



Re-opener Report

Bespoke – RIIO-2 Substation Civils Works

August 2022

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1. Executive summary

- 1.1. This reopener report justifies RIIO-T2 (2021-2026) expenditure of £58.07m in 2018/2019 prices, in addition to initial funding of £25.45m previously granted, taking the request to £83.52m for the full RIIO-T2 Term. This is inclusive of Opex escalator. This funding will enable us to maintain the reliability of civil infrastructure at 186 sites across the Main Interconnected Transmission System. Civil assets and infrastructure are intrinsic to maintaining safe and effective High Voltage (HV) assets and control systems. “Civil Infrastructure” refers to the built environment within which our HV assets reside and our people work. It includes buildings (both asset housings and working spaces), roadways & access provisions, support structures for assets, environmental infrastructure, security fences, and cable crossings.
- 1.2. Our stakeholders have told us that ensuring the reliability of the network is important to them. One of the greatest challenges facing network companies, both now and in the future, is ensuring that they are reliable and resilient, particularly considering the age profile of much of the network. We believe it is crucial that our critical infrastructure both continues to function as intended and that it remains secure for the future demands of the transmission system.
- 1.3. Activities in this area help to deliver a fair transition to Net Zero by 2050. A reliable network is required to facilitate the increasing system access needed to connect new types of generation. Additionally, repairing/refurbishing existing structures minimises the carbon cost associated with the use of concrete and steel for new structures.
- 1.4. As part of the RIIO-T2 final determinations detailed in NGET_A09.10 Ofgem decided, for this asset category, to initially fund activities in this licence period with £25.45m of the original submission. This enabled work to continue, preventing any delays to delivery. Ofgem’s Final Determination NGET Annex REVISED section 3.97 stated that Ofgem have “...decided to provide a bespoke Substation Civil Investment Works reopener to consider additional funding when NGET has collected the levels of condition data required to establish a robust needs case for any further investment”. Special Condition 3.32 of the Licence requires the submission of a reopener not exceeding £58.1m to approve the remaining RIIO-T2 spend. During a series of bilateral meetings through 2021 with Ofgem, and further contact in 2022, an approach for gathering and recording asset health data and presenting options analysis in support of this funding request was agreed. This reopener seeks the remaining £58.07m of RIIO-T2 funding to ensure that efficient and economic delivery of Civil Related Works (CRW) is maintained.
- 1.5. The initial RIIO-T2 submission was built upon a review of the National Grid Electricity Transmission (NGET) Plant Status data set, which identified defects on civil assets at the time of submission. In this submission, we proposed to continue the run rate achieved in RIIO-T1 but following feedback from Ofgem, along with surveys and options analysis conducted during the first 18 months of the RIIO-T2 period, we can now provide more detail on the work required and associated costs. The scope of the CRW outlined in this submission is now predicated on 228 interventions from the plant status data set, site-specific options analysis and other site survey activities.
- 1.6. We are developing our approach to civils asset management, and this has partly been enabled by the RIIO-T2 allowances for ‘Civils Asset Data Creation’. These allowances enable us to target resource and activities to increase the number of physical assets recorded in core data systems. This will enable financial value, work activity and asset condition to be recorded against critical assets more comprehensively, whilst also improving efficiency in our reporting capability. Whilst we plan to continue to develop this approach, it has enabled a significantly enhanced level of detail for both the needs case and cost of interventions provided with this submission.

1.7. This funding will allow us to develop and implement CRW appropriately and exploit opportunities to align works to reduce HV system outages where required, such as coordinating works with planned maintenance and other capital project works. Alignment with wider site activities in RIIO-T2 and longer-term plans is important, particularly as some civils asset families, for example, HV asset support structures and buildings, can have a major impact on optimal investment options for a whole site. Preparations for this submission have been cognisant of wider site interactions and these have been identified where appropriate.

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2. Summary Table

Name of scheme	Substation Civils Infrastructure
Primary driver	Asset Health and Condition
Scheme reference / mechanism of category	Bespoke
Output references/type	Civils
Cost	£58.07m
Delivery year	2021- 2026
Reporting table	Special Condition 3.32
Outputs included in previous RIIO Business plan	Yes
Spend apportionment	RIIO-2

Table 1: Summary Table

Cost Table

Category	Cost
Non-Outage Plant Status Interventions < £250k	£8.150m
Outage Related Plant Status Interventions < £250k	£8.051m
£1m> Interventions >£250k	£7.548m
Interventions > £1m	£7.091m
Fixed Wiring	£3.097m
Site Condition Monitoring	£11.665m
In Regulatory Period Urgent Interventions ¹	£4.080m
Total Works:	£49.697m
Opex Escalator (Calculated without Risk)	£8.390m
Total	£58.07m

Table 2: Cost Table

¹ Currently unknown and unexpected urgent interventions required during RIIO-T2 e.g. impacts from extreme weather events.

3. Introduction

- 3.1. The Substation Civils Infrastructure category refers to the built environment in which our assets reside and where our people work. It includes buildings (both asset housings and working spaces), roadways & access provisions, support structures for assets and environmental management such as drainage and oil containment. In the initial RIIO-T2 submission, we also included a specific provision for civil asset inventory creation that will facilitate enhanced understanding & management of our civil assets, principally substation support structures such as plinths and A-Frames / Gantries, owing to their critical role within the network. This development will influence and enhance our future regulatory submissions, including those for RIIO-T3.
- 3.2. In parallel, we are developing a condition assessment framework that will be applied to all assets - including civil engineering assets – using a standard scoring system to describe the condition and probability of failure of assets.
- 3.3. Activities in this area help to deliver a fair transition to Net Zero by 2050. A reliable network is critical to facilitate the increasing system access needed to connect new types of generation. Additionally, repairing/refurbishing existing structures minimises the carbon cost associated with the use of concrete and steel for new structures.
- 3.4. Our future approach to identifying and prioritising CRW will focus on three key areas:

Civil Asset Data Creation: Creating an asset register for priority civil assets across our Electricity Transmission portfolio.

Condition Assessment Framework: A standardised approach to classify the condition of assets.

Gather Data to Measure Performance: Understand the failure risk of the network, historic and expected trends and use these measures to enable informed decisions in relation to investment requirements.

