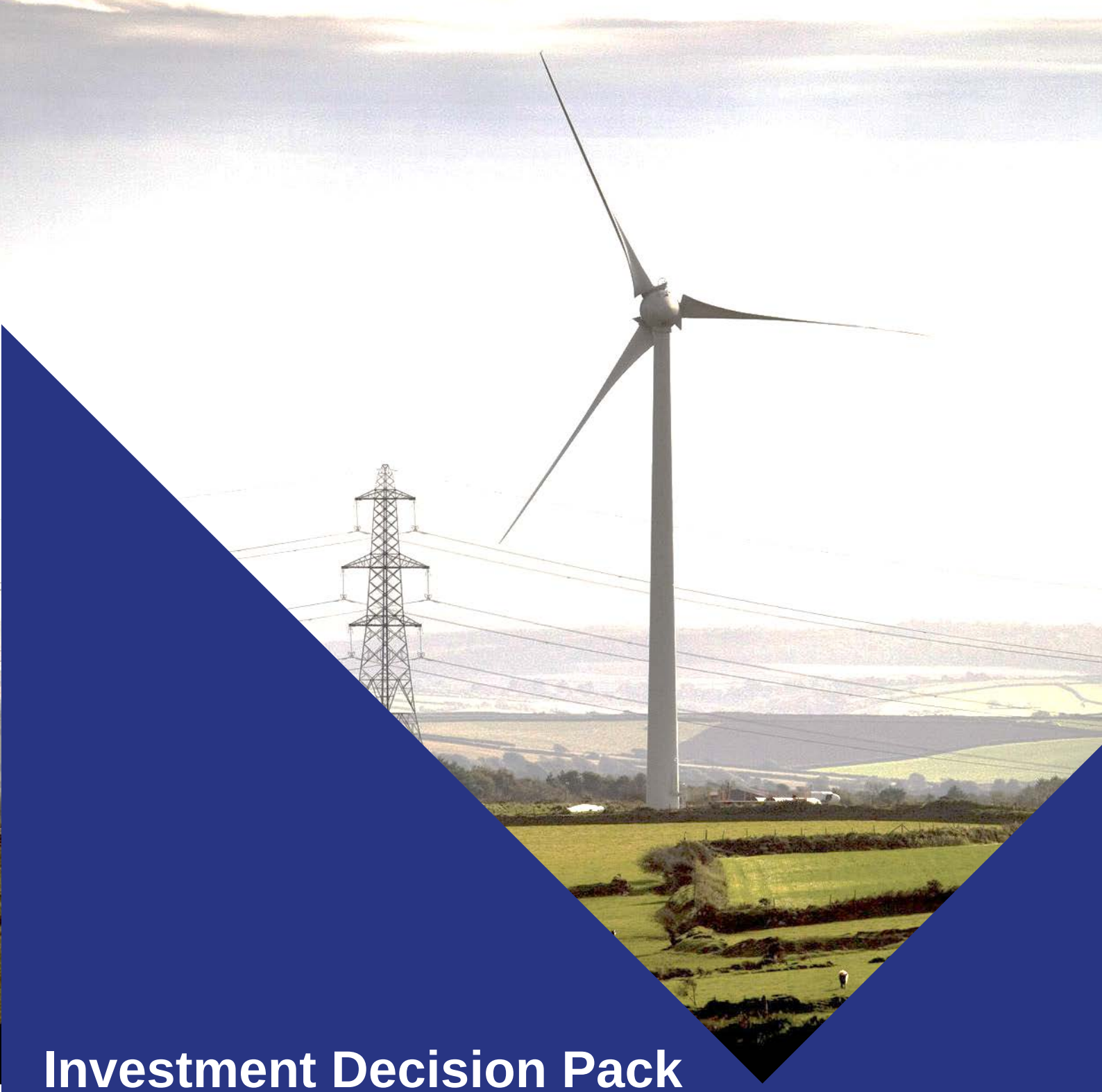

Investment Decision Pack NGET_A10.08_OpTel Refresh December 2019

As a part of the NGET Business Plan Submission

nationalgrid

Justification Paper OpTel Refresh			
Asset Family	Telecoms / Light Current		
Primary Investment Driver	Asset Health		
Reference	NGET_A10.08_OpTel Refresh		
Output Asset Types	- OpTel telco assets [redacted] NGET Substations - OpTel Telco assets [redacted] tertiary locations (Generators etc.) - OpTel Telco assets at [redacted] CNI Data Centres - OpTel assets in [redacted] Network Management Centres - OpTel assets in [redacted] Electricity Control Centres - OpTel Overhead Fibre infrastructure		
Cost	£208.5m (£186.9m in T1, £21.6m in T2)		
Delivery Year(s)	RIIO T2 2022 – RIIO T3 2028		
Reporting Table	C2.25		
Outputs included in RIIO T1 Business Plan	N/A		
Spend Apportionment	**T1**	**T2**	**T3**
	£O	£186.9M	£21.6M

Contents

Executive Summary

The Operational Telecoms (OpTel) network is a high resilience telecommunications network, providing secure connectivity between 300+ substations and control rooms across the England and Wales high voltage electricity transmission system. The OpTel network provides the connectivity between our control rooms and DNOs, generators and the TO Operators in Scotland. The network comprises telecoms terminal equipment at [redacted] sites and some 4000km of optical fibre which is either wrapped around the earth wire of our overhead lines (fibre wrap) or runs through the core of the earth wire (Optical Path Ground Wire – OPGW). The OpTel network is owned by NGET and services are provided to ESO through a managed services agreement.

The OpTel network underpins critical safety and operational services on the high voltage transmission network including; Teleprotection, network monitoring and control (supervisory control and data acquisition – SCADA), control telephony and metering services. Teleprotection is required to clear electrical faults on the network in extremely onerous conditions (less than 100msec) to ensure the safety of the general public, our operational teams and to ensure the stability of the electricity transmission network.

The OpTel network is essential to the safe, secure, reliable and economic operation of the electricity transmission network, and is a designated Critical National Infrastructure (CNI) asset. Loss or compromise of the OpTel network could lead to a loss of visibility, control and protection of our sites, resulting in a partial or complete loss of supply. In the event of a Black Start event OptTel provides the secure communication channels that enable us to effectively coordinate activities to restore electricity transmission when other communications networks are not available due to loss of electricity supplies.

