Draft Determination Supporting Document NGET ETAnnex Q9d NGET A10.08 OpTel Fibre Refresh DD Update v1.2

As a part of the NGET Draft Determination Response

nationalgrid

Contents

1. Executive Summary

The Operational Telecoms (OpTel) network is a high resilience telecommunications network, providing secure connectivity between 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's in Scotland. The network comprises telecoms terminal equipment at 274 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; Tele-protection, network monitoring and control (supervisory control and data acquisition – SCADA), control telephony and metering services. Tele-protection is required to clear electrical faults on the network in extremely onerous conditions 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 OpTel 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.

This paper considers our requirements for OpTel Fibre refresh and the requirements for OpTel Telecoms equipment are considered in a separate paper NGET_A10.08_OpTel Refresh_DD Update_Telecoms. Our December Business Plan Submission identified a requirement for £186.9m capex investment for OpTel Refresh, with £78m identified for fibre-wrap replacement as the network was built in the 1990's and is now approaching the 30-year asset life. Ofgem's Draft Determination 'does not fully accept the need case for OpTel refresh at present' and expressed concerns about deliverability and system access requirements. In addition, it does not differentiate between fibre-wrap and telecoms equipment refresh and proposes £62.1m allowance 'to enable works to begin'.

Following our Business Plan submission, we have been working to develop an alternative approach for fibre-wrap replacement which combines enhanced condition assessment and the replacement of priority circuits in the last two years of T2 and into the T3 period with an innovative new self-supporting optical fibre solution (SSOF). The SSOF solution is deployed through the body of the tower and does not require a transmission outage to complete the work, therefore making delivery much easier, and addressing the concerns raised by Ofgem in their Draft Determination.

We believe that the SSOF solution provides the most effective approach to replacing fibre-wrap from a cost and deliverability perspective and represents best value in maintaining this essential service for the end consumer. Investment of £37.1m is required in the T2 period to; fully develop the SSOF solution, undertake enhanced condition assessment on 16 routes (20% sample) and replace [redacted] of priority circuits with SSOF.

The changes in forecast replacement volumes for fibre-wrap since our initial strategic review in 2017 are summarised in the table below and show that a further [redacted] of fibre-wrap will be replaced through the overhead-line asset replacement programme in T2 with a similar amount in the T3 period.

Source	Volume (km)	Comments
Wavestone Strategic Review 2017	1856	With 593km replaced via OHL work
Business Plan Submission – Dec 2019	1856	1856km based on estimated span length
SQ Update – Feb 2020	[redacted]	[redacted] based on actual route schedules and [redacted] replaced via OHL work in T2
Supplementary Evidence – Aug 2020	[redacted]	Total fibre-wrap New fibre-wrap not requiring replacement [redacted] replaced via OHL work in T2* [redacted] replaced via OHL work in T3 Fibre-wrap requiring replacement
Draft Determination – Sep 2020	[redacted]	Fibre-wrap to be replaced via OpTel in T2 & T3 periods
	[redacted]	Fibre-wrap to be replaced in T2
	[redacted]	Fibre-wrap to be replaced in T3

- The overhead-line asset replacement programme currently includes [redacted] of re-conductoring, where old earth-wire and fibre-wrap will be replaced with new earth-wire incorporating OPGW fibre. A similar volume has been included for T3.

1. Context

This document was written following publication of Ofgem's Draft Determination and should be read alongside our December 2019 Business Plan submission and associated Annexes, as well as information provided through Ofgem's Supplementary Questions (SQ) process. In response to feedback received during the SQ process and in the light of Draft Determination, the objective of this document is to re-present the principles that underpin the development of our Business Plan submission, setting out specific considerations and demonstrating how we have applied these principles to inform investment decisions. This document seeks to demonstrate to Ofgem that:

- our approach to OpTel fibre-wrap refresh is robust, well-balanced and reflects our latest understanding of fibre-wrap replacement options
- we are developing the capability to assess fibre-wrap condition data alongside asset age and other variables
- our approach to fibre-wrap replacement is aligned to other fibre-wrap replacement delivered through our overhead line replacement programme
- our approach recognises system access constraints and minimises outage requirements and combined with phasing the programme into the T3 period enhances deliverability
- the funding for OpTel Refresh allowed in the Draft Determination could have a significant adverse impact on the levels of risk carried into the T2 and later periods

Background

Vodafone are contracted to manage and maintain National Grid's optical fibre network under a Managed Fibre Agreement (MFA) until May 2029. Previously, Vodafone used National Grid's fibre network for commercial purposes, but have since carried out a phased removal of their commercial traffic, which was completed in August 2019.

Under the MFA Vodafone are contracted to maintain National Grid's optical fibre network as follows:

- Replace broken splice enclosures (joints)
- Replace broken fittings
- Mobilise and diagnose faults
- Restore service, including splicing onto spare fibres or installing temporary ground-deployed cables

National Grid is working with Vodafone to review the optical performance of fibre wrap routes being handed back following removal of their commercial traffic. To date, 16 of the 70 routes have been handed back, which conform to strict optical performance criteria. The remaining routes containing wrap fibre which have not yet been handed back either have not been tested yet, or do not conform to the required hand back criteria and further work is needed to pin-point the cause and determine the remedial work required

2. Justification

The OpTel network is essential to the safe, secure, reliable and economical 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 and control of our sites, and loss or depletion of critical protection systems, which may require generation to be constrained and result in a partial or complete loss of supply. In the event of a Black Start event, the OpTel network provides the secure communication channels that enable us to effectively coordinate activities to restore electricity transmission when other communications networks are unlikely to be available due to loss of electricity supplies.

The majority of the fibre wrap on National Grid's network was installed in the early to mid-1990s with a 15-year asset life. This was subsequently extended to 30 years for the latest versions of Sky Wrap, as the industry gained more experience about fibre-wrap asset management. However, across the industry there is limited understanding of the condition and end of life failure modes for this age of fibre-wrap.

The information we have as part of the hand-back from Vodafone is that one third of fibres are no longer operational (8 of 24), see Appendix for detail. Indications from testing are that a number of sections have deteriorated and require replacement.

It is estimated that a programme of replacement would take approximately 7 years and, in order to gather condition information and develop the implementation approach, work should start immediately, with first deployment targeted for the last 2 years of T2.

3. Option Analysis

Following our Business Plan submission and in response to the Draft Determination, we have reviewed the driver and approach to delivery of the fibre-wrap replacement. We have considered options both around technical solutions and the phasing of work.

Solutions considered

1. Replace the full network with OPGW earth wire
2. Replace fibre-wrap with new fibre-wrap
3. Targeted replacement of fibre-wrap with OPGW to provide at least one circuit of OPGW
4. Self-Supporting Optical Fibre (SSOF)

The conventional approach for replacing old fibre-wrap requires the installation of a temporary fibre bypass to maintain the communication services prior to commencing earth-wire works. Once the temporary fibre bypass has been installed the old fibre-wrap can be removed and new OPGW installed. When the new OPGW is installed and the optical services have been transferred onto it, the temporary bypass can be removed. Using a temporary bypass is expensive and we have been assessing other options which negate the requirement for a fibre by-pass and an electricity transmission system outage.

Self-Supporting Optic Fibre is a term used to describe a fibre-optic cable installed at the bottom cross arm level, through the centre of the tower body. There are a number of solutions which could be suitable for use on our network, such as Keziah OPGW, Horse OPGW or MASS.

ADSS (All-Dielectric Self-Supporting) is only approved for use on permanent installations up to 150 kV, as it can result in catastrophic failure due to dry band arcing. Therefore, since

National Grid's high voltage electricity network operates at 275 kV and 400 kV it is not suitable for use.

Keziah OPGW is already type registered for use on National Grid's network and it has historically been used for a temporary bypass when the fibre wrap was being replaced during a conductor replacement scheme. However, Keziah OPGW is designed to be an earth-wire for fault current and lightening protection. It is a large, heavy conductor with an overall diameter of 20.6mm. It is therefore not suitable for installing on the towers as a by-pass or permanent fibre cable at bottom cross arm level.