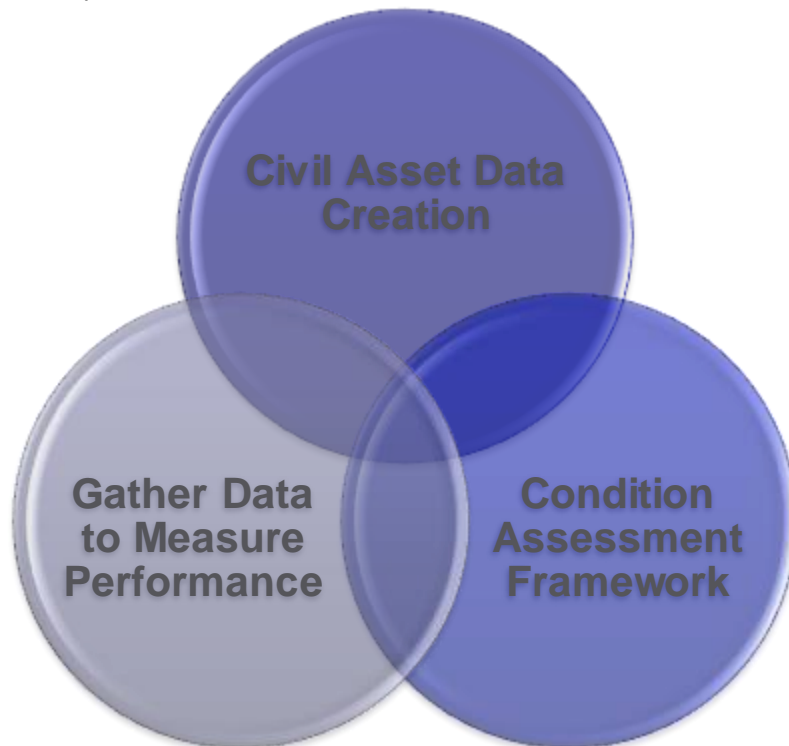


Figure 1: Civil Engineering Strategic Areas

- 3.5. This document is a bespoke reopener submission to Ofgem by NGET for CRW in the substation civils infrastructure category during RIIO-T2. It is submitted under the re-opener provided for in Special Condition 3.32 of the NGET Transmission Licence. This submission is made in accordance with the 'RIIO-T2 Re-opener Guidance and Applications Requirements Version 2' published by Ofgem in February 2022. The contents of the submission have also been informed by engagement between NGET and Ofgem with the aim of ensuring that this submission enables the Authority to make a positive, timely decision on funding.
- 3.6. As a result of RIIO-T2 Final Determinations, it was confirmed that of the £83.56m funding requested in Investment Decision Pack NGET_A9.10 Substation Other and Other TO Equipment for Plant Status Civils, partial funding of £25.45m was allowed to deliver certain interventions within the first 1.5 years with specific funding also allocated to Civil Data Asset Creation, with the request for the remaining £58.1m for the next 3.5 years of RIIO-T2 to be resubmitted using enhanced supporting information via this re-opener process.
- 3.7. Following site surveys carried out since the beginning of the RIIO-T2 period, we have populated cost estimates for intervention work within our Plant Status database. One of our specialist framework contractors has developed estimates for 103 interventions included within this submission. These have been internally assured and benchmarked against historic rates. With the current levels of inflation seen across the UK, contractors typically will honour the value of a quote for four weeks for smaller works or three months for major works. If we were to increase the time for the quotes to be held, contractors would only increase the costs to accommodate and hence transfer the cost uncertainty to NGET and ultimately, the consumer. Given the time period that the Civil Related Works portfolio covers, it is impractical and disproportionate to seek quotations for the volume and varied nature of these works.
- 3.8. Therefore, for the remainder of the interventions, we consider that cost estimation utilising the data from estimates produced by our existing framework contractors alongside actual spend since April 2021 to be the most suitable, consistent and proportional approach to forecasting the cost of this portfolio.
- 3.9. Further details of our approach to cost estimation are provided in Section 7. The funding we are seeking as a result of this re-opener submission will allow us to carry out the identified remedial works requiring intervention within the remainder of the RIIO-T2 period.
- 3.10. Following the RIIO-T2 funding request, this reopener provides greater clarity of the works required than originally submitted. As a result of an increase in the level of information we hold about our civils assets and more proactive identification of defects than in RIIO-T1, we are expecting to deliver an increase in volume of works over the remainder of the RIIO-T2 period. A number of interventions have been identified but based on an enhanced assessment of their condition, will not be required until 2026 or later. These have been excluded from this submission.
- 3.11. This reopener requests £58.07m for the remainder of the RIIO-T2 regulatory period following this submission. The value derived by the Opex escalator mechanism is included within the total of this request. When combined with the £25.45m already funded within the RIIO-T2 period, a total value of £83.52m for the full RIIO-T2 period is required.

4. Structure of the reopener submission

4.1. This CRW Reopener follows the guidance set out within the special condition 3.32 of the Licence along with the RIIO-T2 Re-opener Guidance and Application Requirements Version 2. A breakdown of the requirements for application can be found in **Table 4** along with a mapping to the relevant sections of this report.

Special Condition	Requirements of Special Condition 3.32	Section of this report
1.16 (a)	A statement of the of the adjustment of the CWRt that the licensee is requesting and the regulatory years to which the adjustment relates,	3. Introduction
1.16 (b)	An explanation of the basis of the calculation for the proposed adjustment to the CWRt;	9. The preferred option and detailed costs
1.16 (c)	The specific Civil Related Works that the licensee proposes to deliver;	Appendix 02 & Appendix 04
1.16 (d)i	A needs case for the Civil Related Works informed by network surveys	6. Demonstration of needs case
1.16 (d)ii	A breakdown of costs associated with the Civil Related Work for the Authority's review;	Appendix 02 & Appendix 04
1.16 (d)iii	The resultant impact on asset health due to the proposed Civil Related Works;	5.Alignment with overall business strategy and commitments
1.16 (e)	An explanation of whether the licensee considers that the adjustment to allowances sought and the works set out in accordance with sub-paragraph (c) should be made an Evaluative PCD, including what delivery date and PCD output definition the licensee considers should be specified.	11. Price control deliverables and ringfencing.

Table 4: Requirements for the Application

4.2. Following bilateral engagement meetings with Ofgem throughout 2021 and 2022, and to ensure proportionality of approach, individual CRW have been categorised based on their funding request values:

Interventions < £250k

Are detailed within Appendix 02, these interventions have a cost breakdown and a risk percentage applied as described in Section 7 with further justification detailed in Appendix 05.

Interventions >£250k but <£1M

Are detailed within Appendix 02 but have further detail within Appendix 03. These interventions have an investment paper containing resource constraints, delivery risk and costing methodology.

Interventions > £1M

Are detailed within Appendix 02 but have further detail within Appendix 03. These interventions have more detailed investment paper containing project dependencies, resource constraints, risks, delivery strategy and a breakdown of options considered.

- 4.3. The approach to costing risk is detailed within Section 7: Options and option costs, and aligns to the intervention values above.