The OpTel network was built in the 1990s and the telecoms terminal equipment has been through one asset replacement cycle. During the T1 period we have invested £43.5m in OpTel, to complete the network refresh initiated prior to the T2 period and BT21CN network mitigations, replacing leased private wire services following cessation of products deployed by BT. The fibre wrap is now approaching the end of its serviceable life and is exhibiting increasing fault levels, primarily caused by weather damage and the effects of UV radiation.

We have engaged Wavestone, a leading technology consultancy, to provide insight and to help us to develop and evaluate options to meet our future operational telecommunications requirements. Their report is attached as an annex to this document. The conclusion of this review was that the stringent performance, resilience and security requirements can only be achieved through a dedicated fibre-optic network. For the RIIO T2 period we propose investment of £186.9m to replace telecoms terminal equipment at [redacted] sites and [redacted]km of fibre wrap and to increase the capacity of the network in response to growing demand, through a high bandwidth overlay. We will deliver efficiencies through alignment with overhead line refurbishment work to deliver OPGW fibre and Protection and Control replacement to deliver telecoms equipment. The OpTel refresh programme is phased into the T3 period to ensure deliverability.

Introduction

The National Grid OpTel network supports operational telecommunications services which are essential for the continued safe, reliable and efficient operation of the electricity transmission network. The current service requirements, as described below, ensure that the transmission network is protected from faults, can be remotely monitored and controlled and that maintenance engineers can work effectively in a substation environment.

The OpTel network is a private Synchronous Digital Hierarchy (SDH) network, designed to provide maximum resilience from individual component failure, with zero single points of failure, full mains independence for an extended period and minimise dependency of 3rd party infrastructure. This means that in the event of a fault within the OpTel network, the network has enough redundancy and resilience to deal with several faults before operational service is impacted. These are important design criteria that ensure that the OpTel network is functional during the times of critical need.

