the energy supply chain, as set out in Chapter 3 of the SIF Governance Document.

The Funding Party must collaborate with other parties and with UKRI to organise an annual conference in a format appropriate to enabling the building of consortiums and disseminating learning widely. The conference may be a single event for gas and electricity, or more than one event, as appropriate.

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<sup>18</sup> As detailed in the Application.

## **17. AMENDMENT OR REVOCATION**

As set out in Chapter 7 of the SIF Governance Document, this SIF Project Direction may be amended or revoked under the following circumstances:

- (i) if the Funding Party considers that there has been a material change in circumstance that requires a change to the SIF Project Direction, and the Authority agrees; or
- (ii) to reflect amendments made to the Licence.

## **18. HALTING OF PROJECTS**

This SIF Project Direction is subject to the provisions contained in Chapter 7 of the SIF Governance Document relating to the halting of Projects. By extension, this SIF Project Direction is subject to any decision by the Authority to halt the Project to which this SIF Project Direction relates and to any subsequent relevant SIF Funding Direction issued by the Authority pursuant to Special Condition 9.19 of the Electricity Transmission Licence (the "Licence").

Further to the requirements in Chapter 7 of the SIF Governance Document, in the event the Authority decides to halt the Project, to which this SIF Project Direction relates, the Authority may issue a statement to the Funding Party clarifying the effect of that halting decision as regards to the status and legal force of the conditions contained in this SIF Project Direction.

## **NOW THEREFORE:**

In accordance with the SIF Governance Document issued pursuant to Special Condition 9.19 of the Electricity Transmission Licence (the "Licence") of the Licence the Authority hereby issues this SIF Project Direction to the Funding Party in relation to the Project.

This constitutes notice of reasons for the Authority's decision pursuant to section 49A (Reasons for decisions) of the Electricity Act 1989.

Failure to comply with the conditions of this SIF Project Direction means that Ofgem may treat all or part of the SIF Approved Amount received by the Funding Party as SIF Disallowed Expenditure.

## ANNEX 1: PROJECT BUDGET

SIF Project Direction costs		
Cost Category	Total Project costs (£)	Total SIF Funding requested (£)
Labour	£1,562,268	£1,415,847
Materials	£974,411	£874,429
Subcontracting	£2,815,526	£2,526,244
Travel and subsistence	£21,250	£19,254
Other costs	£723,671	£651,020
<b>Total</b>	<b>£6,097,127</b>	<b>£5,486,794</b>

Project Partner	Total project costs (£)	Project contribution (£)	Total SIF Funding requested (£)	In-kind contribution (£)	Project contribution (%)
SCOTTISH HYDRO ELECTRIC TRANSMISSION PLC	£4,408,954.00	£453,000.00	£3,955,954.00	£0	
UNIVERSITY OF EDINBURGH	£1,241,391.00	£124,104.00	£1,117,287.00	£0	
CARBON TRUST ADVISORY LIMITED	£114,492.00	£0	£114,492.00	£0	
NATIONAL GRID ELECTRICITY SYSTEM OPERATOR	£103,330.00	£10,333.00	£92,997.00	£0	
SUPERGRID INSTITUTE	£228,960.00	£22,896.00	£206,064.00	£0	
<b>TOTAL</b>	<b>£6,097,127.00</b>	<b>£610,333.00</b>	<b>£5,486,794.00</b>	<b>£0</b>	<b>11%</b>



**ANNEX 2 TO SCHEDULE: TEMPLATE OF BANK ACCOUNT DETAILS TO BE PROVIDED TO EITHER NGGT ([BOX.GSOSETTLEMENTS@NATIONALGRID.COM](mailto:BOX.GSOSETTLEMENTS@NATIONALGRID.COM)) OR NG ESO ([revenue.invoice@nationalgrideso.com](mailto:revenue.invoice@nationalgrideso.com))**

**Company name:**

**Primary Contact Details (only one contact permitted)**

First Name:

Last Name:

Email address:

Mobile phone number:

Work phone number:

**Address details**

Address name:

Street address:

City:

State / region:

Post code:

PO box: (if applicable)

PO box post code: (if applicable)

**Banking details**

These should be evidenced in non-editable format. The evidence provided must show company name and bank details and it should be dated within the last 6 months.

Any of the below documents will suffice:

- Bank statement (scanned document)
- Void cheque
- Paying in slip
- Screenshot of online banking (showing a logged in account with bank account and sort code, with browser visible)