5. Alignment with overall business strategy and commitments

- 5.1. In response to the RIIO-2 Final Determinations, we have developed a more granular level of detail in relation to CRW required during RIIO-T2 along with accompanying costs. We have also developed a strategy to ensure wider improvements to CRW will be developed and sustained in future.
- 5.2. We are developing and enhancing our approach to management of civil engineering assets. This is demonstrated through the use of asset-specific condition reporting to justify the interventions requested in this submission. Previously we have submitted historic spend run-rates. It is our aim that our approach demonstrates a clear need and cost justification for spend, as well as delivering a reduction in safety and reliability risks attributed to civils assets.
- 5.3. In RIIO-T2, we are capturing asset inventory data that enables asset-specific failure risk reporting in line with our priorities below. This will enable us to justify future business case submissions, such as RIIO-T3, with easily accessible, more accurate, reliable data and associated costs.
- 5.4. Additionally, our investment in 'Civils Asset Data Creation' will increase the visibility of critical infrastructure, its associated failure risk, cost of ownership and residual value. This will enable us to develop more granular and confident measures of network risk and lead to transparent and more clearly justified intervention decisions.
- 5.5. Our strategy is to develop a network-wide view of asset condition and failure risk, however this will not be fully complete by the date of submission of our RIIO-T3 business plan. This is because the asset data capture process will be ongoing throughout the RIIO-T2 period and surveying 400+ operational sites to the level of detail required in the remaining timeframe of RIIO-T2 is not feasible. For our RIIO-T3 submission, we will therefore focus on capturing condition and defect information for priority sites including:
 - 'The historic core':
 - HV asset support structures and busbar infrastructure within 132kV and 275kV reinforced concrete substations.
 - HV asset support structures and busbar infrastructure in 400kV AIS substations.
 - Current and Legacy Power Station sites (including Nuclear).
 - Sites with significant and converging load-related and non-load related drivers.
 - New issues reported directly from our field teams through the 'Plant Status' process.

The strategic context

- 5.6. Our responsible business charter articulates what responsibility means for our organisation across the environment, our communities, our people, the economy and our governance. A significant part of this charter is our role in achieving 'Net Zero'. We are committed to achieving a 50% reduction in carbon dioxide emissions from our operations by 2030 and Net Zero by 2050. We have ambitions to eliminate all SF₆ from our assets by 2050 as well as accelerating our net zero target wherever possible. We will always do this **reliably**, **safely** and in a **fair** and **affordable** way.
- 5.7. These commitments and ambitions present a significant challenge, requiring significant investment of resources (access to the transmission system, people and finance). The management of our existing civil infrastructure is important to the success of a reliable, safe, fair and affordable transition to Net Zero.
 - The path to Net Zero will see an increase in the number of locations and types of connections, increasing the volume of civil assets that we will need to manage.

- The ambition to remove all SF₆ from the NGET system by 2050 will require major substation modifications, upgrades and retro-fill interventions (where technically feasible).
- A safe and reliable network is required to facilitate new connections and transitions from SF₆-filled technology.
- The management of asset failure risk has an indirect carbon cost from replacement and repair/refurbishment actions. Interventions must be 'carbon-optimal' overall.

5.8. The **primary driver** of this specific investment proposal is the management of **safety and reliability** risk associated with the **failure of civils infrastructure**. Our stakeholders have told us that this is important to them. A fair and affordable transition to Net Zero is not possible without the backdrop of a safe and reliable network for new generation, demand and SF₆-free technologies to connect to. The investments in this paper reduce the risk of failure in the assets identified. Conversely, not all intervention priorities are addressed in the scope of this RIIO-T2 paper. Some risk-reducing interventions, for example at Fawley, are to be coordinated with wider site investment plans which will require significant further works through T3 and beyond.

Our Approach

5.9. Our approach to assessing the justified need and cost of the CRW identified in this submission encompasses the following elements:

- 5.9.1. **Asset-specific risk is understood** - asset condition and criticality are categorised enabling a prioritisation of interventions.
- 5.9.2. **Interactions with other drivers are identified** - intervention priorities are compared with other non-load and load related drivers for associated assets and substation sites. Any interactions are identified as opportunities or threats to the programme.
- 5.9.3. **Interventions are categorised** - assets are categorised according to the scale of investment expected.
 - **Interventions < £250k** are detailed within Appendix 02, these interventions have a cost breakdown and a risk percentage applied as described in Section 7.
 - **Interventions >£250k but <£1M** are detailed within Appendix 02 but have further detail within Appendix 03. These interventions have an investment paper containing, resource constraints, delivery risk and costing methodology.
 - **Interventions > £1M** are detailed within Appendix 02 but have further detail within Appendix 03. These interventions have more detailed investment paper containing project dependencies, resource constraints, risks, delivery strategy and a breakdown of options considered.
- 5.9.4. **Deliverability of different options is assessed** - outage and resource requirements are identified and secured within the RIIO-T2 regulatory period where possible.
- 5.9.5. **Failure risk output of different interventions is defined** - the impact on the condition score and expected lifetime of each intervention.
- 5.9.6. **The percentage of direct and indirect activities, other materials, goods and services is defined** - each intervention is a function of temporary works, materials and direct site labour. The ratio of each is dependent on the type of intervention with closely associated indirect costs captured via the Opex escalator mechanism.

Future and forecast data

5.10. The following table identifies the anticipated asset life of our Substation Civil components. In future, the anticipated asset life will be used, in conjunction with our Civils Data Asset Creation, Condition Assessment Framework and Data Gathering work, and will enable us to proactively forecast and plan future works ahead of reactive maintenance.

Asset	Component	Anticipated Asset Life
Substation HV Support Structures	Concrete Pre 1970	40
	Concrete Post 1970	50
	Steel	50
	Aluminium	50
Cable Tunnels	Cross Site	80
	Major/Minor Route	100
Cable Bridge		50
Cable Trench		40
Building	Cladding - Metallic	35
	Cladding – Masonry	50
	Roofs – Pitched	40
	Roofs – Flat	20
	Structural Frames	50
Roads		60
Structural Foundations		50
Site Drainage	Drainage Infrastructure	50
	Sewage Treatment Plant	30
	Penstocks	40
Security Assets	Perimeter Security Fencing (Mesh/Palisade)	50
	Electric (PID) Security Fencing	20
	Technology (CCTV Camera, Control Systems)	15
	Lighting	15
	Lighting/CCTV Towers	40
	UPS	15

Oil Containment	Oil Storage Tanks	40
	Bunded Areas	50
	Oil Separators/Interceptors	40

Table 5: Anticipated Asset Life

KPIs and performance measures

- 5.11. The proposed interventions detailed within the Appendices aim to restore the asset condition (detailed within Section 6: Demonstration of Needs Case) of each asset to '0' as per our Asset Condition Framework (Table 7). This will be monitored and reported as part of the RIIO-T2 close out process.