The current OpTel network supports the services described in the table on the following page.

Table 1 OpTel service descriptions

Protection	Teleprotection services provide essential fault identification and clearance for the transmission network – these provide automatic transmission circuit switching in the event of a fault being detected. To avoid potential damage to transmission infrastructure, network instability and to ensure safety of the public, protection switching systems place extremely stringent latency requirements on the OpTel communications network as part of the overall fault clearance time. The Transmit (Tx) and Receive (Rx) latency must not exceed 6ms, and for differential protection systems Tx and Rx latency must not differ by more than 400µs. Teleprotection services require alternative routed communications channels and mains independence and critically must remain cyber secure. These demanding requirements cannot be guaranteed using commercial telecoms services.
SCADA	SCADA provides connectivity to allow the remote operational management and control of the transmission system to manage real-time power flow across the network and ensure safe operation. SCADA also supports alarm monitoring.
Control Telephony	Control Telephony provides independent voice telephony for operational personnel at NG sites, control centres, power stations and DNO & Scottish TO control centres. It is designed to continue working during extended mains power failure to enable operational personnel to manage power system restoration including Black Start
Dispatch (EDL)	Sends electronic instructions to generators to balance the system.
IEMS/BM/ EBS WAN	A high-speed WAN interconnecting the three control centres used by the Energy Management System and Balancing Systems
OPTEL BWAN	Provides point-to point connectivity via OpTel to the business wide area network – including data centre connections, this supports the day-to-day running of the National Grid business.

Teleprotection applications place stringent technical requirements on OpTel for low-latency, synchronous and resilient communications services. With a likely future increase in small-scale embedded generation, reduced system inertia will place greater demands on fault discrimination and require reduced fault clearance times. OpTel is also critical to the timely restoration of electricity supplies following a Black Start event. This necessitates that the current OpTel performance is maintained or enhanced where possible. In addition, the emergence of future grid management and cyber-security technologies is driving a need for an increase in OpTel capacity. As the generation market evolves and alternative Transmission Operators (CATOs) emerge, there will also be a requirement for increased interconnections between SO and TO systems, which OpTel will be required to support. In addition, Physical Security measures (PSUP) are expected to increase data traffic through video imagery.

During the RIIO T2 period changes in asset management techniques and the evolving response to the cyber threat in the operational technology (OT) space will drive a dramatic increase in the volumes of data carried by our OpTel network. Data to enable risk-based asset management vital to driving ever more efficient operations and data to provide 24/7 cyber monitoring of all devices in the operational estate. In order to deliver a scalable solution capable of meeting the growing data need, we propose building a high bandwidth overlay that can scale with demand. By leveraging the existing infrastructure and support arrangements this capability can be delivered with very low incremental operational cost.

Failure to maintain the highly resilient telecoms solution required for the electricity transmission network would severely compromise safety, increase the likelihood of energy disruption and equipment damage due to maloperation of protection and inter-tripping devices, and degrade the ability of the control rooms to remotely manage the electricity networks requiring additional field resources.

To support the RIIO T2 submission we initiated a strategic review to identify and evaluate the investment needs for the OpTel solution, examine alternative ways of providing the solution and review likely future capacity requirements. The strategic review highlighted that a large volume of the existing fibre wrap (fibre cable wrapped around the earth conductor of the overhead lines) was at or reaching end of life, requiring replacement with the updated OPGW fibre (fibre run through the centre of the earth conductor) which has enhanced physical and UV light protection. The principal electronic components of the SDH network have already passed the last time buy from the manufacturer. We acted to procure the required level of spares holdings, and provide for limited network expansion, but further expansion of the network to support new substations or track side feeders for electrification of rail is limited and the last time buy will be followed by end of life notification, which is driven by non-availability of spares and declining support knowledge, and with that the end of support by 2029 at the latest.

After a detailed review of current market service and technology offerings it is concluded that the stringent performance, resilience and security requirements for operational telecoms can only be achieved through a dedicated fibre-optic network.