Asset performance and risk modelling

- 5.12. Part of the long-term strategy for CRW is to be able to gather data and measure the performance of assets over time. Once we have established and categorised a civil infrastructure data set with a fully inventoried site condition assessed portfolio, we will be able to track trends and forecast interventions on critical assets in a proactive manner.
- 5.13. To date, we have undertaken Whole Site Condition Assessments on 20 sites which were determined based on high priority plant status works. These surveys have validated known interventions or captured new ones not previously logged. We have set up a dedicated team to continue this work throughout RIIO-T2 and beyond. It is our intention to continually monitor sites on a rolling basis utilising a centralised assessment team to control and reduce ambiguity and inconsistency that can often occur with decentralised teams.
- 5.14. Our aim is to reduce our reliance on Plant Status and transition to primarily using the Civil Data Asset Creation and Site Condition Monitoring supported by Digital Workflow Management. Systematically capturing issues and delivering interventions to address them will be central to the success of this transition.

Works Outside T2 Submission

- 5.15. We have identified interventions to civil asset structures for which we are not seeking funding as part of this submission. These interventions are costs outside of the submission as they were either related to work we are delivering in RIIO-T2 which was originally planned in RIIO-T1, or fall outside of the £58.1m reopener price cap. A list of these interventions is included within Appendix 06.

6. Demonstration of the Needs Case

Needs Case

- 6.1. A significant portion of our infrastructure on substation sites, having been installed in the 1960s and 1970s, is deteriorating to a state where it requires intervention to reduce the level of risk associated with the infrastructure asset(s), and this is reflected in the condition reported by our Operations teams. When interventions are planned on our HV assets, this is the ideal time to intervene on our civil assets but these asset interventions aren't always required at the same time. Therefore, independently to HV asset interventions, we need to ensure that the condition of our civil assets do not have an adverse effect on the condition and/or performance of our HV assets.
- 6.2. The Plant Status database is utilised by our operational field staff to flag infrastructure assets that require review and assessment by our Asset Management teams. Once the asset has been assessed and there is a need for intervention, the Plant Status database is updated and the relevant entry flagged for investment.
- 6.3. In order to assess the requirement for intervention, it is necessary to quantify the criticality of the asset on the network. To do this we have referred to CIGRE (Council International des Grande Réseaux Electriques) Technical Brochure 858: Asset Health Indices for equipment in existing substations, to develop scores for the criticality of the asset in relation to its failure. Each asset is given a criticality score based on four possible consequence scenarios for failures within each asset category:
- 6.4. These four possible consequence scenarios for failures in buildings and structures asset lists are aligned to the following priorities and explanations:
 - **Civils Criticality 1** – If something happens then substation is unable to function properly. For example, when roof of the control building is leaking heavily then all the equipment inside may suffer from water damage and therefore stop functioning. Safety of workers.
 - **Civils Criticality 2** – If something happens then asset (primary or secondary) related to that is unable to function properly. For example, when support of disconnector is failing then it is unable to use that disconnector.
 - **Civils Criticality 3** – If something happens then nothing will happen to substation in short term, but it will affect reliability in long term. For example, when drainage is not functioning properly.
 - **Civils Criticality 4** – If something happens then nothing will happen to substation that may affect reliability but makes service more inconvenient. For example, when road is broken.

Each asset component is aligned to a civils criticality score shown in Table 6 below:

Asset	Component	Civils Criticality
Substation HV Support Structures	Concrete Pre 1970	1
	Concrete Post 1970	1
	Steel	1
	Aluminium	1
Cable Tunnels	Cross Site	2
	Major/Minor Route	2
Cable Bridge		2

Cable Trench		2
Building	Cladding – Metallic	2
	Cladding – Masonry	2
	Roofs – Pitched	1
	Roofs – Flat	1
	Structural Frames	1
	Walls	2
	Doors	3
	Windows	3
	Roads	
Structural Foundations		1
Site Drainage	Drainage Infrastructure	2
	Sewage Treatment Plant	2
	Penstocks	2
Security Assets	Perimeter Security Fencing (Mesh/Palisade)	3
	Electric (PID) Security Fencing	3
	Technology (CCTV Camera, Control Systems)	2
	Lighting	2
	Lighting/CCTV Towers	2
	UPS	1
Oil Containment	Oil Storage Tanks	1
	Bunded Areas	2
	Oil Separators/Interceptors	2

Table 6: Criticality table

6.5. In addition to this, we have recognised the need for a scoring or classification system in order to articulate the condition severity of assets as consistently as possible. We currently employ some basic descriptors on our maintenance and inspection scripts that we have found to be too subjective and for this analysis (“Excellent, Good, Average and Poor”). In re-evaluating our approach we have aimed to produce classifications with more precise and measurable descriptors of condition to increase the confidence in the assessment made. Training material and a visual assessment guide will be produced to complement these classifications and to support their wider implementation and consistent application across National Grid.

6.6. Whilst producing this scoring system we have looked to other organisations and methodologies, principally CIGRE technical brochures 761 and 858 as well as the Common

Network Asset Indices Methodology (CNAIM) employed by Distribution Network Operators. We believe our classifications map best to our scoring system in this way, as shown below.

0	10	20	30	40	50	60	70	80	90	100
Cigre - A			Cigre - B			Cigre - C		Cigre - D		Cigre - E
CNAIM As New/ Good	CNAIM Normal Wear/ Good		CNAIM Slight Deterioration	CNAIM Some Deterioration / Poor			CNAIM Substantial Deterioration/ Very Poor			

Table 7: Asset Condition Score Descriptions

6.7. We employ a 0-100 scale with the intention of creating an equivalent to the ‘EoL (End of Life) Modifier’ utilised in the NARM framework. We strive to standardise the way we communicate asset health across our different fleets. This aids transparency and more effectively leverages the power of digital tools to share data. This becomes increasingly important as we seek to build coordinated, long-term plans that deliver a fair transition to Net Zero within and outside National Grid.