The high costs of implementation and then leasing third party services that meet the stringent performance requirements, including mains independence and split path routing mean the case for a technically acceptable third-party service is not economically viable. Retaining a dedicated NGET owned fibre network will provide the required operational telecoms services and offers the opportunity to leverage the infrastructure to meet demand for additional capacity, required to support high-bandwidth IP-based communications services and upgrades to the OpTel architecture that will be required in the T2 period.

Given the need to have replacement networks built and ready for service before the existing network becomes unreliable or reaches end of support, a network build-out of not less than 6 years requires the procurement and build process to begin in the early part of the RIIO T2 period.

Background Information

The current OpTel solution was built-out in the 1990s, transforming the network to a Synchronous Digital Hierarchy (SDH) based platform. The initial Marconi SDH network was replaced together with legacy BT21CN circuits by a project which started prior to T1 and completed in 2016. The hardware implemented during this build-out will reach end of life between 2024-2029 and varies between platforms and vendors. Operational constraints associated with the build and subsequent migration to a replacement network, will require a minimum of a 6-year programme. The primary limiting factors that drive this timeline are in the migration phase, due to the maximum number of protection depletion outages that can be granted on the network (6 per day, geographically diverse across 3 independent regions). With over 1,600 protection services to migrate in the network migration phase, all strictly controlled by pre-agreed and assessed protection depletion outages. The complete network refresh programme will take a minimum of 6 years to complete. With a 6-year replacement programme, failure to commence replacement in the early part of RIIO T2 would leave the current technology in place well beyond the end of design life, without vendor support and liable to accelerated hardware failure common with end of life electronics. Due to the criticality of the OpTel network in an environment where the need for a resilient electricity network is increasing, we do not consider it an acceptable risk to allow these assets to pass end of life.

The operational telecommunications equipment located within the substation and control room environments are connected using fibre optic routes. The fibre infrastructure is made up of National Grid owned fibre and dark fibre leased from other telco providers. Within our fibre estate there are sections of dug fibre run in ductwork in the ground, fibre wrap and OPGW (Optical Path Ground Wire) which carry the fibre on the earth wire on the overhead lines. Of the technologies in the overhead network the wrap is an older technology where the fibre is wrapped around the outside of the earth conductor, this leaves the fibre cable exposed to the environment. The fibre wrap is now approaching its 30 year asset life having been installed in the mid 1990's and is exhibiting signs of damage. The damage is a function of the length of time these fibre assets have been exposed to environmental impact of weather and UV exposure. UV light damages the outer sheathing making it brittle and prone to cracking, this cracking allows water ingress into the cable structure which subsequently causes damage to the fibre itself.

Condition assessments of the existing fibre wrap have shown increasing levels of fibre failure associated with exposure to the climate and ultraviolet light.

Please see file NGET_A10.08B_Wrap Health KMSJB.xlsx

The attached assessment of 72 routes found damage to 44 (61%) routes, which while manageable in the short term by switching service to an undamaged pair of fibres within the cable, will require replacement in the medium term. Replacement of fibre wrap is a major engineering undertaking. The 72 routes assessed represent [redacted]km of fibre, the replacement of which will take time to achieve. With a deteriorating asset the risk is that the fibre condition could reach a cliff edge at which point we would be exposed to unsustainable levels of failure, with the consequential impact on the electricity transmission network. In order to mitigate this risk, it is proposed to replace the fibre wrap with OPGW. OPGW has a 40+ year asset life and where routes are a combination of OPGW and fibre wrap, only the fibre wrap will be replaced.

Planned replacement of the wrapped fibre infrastructure with OPGW has the benefit of being much more durable, as the fibre runs within the earth conductor core, providing protection from physical damage and UV light. OPGW has an expected asset life of greater than 40 years.