6.8. For clarity, please find below two examples of the classification utilising the Asset Condition Framework scoring methodology:

Example 1:

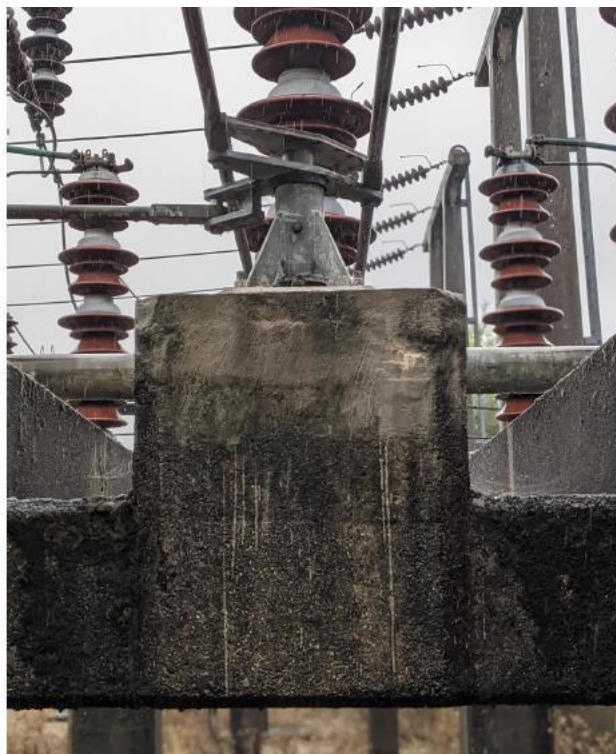


Image 1: Repaired Disconnector Plinth

Condition Score	0/100
Condition Description	'No Defect'
General Description	Very good condition. No observable or measurable deterioration.
Common Network Asset Indices Methodology (CNAIM) Equivalent	No Deterioration: Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion or cracks.
CIGRE TB WG48 for B3	Very Good: Very low likelihood of failure over many years. This would be in the original factory condition or after extensive refurbishment.
CIGRE Transformer Equivalent	A -Minimal signs of ageing or deterioration.
Observed Symptoms	A 'weathered appearance' and/or good condition repairs are acceptable for this condition score.

Table 8: Example 1

Example 2:



Image 2: Reinforced Concrete Support Structure Defect

Condition Score	60/100
Condition Description	'Heavy Defect'
General Description	Action is now required to arrest the decline of this asset, otherwise probability of failure will begin to increase non-linearly and future corrective actions may become very costly. The asset requires maintenance, refurb, repair or even replacement if cost assessment is favourable.

CNAIM Equivalent	Some Deterioration: Evidence of previous concrete repairs, repairs have begun to fail in places. This may include: For concrete structures, minor cracks and loss of section. For steel structures, some surface level corrosion.
CIGRE TB WG48 for B3	Poor: Progressive deterioration has been detected, with high likelihood of failure in the short term. The unit can remain in service, but short-term reliability is likely to be reduced. Subcategories are useful to define urgency of repair or replacement timeframes.
CIGRE Transformer Equivalent	C -Poor Condition. Repair or replacement should be considered within the short term. Reliable operation may be impaired or compromised. Performance or component may be causing deleterious effects. Consider review of rating and operating condition.
Observed Symptoms	Single instances of visible steel reinforcement, cracking, spalling, loss of concrete cover up to 20% of the length, width or depth of the structure element (leg or beam).

Table 9: Example 2

6.9. Plant Status

Within this reopener submission we are requesting funding for the Plant Status database entries that we have assessed in need of intervention based upon both their Asset Condition score (desktop based assessment using recent survey data and current photographs) and their criticality to the network. Each Asset Condition score and CIGRE criticality score is detailed along with the asset and intervention within the Appendix 02. In addition to this, we have also included works that focus on improving the operational capability of our staff where works are required for structural building modifications.

6.10. Site Condition Monitoring

Following the trial assessments on whole site civil structures (20 high priority sites), each asset has been given an Asset Condition score. Each Asset Condition score is given along with a detailed cost build within Appendix 07. Some elements of work will require additional surveys in order to produce a cost for remediation. We are unable to estimate these costs and have highlighted these within Appendix 07. Therefore, no costs are included in this submission where this is the case. A summary of costs is included within the Plant Status submission Appendix 02.

6.11. Fixed Wiring

The Fixed Wiring portion of the work does not exist as a Plant Status entry. This element of the reopener comprises of c.3000 different observations. This work has been identified following a comprehensive site survey programme conducting Electrical Intervention Condition Reporting (EICR) in line with BS 7671: 2018. The observations have been classified into their respective codes in line with the Institute of Engineering and Technology's (IET) Guidance Note 3 – Inspection and Testing 18th Edition.

The categories comprise of:

Code C1 – 'Danger Present'. Risk of injury. Immediate remedial action required.

To be attributed for matters that cannot be left. It is suggested that these are rectified or possibly, isolation may be recommended or necessary. Examples include accessible bare live parts, badly damaged equipment with risk of access to live parts, incorrect polarity, arcing found in switchgear.

Code C2 – ‘Potentially Dangerous’. Urgent remedial action required.

To be attributed to issues that, whilst urgent, do not require immediate remedial action. Examples include a non-earthed installation (this requires a further fault to result in danger), fundamentally undersized cables, earth fault loop impedance values greater than required by BS 7671, a ‘borrowed’ neutral, equipment with inappropriately selected IP (this may warrant a C1 if severe), insulation readings under 1M Ω , connections not housed within appropriate enclosures.

Code C3 – ‘Improvement Recommended’.

To be attributed where C1 or C2 do not apply. Examples include the absence of most warning notices, absence of the required diagrams and charts, no or incorrect marking of conductors at terminations, absence of an RCD specified for additional protection (where the circuit otherwise tests as normal).

Code FI – ‘Further Investigation required without delay.

To be attributed where the inspection has revealed an apparent deficiency that could not, due to the limitations or extent of the inspection, be fully identified and further investigation may reveal a Code C1 or C2 item. An example could be where characteristics of an electricity supply (such as voltage or external earth fault loop impedance) do not conform to supply industry norms.

Code LIM – Indicates a limitation on testing.

A breakdown of the fixed wiring work can be seen in Appendix 04 along with the classification codes associated with each site. Where possible we have immediately undertaken works to address C1 observations and put mitigations in place for the others.

6.12. Oil Containment Works

We recognise that a number of our oil containment civil assets (bunds) are reaching an age where their integrity can start to deteriorate. As they are underground it is extremely difficult to access without significant invasive work. Within the Plant Status listing we are requesting funding for the remediation of several assets prioritised in line with wound plant health.

6.13. In Regulatory Period Urgent Interventions

This element of funding refers to interventions that occur within the RIIO-T2 period that are unforeseen but have a critical high priority. Historically we have managed these occurrences by deferring less critical works and investing the funds into the highest priority work. All the interventions included in this funding request should be delivered during RIIO-T2. Therefore, it is necessary to introduce a funding element to allow immediate reactive work that is identified within the funding period.