Stakeholder Engagement

We have engaged widely with relevant stakeholders to consider future requirements of the telecom's networks, engineering alternatives and solutions. Specifically, we engaged with other Transmission Operators in the UK electricity system at Scottish and Southern Electricity Networks (SSEN) and Scottish Power Energy Networks (SPEN) to validate the rigorous engineering standards applied to the provision of the telecoms solution. It was confirmed that SSEN and National Grid applied virtually identical engineering approaches to the provision of operational telecoms, and SPEN were updating their standards to align to National Grid and SSEN standards [redacted]. Both SPEN and SSEN have already completed a programme of fibre wrap replacement having replaced all fibre wrap within their networks during the RIIO T1 period.

NG ESO were engaged to understand the likely future requirements of the telecommunications system to facilitate NG ESO requirements. NG ESO Black Start requirements are set out in the Restoration chapter of the Operability Strategy Report – November 2018.[1]

We are also a member of Europe Utility Technology Council (EUTC) which engages with many other electricity TO's across Europe and beyond, ensuring an accurate understanding of the status of emerging technologies, how technology is adopted by other providers and best practice in the wider utility sector.

The design and engineering standards applied to Operational Telecoms by National Grid are reviewed and approved by CPNI ensuring they meet the required standards for Critical National Infrastructure.

Outputs

The principle outputs proposed for the RIIO T2 Period are listed in Table 2 below.

Output	Description	RIIO T2 Cost (£m)
Fibre Optic Wrap Replacement	Replacement of [redacted] of existing fibre-optic wrap cable. This cable is approaching the 30 year asset life, and is exhibiting fibre failure associated with exposure to the environment and UV light over the life of the cable.	78
Improved Comms Link Performance	[redacted] of Teleprotection services do not meet the technical specification and are currently subject to performance concession, additional fibre routes will allow reconfiguration to eliminate these concessions.	3
Improved Physical Security	[redacted] This investment proposes to extend the number of high priority sites in line with the number of "hardened" substations.	0.7
OpTel Network Refresh	Existing OpTel communications equipment at [redacted] sites requires replacement by 2029 to maintain service within manufacturer end-of-support dates for these devices. End of support is expected between 2024-2029 and varies between platforms and vendors	77.4

[1] NGESO Operability Strategy Report – November 2018 https://www.nationalgrideso.com/document/134161/download

High Bandwidth Overlay	By investing in a high-capacity additional overlay network that uses existing OpTel fibre paths, current OpTel low bandwidth, low latency capacity will be maintained to support existing services (including Teleprotection), and significant additional high bandwidth packet-based capacity can be enabled. This additional capacity is required to support increases in demand for current OpTel services and the introduction of new electricity network management and monitoring technologies	19.8
Control Telephony	The systems providing Control telephony were last refreshed through a project that completed in the early years of T1 and will require a further cycle of asset health replacement at the end of RIIO T2	8
TOTAL		**186.9**

Table 2

Table 3 below provides detail of the proposed spend profile within the RIIO-T2/ T3 period.

Output	**Fy22**	**Fy23**	**Fy24**	**Fy25**	**Fy26**	**T2 Total**	**T3 Total**
Fibre Optic Wrap Replacement	15.6	15.6	15.6	15.6	15.6	78	0
Improved Comms Link Performance	0.6	0.6	0.6	0.6	0.6	3	0
Improved Physical Security		0.35	0.35			0.7	0
OpTel Network Refresh	1	6.4	30	20	20	77.4	17.6
High Bandwidth Overlay	1	10	8.8			19.8	0
Control Telephony					8	8	4
TOTAL	**18.2**	**32.95**	**55.35**	**36.2**	**44.2**	**186.9**	**21.6**

Table 3

Investment of £21.6m is required in the first two years of the T3 period to complete installation works and to migrate services.

Optioneering

Wavestone were engaged to assist in the development of proposals and options to meet the assessed requirements of the OpTel solution through the T2 period and beyond. Wavestone is a leading technology consultancy with considerable expertise in the operational telecoms space having worked with a number of utilities across the world.

The full Wavestone report is provided as Annex NGET_A10.08A_Wavestone Report.