7. Options and option costs

Interventions and intervention strategies

- 7.1. Our immediate strategy is to continue identifying investment drivers through our predominantly time-based, periodic asset inspection and maintenance routines. The defect and plant status reporting process will be used to generate work requirements that will be assessed for prioritisation until we have fully embedded our new approach.
- 7.2. For each civil asset identified as requiring intervention, a number of investment options are considered prior to delivering the work:
 1. Do 'Nothing' or 'Minimum' – the risk may be manageable without the need to intervene or there may be an opportunity to coordinate with a bigger substation scheme involving more extensive replacement or removal of associated assets.
 2. Decommission part of or the complete system. A reduced cost of ownership may be achieved by repairing the defect that triggered the Plant Status Report and modifying the system so that it is the right size for the assets it is supporting.
 3. Repair/Refurb (will usually involve replacement of components within a system such as a new pump and fan motor for a transformer cooling system).
 4. Full Replacement of a system (smaller or larger).
 5. Full Replacement of a system (like for like).

Cost assessment

- 7.3. Where possible the principles within the Infrastructure and Projects Authority Cost Estimating Guidance have been adhered to. Investment decision-making during the course of RIIO-T2 is driven by our standard investment process, incorporating proportional cost and benefit considerations.
- 7.4. In order to provide robust cost estimates for the investment options, we have utilised our 'Minor Schemes Delivery Services Framework' to appoint a contractor with the remit of surveying the notified Plant Status defects and providing a cost estimate of the intervention required based upon their knowledge and experience of undertaking similar works. The framework contractor has undergone our procurement verification process to ensure that they are able to provide the level of service required and to ensure that they are competitive within the current market. This strategy is further detailed in Section 9.
- 7.5. Contractors were appointed with the remit to produce estimates in accordance with the following objectives:
 - **Robust:** Estimates will be a comprehensive and accurate representation of the cost of completing the works.
 - **Consistent:** Estimates will be consistent with all relevant project scope requirements, constraints, specification, risks, and construction methodology. Estimates will be consistent in their structure, quantification, use of rates and allowances, exclusions, definitions, presentation, base dates, location factors and coverage rules.
 - **Clear:** Estimates will be presented in pounds sterling and at the project base date price levels (2018/19).
 - **Appropriate:** Estimates will be prepared at a level of detail commensurate with status, depth and quantity of the design information they seek to reflect.
 - **Basis of Estimate:** Estimates will represent the most likely, acceptable tender price for the works at the project base date. Estimates will exclude for risks typically transferred to the contractor, and those risks typically retained by the employer. Estimates will not attempt to include for potential change and will be free of bias. Estimates will set out the basis of inclusion for key rates and allowances e.g.

benchmarking, market testing, quotation, approximate estimating, first principles estimating etc. Where appropriate, evidence should be provided to support such key rates and allowances.

7.6. Following submission of the contractor's estimated costs we have undertaken our own review and assurance process to ensure that costs are logical, in line with existing industry rates and benchmarked against previous quotations that we have received.

7.7. We have concluded that cost estimation based on historical data and industry expertise is the best method to detail the request to Ofgem at this time. The individual interventions included in the CRW portfolio are relatively small scale in nature, spread across 184 sites and being planned to be undertaken within the remainder of the RIIO-T2 period. Therefore, formal quotations would not be viable as they will be time limited (four weeks for minor works and three months for major works in the current market due, principally, to inflation) and more resource intensive to ensure they represent a balanced view of all types of CRW across a wide geographical area. Additionally, the quantity of interventions that would require quotations would not favourably lend itself to inviting contractors to tender ahead of this reopener submission.

7.8. The cost base for all estimates is in 2018/2019 prices with the following costs excluded:

- Operational IT & Telecoms
- Network Design & Engineering
- Network Planning
- Project Management
- Engineering Management and Clerical Support
- System Mapping
- Stores and Logistics
- Operational Training
- Vehicles and Transport
- Market Facilitation
- Health and Safety

These costs are considered Closely Associated Indirect (CAI) costs and as such are requested via the OPEX Escalator Mechanism.

Risk

7.9. The Royal Institute of Chartered Surveyors Guidance Note 'Management of Risk, 1st edition (2016) gives the following definition:

"A risk can be defined as an uncertain event or circumstance that, if it occurs, will affect the outcome of a programme/project."

7.10. Owing to the volume of interventions within this portfolio alongside the varying nature of the work activities, defining the specific uncertain events or circumstances that may be encountered would be impractical. There are however a number of commonalities that can be applied to the majority of interventions seen within the portfolio. Therefore, we have utilised internal risk management expertise and undertaken a risk review utilising the average cost of a Plant Status Intervention under £250k as these form 94% of the Plant Status interventions for which we are requesting funding. The average intervention from those costed by our external contractor is £51,000.

7.11. Smaller value construction works often carry a bigger proportional value of risk as seemingly small issues can have a high-cost relative to the total of the project. The risk percentage has been calculated utilising a risk register with mitigations and Monte Carlo analysis. Risk allocation can be seen in Table 10 below with a full breakdown of the analysis undertaken in Appendix 05.

Intervention Category	Risk Percentage
Plant Status < £250K	24.52%
£250k<Plant Status <£1M	7.5%
Plant Status >£1M	7.5%
Fixed Wiring	10%
Site Condition Monitoring Interventions	7.5%

Table 10: Percentage Risk Contingency Applied to the Delivery of Interventions

Options

7.12. Where multiple remedial options existed for an intervention, these are detailed within the individual asset specific investment paper. The investment paper details why each option was rejected and an explanation as to why the preferred option was identified (Appendix 03).

8. Methodology for selection of the preferred option

Approach

- 8.1. As outlined in Section 5, investments with an estimated value over £1m are considered on an individual basis. The justification for the selection of each option is detailed within the Asset Specific Investment papers within Appendix 03.
- 8.2. For the remaining interventions, in general, where repair is possible and will reduce the Asset Health Condition score to 0 for 10 or more years, we will seek to repair the asset. Where the cost for replacement is relatively comparable to that of repair but replacement will significantly extend the life of the asset, we will look to replace it.
- 8.3. Owing to the varied nature of interventions we have determined our preferred option estimating approach using the recommendations of our specialist framework contractors and our knowledgeable and experienced operations teams. These will be further reviewed as detailed investigations take place at the point of quotation.
- 8.4. All options are weighed in line with their specific risks and where a repair does not meet these conditions or is not possible, we consider it more beneficial to replace the asset.

9. The preferred option and detailed costs

Preferred option

9.1. Costs for each option are included in the following appendices:

Data Set	Location of Preferred Option
Plant Status	Appendix 02
Investment Paper	Appendix 03
Fixed Wiring	Appendix 04

Table 11: Preferred Option Location

9.2. Items within the Plant Status Database that had a preferred option of 1 (Do Nothing/ Minimum) have not been included within this reopener.

9.3. Items within the Plant Status Database that are over £1m in estimated value detail the options that have not been taken forward along with a cost estimate and justification for the selection of the preferred option.

Detailed costs

9.4. We have utilised one of our specialist framework contractors to develop estimates for 103 interventions. Taking these estimates and classifying them by asset and size of intervention we have utilised the following table to estimate across the portfolio.

9.5. In addition to this we have assessed the outturn spend of the works delivered to date during the RIIO-T2 period. Comparison between NGET's estimated costs and the estimated costs developed by our contractor indicate a relatively small variance, validating this approach.

Category	Small	Medium	Large
Access Covers, Ducts, Trenches and Roads	XXXXX	XXXXX	XXXXX
Internal HV Fence	XXXXX	XXXXX	XXXXX
Lighting	XXXXX	XXXXX	XXXXX
Noise Enclosure	XXXXX	XXXXX	XXXXX
Oil Containment Drainage	XXXXX	XXXXX	XXXXX
Operational Buildings	XXXXX	XXXXX	XXXXX
Perimeter Boundary	XXXXX	XXXXX	XXXXX
Site Drainage	XXXXX	XXXXX	XXXXX

Switchgear Support Structures	XXXXX	XXXXX	XXXXX
Gantry Structures	XXXXX	XXXXX	XXXXX

Table 12: Categorisation and Average Cost

9.6. The size of each intervention was classified by its respective cost utilising the following table:

Size	Description
Small	<£25k
Medium	£25k-£100k
Large	£100k-£250k

Table 13: Size Classification

9.7. Interventions over a value of £250k all have a contractor produced estimate or where possible a quotation. Each Item within the CRW portfolio has a cost estimate detailed where it is listed in its relevant appendix. Please see Table 11 for details of where types of items can be found.

9.8. Closely Associated Indirect Costs have not been included within the estimates. Please see Section 7 for a list of exclusions.

9.9. Contractor produced estimates are built up using previous cost data from similar projects or are built up utilising industry rates and guidance. They are broken down into materials & prelims cost, construction cost and a cost for any necessary temporary works required to undertake the work (e.g. scaffolding) Throughout the cost estimation process several fixed percentage rates have been utilised. These are detailed below:

9.9.1.1. Preliminaries – XX%, XX% & XX%

Preliminaries' are the cost of site-specific overheads directly related to running of the project and the site that are not measurable as either plant, materials or labour. This would typically include the site establishment (site cabins, welfare, parking areas, laydown areas etc) and the cost of site and contract management.

XX% was used as the basis for this cost as it is the median value seen across seven competitive tenders received in January 2020. For larger value schemes the percentage allocated to preliminary costs tends to decrease. As such XX% has been used for schemes between £100k - £500k and XX% utilised for schemes over £500k.

9.9.1.2. Contractor Fee – XXXX%

Where there hasn't been a suitable rate available for a cost build from previous projects the contractor has been required to produce an estimate. This is done using plant and labour constants from Spon's pricing books with the addition of a fee percentage derived from our Minor Civil Framework's contract rates. The median contractor rate from the framework has been utilised at XXXX%.

In Regulatory Period Urgent Interventions

9.10. This element of funding refers to interventions that occur within the RIIO-T2 period that are unforeseen but have a critical high priority. Historically we have managed these occurrences by deferring less critical works and investing the funds into the highest priority work. All the interventions included in this funding request should be delivered during RIIO-T2 (save for any justified reprioritisation following more detailed surveys). Therefore, it is necessary to introduce a funding element to allow immediate reactive work that is identified within the funding period.

An example of such reactive work is detailed below:

Example 1: Blyth Cladding



Image 3: Missing cladding at Blyth Substation

9.11. Recent storms within the UK caused the cladding on Blyth Substation to lift resulting in damage to the hook bolts and ultimately the loss of cladding to the building. This incident requires immediate rectification and was unforeseen during the initial RIIO-2 submission period.

9.12. Within a given financial year we have seen approximately 20-25 instances whereby urgent action has been required. At the point of submission there remain 3.5 years of the RIIO-T2 regulatory period. As such we estimate that we will experience approximately 80 of these events throughout the remainder of the term. The nature of the intervention required can vary significantly.

9.13. The average cost of our Plant Status Interventions, contractor estimates and quotations, under £250k is £51k per intervention. Combining this with the estimated volume of interventions required indicates that we will need £4.08m allowing us to continue with the prioritisation that we currently undertake whilst also enabling us to deliver the defined interventions contained within this submission. A single intervention of this type may cost significantly more than the average intervention costs to remediate. Therefore, we would like for this sum to be available to cover the actual urgent unplanned interventions experienced within the remainder of the regulatory period, regardless of the number of interventions required. Unspent funding will be returned through the UIOLI mechanism.

Submission Cost Table

Category	Cost
Non-Outage Plant Status Interventions < £250k	£8.051m

Outage Related Plant Status Interventions < £250k	£8.150m
£1m> Interventions >£250k	£7.548m
Interventions > £1m	£7.091m
Fixed Wiring	£3.097m
Site Condition Monitoring	£11.665m
In Regulatory Period Urgent Interventions	£4.08m
Total Works:	£49.697m
Opex Escalator (Calculated without Risk)	£8.390
Total	£58.07m

Table 14: Overall Costs

10. Project Delivery and Monitoring

- 10.1. Owing to the scale and variation of the interventions contained within the CRW portfolio it is not possible to provide an overall project delivery plan. However, all CRW within this reopener follow a similar delivery and monitoring model as detailed within the approaches listed below.
- 10.2. Once the funding mechanism has been agreed and an appropriate outage window identified (where necessary), a contractor is assigned utilising one of the pre agreed competitive frameworks. The frameworks available are:
- Minor Schemes Delivery Services Framework (Lot 1 Project Management Services - 2 appointments, Lot 2 Design - 6 appointments, Lot 3 Health & Safety Consultancy – 1 appointment)
 - Minor Civils Framework (14 Contractors appointed in total for different geographical areas and LOB)
 - Roofing & Cladding Framework (6 contractors appointed)
 - (Non ISS) Security Fencing Framework (5 contractors appointed)
- 10.3. All contracts are NEC3 compliant and the number of suppliers within each framework ensures that we have the capacity for project delivery, competition at mini tender and leverage for direct award where appropriate. In addition, it also provides access to contractors with specific skill specialisms and geographic location advantages.
- 10.4. The contractor/contractors are requested to submit a tender/quotation before an order is awarded to the most suitable return. The contract is then tracked and monitored through delivery and execution, with the final costs and work logged in accordance with internal procedures.