Fibre Wrap Replacement

In considering the options for the replacement of aged fibre wrap we must balance the operational risk, cost and deliverability. It is clear from the condition assessment that we are seeing evidence of deterioration of the assets, so from a purely risk based perspective it would be desirable to replace the fibre assets. The deliverability of replacing all [redacted]km of fibre at the end of its asset life is however very challenging, and not all fibre routes assessed have damage. From a cost perspective it would be in the consumer interest to extend the replacement period where possible, without creating excessive risk.

As detailed in the CBA, provided as **A10.08_Optel Refresh_CBA01** we considered a range of options including; extend the asset life, replace the fibre wrap with leased services, replace the fibre wrap with underground dug fibre, and replacing fibre wrap with OPGW.

The potential to reach a cliff edge with substantial failure rates would represent an unacceptable risk to the safe and reliable operation of the electricity system. When coupled with the timescales required to replace the volumes of fibre required, this means that extending the asset through the T2 period without investment is not a viable option.

Leased services provide a capital efficient replacement, mitigating the risks, but the excess construction costs to deliver diverse routing of commercial services and the associated run the business (RTB) costs in the form of annual lease charges make these an expensive option when considered in terms of total cost of ownership (TCO).

Underground ‘dug’ fibre is assessed at almost twice the cost of providing fibre in the overhead line via OPGW, would take longer to execute and would require the negotiation of wayleaves and/or easements with land-owners and agents and is therefore not an option in terms of cost or deliverability.

Replacement of fibre wrap with OPGW represents the best value for money to the consumer in TCO terms when considered across the full asset life.

OpTel Network Refresh

The primary driver for operating such a complex telecommunications solution dedicated to the electricity transmission system is that no other viable solution has been identified that meets all the performance characteristics and satisfies the resilience and mains independence requirements.

Notwithstanding the constraints covered above we considered the option to extend the life of the existing asset through the T2 period. The principle issues preventing this were the fact that the existing hardware is approaching end of life. While not presenting symptoms of any form of accelerated end of life failure and factoring in that we has been proactive in managing end of life and last time buy opportunities to secure sufficient spares, we are not able to support continued network growth that will be required for new connections and to support the electrification of transport during the RIIO T2 period. In addition to the limitations on network growth, the extended timeframe taken to safely build out and migrate to the

replacement would mean effectively committing the existing hardware to remaining operational into the mid 2030's.

The combination of limiting the electricity network growth capabilities and the requirement to extend the existing assets significantly beyond their expected service life into the mid 2030's make this option untenable.

The operating parameters of the OpTel network driving the need for a dedicated network using optical fibre are primarily driven by the requirement of the teleprotection services. In considering options for the replacement of the current network we considered providing dedicated point to point communications for these 1600 critical services, allowing the remainder of the service mix covered by the OpTel network to operate on commercial services without the onerous performance requirements of teleprotection. While the bulk of the services can leverage those commercial services at lower costs than maintaining the dedicated OpTel network, providing 2 separate networks one for the point to point services for teleprotection and the other commercial services for other traffic is uneconomic.

In order to meet the requirement of teleprotection we need to provide low latency high resilience services, having built those for teleprotection all other services such as SCADA and control telephony leverage the capabilities created for teleprotection at marginal incremental cost. A detailed CBA assessing the options is provided as **A10.08_Optel Refresh_CBA02**

Increased Network Capacity

While volumes of data in everyday life and across business have been rising at ever increasing rates, the data requirements in operational electricity networks such as OpTel have remained stable. Telecommunications protocols and the types of data transmitted have been largely unchanged in the electricity transmission network with only moderate growth generated by new substations.

This stability in the data requirement is starting to change rapidly with new requirements driven by Cyber monitoring of the OT estate, video imagery for physical security (PSUP), increased use of condition monitoring driving an increase in automated sensors and introduction of new technologies to provide enhanced situational awareness for control rooms such as phasor measurement units (PMU), which can be used to monitor dynamic events on the network and to assess power quality. In addition to these new services, the digitisation of the workforce creates greater demand on corporate networks connecting employees with e-mail, collaboration tools and video conferencing tools. Access to company intranets and the wider internet are also a vital part of enabling employees to work effectively across the 300+ sites and are a key enabler for our future digitalisation strategy.