Plant Status Delivery Approach

- 10.5. The majority of work within the 'Plant Status' database revolves around the repair/remediation of single civil assets. Therefore, it is often the case that work can be planned to coincide with system access & outages taking place on site. Where the proposed intervention requires system access a discussion is held with the local Operations Manager to identify the most suitable window of opportunity. This means the Plant Status work is delivered flexibly in line with constraints of the wider system, reducing the requirements for additional network outages and maximising the utilisation of specialist staff (i.e. Senior Authorised Persons (SAP) with specific National Safety Instruction authorisations).
- 10.6. Interventions detailed within Plant Status form the vast majority of the work. This equates to £30.846m of the total £58.08m request. Each intervention within the Plant Status database is further categorised by its value:

Intervention <£250k

This particular category accounts for 95% of all of the interventions within the Plant Status database. The work being undertaken within each intervention is managed on a proactive system access basis (described above), whereby the works will be planned to take advantage of a local system outage and the availability of contractors via one of our competitive frameworks, e.g. taking advantage of OHL outages to work on Transformer noise enclosure roofs. The work is generally small scale and is limited to days or a couple of weeks to complete.

Intervention >£250k but <£1M

Scope that requires this level of investment, whilst also being opportunistic has dates identified within each intervention's specific investment paper. These can be

found in Appendix 03. The paper details project dependencies, resource constraints, delivery risk and costing methodology.

Intervention > £1M

Scope that requires this level of investment, whilst also being opportunistic has dates identified within each intervention's specific investment paper. These can be found in Appendix 03. The paper details project dependencies, resource constraints, delivery risk and costing methodology.

Fixed Wiring Delivery Approach

- 10.7. The Fixed Wiring portion of the work equates to £3.1m of the total request but comprises of c.2000 different interventions. This work has been identified following a comprehensive site survey programme with the remedial work bundled per site. It is managed on a proactive system access basis whereby the works will be planned to take advantage of a local system outage and the availability of contractors via one of our competitive frameworks.

In Regulatory Period Urgent Intervention Delivery Approach

- 10.8. Where an incident occurs that requires urgent intervention this will be managed in line with the Plant Status Delivery Approach detailed above.

Delivery Statement

- 10.9. We have assessed current capability and capacity in both the supply chain and internal teams and believe that that we can deliver the interventions with the funding requested within this submission.

11. Price Control Deliverables and Ring Fencing

11.1. We have taken on board Ofgem’s direction to apply Price Control deliverables (PCDs) to the CRW portfolio along with the uncertainty inherent in producing cost estimates for future years works, as discussed within the pre-submission meetings. We propose the following funding mechanisms based upon the estimated cost data set provided in Appendix 02:

11.2. Use It Or Lose It (UIOLI) uncertainty mechanism for the following categories:

Category	Number of Items	Value
Outage Related Plant Status Interventions < £250k	102	£8.150m
Non-Outage Plant Status Interventions < £250k	108	£8.051m
Plant Status Interventions between £250k - £1m	14	£7.548m
Whole Site Condition Monitoring	20	£11.665m
Fixed Wiring	3278	£3.097m
In Regulatory Period Urgent Interventions	80	£4.08m

Table 15: UIOLI Categories

11.3. Evaluative PCD approach for each investment over £1m:

Plant Status Number	Description	PCD Value
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]
[REDACTED]	[REDACTED]	[REDACTED]

Table 16: PCD Plant Status >£1m

12. Stakeholder engagement and whole system opportunities

- 12.1. We are committed to ensuring that stakeholder engagement takes place where there is potential for stakeholders to be materially impacted by the choice of preferred option. In most cases the work undertaken within this portfolio consists of remedial interventions to assets to ensure their ongoing effectiveness and therefore, we expect stakeholder impact to be minimal for most interventions.
- 12.2. In some instances, we have identified sites that, owing to the volume of work identified, require a whole site approach. This ensures that the maximum benefit can be realised for the associated costs.
- 12.3. An example of such a site is Iver. We understand that investment is required in order to secure the existing civil infrastructure but also note that a site wide approach would drive more value for the end consumer. In addition to this we have been in early communication with the Distribution Network Owner (DNO) at Iver and also understand that they are intending to request a significant increase in demand at this location. As such, we believe that this work is best developed as a standalone investment and works contained within this re-opener are included to ensure network stability until such a time as the formal request is issued and timescales assigned to a complete solution.
- 12.4. We have included an investment request for Iver to run a trial scheme for the assets in worst condition. This trial will involve de-stringing the gantries within a single bay in order to repair insulator strings at the same time as repairing the gantry structures. This trial is included within Appendix 08 and as a single line within Appendix 02.

13. Overview of assurance and point of contact

13.1. We confirm that assurance has been conducted prior to the submission of this report and that appropriate sign off from senior management has been obtained.

13.2. We have undertaken the following assurance measures to ensure that the cost estimates received reflect value for the consumer and believe that the level of evidence provided reflects the proportionality of the case:

- Peer Review
- Cost Estimation Scrutiny
- Cost Estimation Benchmarking
- Risk Management
- Quotation Reviews

13.3. We have reviewed and assured all estimates given by specialist contractors and this data has been verified internally by benchmarking against historical cost. Records for cost build ups and site condition photographs are available upon request.

For further information please contact:

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14. Appendices

01. [Glossary](#)
02. Plant Status Listing
03. Investment Papers

Number	Paper	Link
1	Abham Lighting	https://www.nationalgrid.com/electricity-transmission/document/147066/download
2	Aust Office	https://www.nationalgrid.com/electricity-transmission/document/147071/download
3	Barking Modular Facilities	https://www.nationalgrid.com/electricity-transmission/document/147076/download
4	Barking Switchhouse Floor	https://www.nationalgrid.com/electricity-transmission/document/147081/download
5	Barking GIS access	https://www.nationalgrid.com/electricity-transmission/document/147086/download
6	Blyth Cladding	https://www.nationalgrid.com/electricity-transmission/document/147091/download
7	East Claydon Control Room	https://www.nationalgrid.com/electricity-transmission/document/147096/download
8	Hams Hall Round House	https://www.nationalgrid.com/electricity-transmission/document/147101/download
9	Jordansthorpe Access Rd	https://www.nationalgrid.com/electricity-transmission/document/147106/download
10	Melksham Anti Dig	Redacted in full
11	New Cross Tunnel	https://www.nationalgrid.com/electricity-transmission/document/147116/download
12	Pentir OHL Building	https://www.nationalgrid.com/electricity-transmission/document/147121/download
13	Rayleigh Main Fence	Redacted in full
14	St Johns Wood Tunnel	https://www.nationalgrid.com/electricity-transmission/document/147126/download
15	Swansea North Storage	https://www.nationalgrid.com/electricity-transmission/document/147131/download
16	Swansea North Control	https://www.nationalgrid.com/electricity-transmission/document/147136/download
17	Tottenham Modular Office	https://www.nationalgrid.com/electricity-transmission/document/147141/download
18	Willesden	https://www.nationalgrid.com/electricity-transmission/document/147146/download

04. Fixed Wiring Listing
05. Risk Register for Civil Related Works
06. Works Outside of Submission
07. SCM Cost Builds
08. Iver Trial

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