One option to meet the demands of the increasing data is to simply increase the size of the bearers connecting the telecommunications nodes in the network. Whilst this is technically possible, it is not considered desirable as it would inevitably lead to a mix of operational and non-operational traffic, increasing potential cyber threats to CNI assets and operational services.

We could separate the operational and non-operational traffic, leasing commercial services for the non-operational data traffic. This would however not provide value to the consumer as the costs associated with providing commercial leased services to sites already served by our own networks would be high.

Our preferred solution is to engineer a high bandwidth data overlay that is capable of scaling with demand, logically separated from operational traffic but leveraging the infrastructure we have built to support the electricity transmission network. This enables us to achieve maximum utilisation from our existing assets while providing protection from the cyber risks presented in mixing traffic, thereby delivering essential services at efficient costs for our customers and stakeholders. A CBA is provided as **A10.08_Optel Refresh_CBA03**.

EVALUATION CRITERIA

We have used the following criteria for the assessment of the options identified in this Justification Report:

- Total cost of ownership - capital investment and associated operating costs borne by consumers and the need to ensure value for money
- Capacity to deliver - the level of risk associated with the ability of NGET and its supply chain to deliver the option
- Business/strategic fit - the alignment of this option to our overall business direction
- Addressing the problem – how well the option resolves the identified issue
- Risk – the overall risk to the business associated with this option

Table 4 below provides a summary of the options considered.

Option	Total Cost of Ownership	Capacity to Deliver	Business / Strategic Fit	Addressing the Problem	Risk	Overall
Extend asset life into RIIO T3	Green Extending the asset would increase the value extracted from the legacy solution	Red The project implementation timescale of 6 + years would commit the existing platform to continued operation through to 2032	Amber Fails to address the forecast growth in capacity	Amber The current network meets the current demand but has limited scope for increased capacity	Red The electronic components of the OpTel network will be at end of life by the end of T2, introducing high likelihood of increased failures and risk to the operational network.	Rejected The level of operational risk introduced is considered to be unacceptable
Outsource Telecoms to a Commercial service provider	Amber With much of the infrastructure required in place and limited opportunity to leverage other commercial infrastructure it is not expected to deliver TCO savings	Amber National Grid Safety rules require 100% escort in the HV zones and limited "hot site" experience and trained personnel limit the capacity for commercial providers to operate in this area	N/a	Red ability of commercial networks to meet the stringent operational specification and Black Start capabilities limit commercial operators abilities in this space	Amber The criticality of the Operational telecoms networks call in to question the suitability for outsource	Rejected The level of operational risk introduced is considered to be unacceptable
Replace end of life Fibre Wrap with Microwave links	Red Replacement Microwave services are likely to be more expensive to implement and maintain, the asset life would be much shorter that the estimated 40years of OPGW	Red Microwave capacity is typically limited to 10Gbit in critical applications	Amber Microwave technology requires the tower infrastructure to provide Line of site, the business is increasingly tunnelling HV routes to protect the visual amenity of the countryside	Red While fully functional in ideal conditions, heavy rain and snow impact significantly on Microwave services, impacting operational service and critical times.	Red Weather impacts would cause operational impact at times when reliable operation of teleprotection is needed	Rejected The cost of implementation, operational fit and risk are all unacceptable.

Replace end of life Fibre Wrap with 5G services	Red 5G services are only beginning to be deployed in the UK, availability in rural substation and overhead line areas is unknown	Amber technical capability not yet confirmed	Amber Not yet assessable	Red a potential solution in the future, but Black Start and Quality of service criteria not yet defined	Amber not yet deployed presenting significant risk to adoption	Rejected Not yet deployed early adoption not suitable for Critical services
Replace End of life Wrap with OPGW + Replace network electronics	Green The 40+ year asset life of OPGW would not require further replacement for 8 RIIO Cycles, replacement of the electronic component would likely see asset life into T4/5	Green Asset replacement planned to coordinate with Electricity OHL plans, delivering efficiency	Green Continues to deliver business requirements	Green Meets all technical requirements and fulfils Black Start obligations with capacity to flex with the business need	Green Low risk approach to continued operational telecoms services	Proposed

Table 4

Detailed Analysis & CBA

CBA's have been carried out to examine the options for fibre wrap replacement, OpTel telecoms network asset refresh and the provision of additional network capacity. These CBA may be found as annexes 01,02 and 03 respectively. Estimated costs have been included for the range of options, however benefits and avoided costs have not been included, enabling the CBA to be used as a net cost comparator.

The tables below summarise the CBA output.

Fibre Wrap

Option	NPV @ 2.9%
Baseline - Do Nothing	-6.4
Preferred Solution - OPGW	-72.3
Underground	-151.9
Leased Fibre	-13.2

The do-nothing option is not credible as the fibre wrap is reaching end of life and is exhibiting increasing levels of failure and leased fibre circuits do not meet the required technical performance or security standards.

Telecoms Equipment

Option	NPV @ 2.9%
Baseline - Do Nothing	-14.8
Preferred Solution - Replacement	-79.1
Lease	-192.5

The do-nothing option is 'fix on fail', which is not an acceptable option for a CNI network.

Additional Network Capacity

Option	NPV @ 2.9%
Baseline - Do Nothing	-10.5
Preferred Solution - High bandwithh ov	-18.7

The incremental costs arising from the preferred option provides the most efficient solution to provision increased network capacity by leveraging existing assets and services.

The table below shows the cost profile for our preferred options for the replacement of fibre wrap, telecoms terminal equipment and the provision of additional network capacity.

£m	2022	2023	2024	2025	2026	Total
OPGW Preferred Option - Costs	-15.60	-15.60	-15.60	-15.60	-15.60	**-78.00**
TELCO Preferred Option - Costs	-1.00	-6.40	-30.00	-20.00	-20.00	**-77.40**
HBWO Preferred Option - Costs	-1.00	-10.00	-8.80			**-19.80**

The table below includes sensitivities for a 5% discount rate, and costs at plus and minus 10%. This indicates that the preferred solution is resilient to a credible level of change.

£m	NPV @ 2.9%	NPV @ 5.0%	Costs - 10%	Costs +10%
Fibre Wrap - Preferred (OPGW)	-72.32	-74.47	-65.10	-75.55
High Band Width Overlay - Preferred	14.21	14.63	16.08	12.34
Telco Equipment - Preferred	-79.05	-81.39	-71.14	-86.95

As outlined earlier, the current equipment is increasingly unsupported and at end of life, meaning that asset replacement is required within the T2 period and the preferred options provide the most efficient solution to maintain the network and deliver the increased capacity that is required to meet future demand.

Conclusion

The OpTel network is a designated CNI asset, which underpins the safe, secure, economical and reliable operation of the electricity transmission network and provides a critical service in the event of a Black Start incident.

After a detailed review of current market service and technology offerings it is concluded that the performance and resilience required by our operational telecommunications services can only be achieved by a dedicated fibre-optic based solution. Given the high costs of implementing and leasing additional 3rd-party links (from providers such as BT or Vodafone), retaining and refreshing the dedicated OpTel fibre network remains the most cost-effective approach.

Key operating constraints limiting other options are:

- Teleprotection operational performance requirements (6ms end-end Latency, 400 µs differential latency)
- Black Start Resilience – Mains Independence for an extended period.
- Availability of commercial fibre infrastructure at electricity substation
- Availability of ‘hot’ (induced current) site trained engineering staff and commercial providers
- Un-controlled network access through less secure and resilient telecoms services creates a significant and unacceptable cyber risk to the electricity transmission system

The implementation of the OpTel refresh will be phased across regulatory periods (RIIO T2 AND T3) due to the scale and complexity associated with the network build and migration. The pace of migration is controlled by the number of teleprotection outages that may be taken simultaneously (normally a maximum 3 geographically diverse in any given 2-hour window). With 1600+ Teleprotection services to migrate, this activity alone will account for 18 month – 2 years of activity in addition to the build phase.

Outputs included in RIIO T1 plans

N/A