Horse OPGW (13.95mm diameter) is smaller than Keziah OPGW, but it has not been type registered for use on National Grid's network. Like Keziah OPGW, Horse OPGW is primarily used as an earth-wire for fault current and lightning strikes. It is therefore still not the most suitable solution as it is still relatively large and heavy.

Metallic Aerial Self-Supporting (MASS) is 9mm in diameter and is designed to be used as a self-supporting fibre cable. MASS differs from OPGW in that it is lightweight and has a low conductivity value, due to its aluminium clad steel wires. It is light enough to be installed manually and tensioned up with a winch and can be installed at bottom cross arm level, through the centre of the tower body. MASS can be installed without a transmission system outage, which means that it can be installed all year round and is not subject to outage constraints. The attached file 'Fibre at bottom cross arm level' shows how a MASS SSOF fibre will be installed. Since MASS is bonded at each tower, it is not prone to dry band arcing issues like ADSS. However, MASS has not been installed at 400 kV before, so further testing is required in order to type register it. This design work has been scoped in attached file 'Work Required for T2 Wrap Replacement 18-06-2020'. MASS has been installed on 380 kV lines in Germany by companies including E.ON and Transnet.

The criteria applied when considering and evaluating options is:

1. Cost / Value to the customer
2. Technical solution performance
3. Deliverability
    a. Electricity transmission system assess requirements
    b. Fibre outage requirements
    c. Project management resource and capability
    d. Level of risks

Options

1 Replace the full network with OPGW earth wire (Discounted)

- ✓ Resilient, 60-year life solution for the whole fibre network
- × Highest overall cost [redacted]
- × Un-deliverable system access
- × Large programme delivery team is only feasible if combined with conductor replacement scheme

2 Replace fibre-wrap with fibre-wrap (Discounted)

- ✓ Easiest to mobilise

- ✓ Skills currently existing in OHL
- ➢ Some system access requirements
- × Technically inferior solution
- × Risks with de-wrapping
- × Requires expensive temporary by-pass route
- × Costs [redacted]
- × Will require early asset write-off if earth wire subsequently replaced by conductor replacement scheme

3 Targeted replacement of fibre-wrap with OPGW to provide at least one optical route per site with OPGW (Discounted)

- ✓ Mitigates key Optel network risks (dual wrap failure as happed at Uskmouth)
- × 800+km old wrap risk for future replacement
- × High System Access fibre & electrical outage
- × High cost/km [redacted]
- × Large programme delivery team

4 Self Supporting Optical Fibre (Selected)

- ✓ Mitigates key Optel network risks
- ✓ Lowest total cost in NPV terms [redacted] see table below
- ✓ No need to Optical bypass route
- ✓ Rapid deployment
- ✓ No need for electrical outage
- ✓ Implements enhanced condition assessment to prioritise replacement and mitigate risk
- × May require variation to existing Wayleave / Easement
- × Requires solution development and Type Registration

The output from the cost benefit analysis is summarised in the table below and included separately as NGET_A10.08_OpTel Refresh_CBA01 v1.0. Costs are total costs for fibre-wrap replacement, which include costs in T2, T3 and future periods for the purpose of NPV calculation.

Option	Cost (£m)	NPV (£m)
Wrap for Wrap	[redacted]	-137.7
OPGW	[redacted]	-244.9
Targeted OPGW	[redacted]	-216.7
SSOF	[redacted]	-93.4

Preferred Option

The option selected is the lowest cost option and combines the adoption of enhanced condition assessment with the deployment of Self-Supporting Optical Fibre (SSOF) to replace priority circuits in the last two years of T2 and into the T3 period. This preferred option will:

Collect physical condition information
16 routes comprising 20% of the fibre-wrap network will be sampled and assessed to prioritise circuits for replacement in the last two years of T2 and to inform theT3 replacement programme. Samples will be collected from different geographical locations and environmental conditions and we believe that a 20% sample size is the minimum required to provide a representative view of fibre-wrap condition. We are developing a process to gather samples of fibre-wrap and standard approach to analyse condition. This information will then be combined with optical performance to provide a condition/risk-based replacement programme for T2-T3

Develop a technical delivery capability to install Self Supporting Optic Fibre (SSOF)
The SSOF solution design will install an additional fibre cable at the tower body below the cross-arm and this approach is intended to minimise the need for electrical and optical route outages and be simple to install. It will also remove the requirement for ground deployed cable by-pass which removes a significant cost, making it the best value solution for our customers

Replace high priority fibre-wrap, prioritised based on condition
In the final two years of T2, we will replace 540km of fibre-wrap using SSOF. This will mitigate the risk of our more vulnerable circuits based on condition and provide accurate timing and costs to inform the T3 plan build.

The SSOF solution represents a more cost-effective solution than OPGW or new fibre-wrap and in most cases can be achieved without a high-voltage system outage, therefore reducing system access requirements and improving deliverability. The replacement programme is phased through into the T3 period to further ensure deliverability. A further 75km of fibre-wrap will be replaced in T2 via overhead line refurbishment work with a similar volume in the T3 period.

Benefits

- Lowest overall cost solution, with most favourable NPV
- Resilient, 60-year life solution for the whole fibre network
- Minimises system access requirements
- Minimises fibre outages and removes requirement for Ground Deployed Cable (GDC)
- Easiest and cheapest to install with existing capability in all Operations overhead line teams
- Easiest to maintain
- Lowest programme setup costs and allows existing fibre-wrap to remain in place until future conductor refurbishment programmes
- Solution provides capability to respond to emergency failures

A key benefit of SSOF is that once it has been installed and is in operation, the existing earth-wire and old fibre-wrap at the tower peak will remain in place until such time as a conductor replacement scheme replaces the earth-wire. At this point the old earth-wire can be replaced with a standard earth-wire without fibre, which is cheaper than OPGW or fibre-wrap, providing an overall lower cost solution for the end consumer.

Risks

Key risks to the adoption and implementation of SSOF are:

- Requires technical development and associated cost
- Wayleaves/Legal Agreement time and cost
- Potential steel-work modification
- Fittings installation system to be developed

Development costs are included in our proposal and we do not believe that any of the other risks cannot be managed or mitigated.

4. Implementation Plan and Costs

The programme of works through the T2 period is summarised in the outline plan below.

Optel Fibre Replacement Project Plan					
	2021/22	2022/23	2023/24	2024/25	2025/26
Develop technical SSOF capability	→				
Develop policy for condition based analysis	→				
Gather and analyse Condition Data	→	→	→		
Replacement of the high priority fibre				→	→
Develop condition based plan for T3				→	→

Costs required to deliver the programme are summarised in the table below, with detailed costs set-out in the subsequent tables.

Activity	Cost
Develop technical SSOF capability	[redacted]
Gather and analyse condition data	
Replacement of the high priority fibre	
Total	

	2021/22	2022/23	2023/24	2024/25	2025/26
Develop technical SSOF capability / Policies	[redacted]				
Gather and analyse Condition Data	[redacted]	[redacted]	[redacted]		
Replacement of the high priority fibre				[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

1 Condition information

Deliverable	Costs
National Grid Labour	[redacted]
National Grid Travel & Subsistence	[redacted]
Other, Materials & Services - General	[redacted]
Other, Materials & Services - Fibre	[redacted]
Sample Testing	[redacted]
Microwave Dish Link	[redacted]
Total (per section)	[redacted]
No. of Routes for RIIO T2 Sampling	
Total Cost of RIIO-T2 Sampling	[redacted]

Fibre condition samples for wrap will be taken as described in the attached file: 'Focas_AFL Fibre Samples'. A similar process will be used for BICC fibre installations. The fibre samples will be sent to AFL in Swindon for forensic analysis. The analysis will include the tests listed in IEC-60794 to the performance levels specified by the manufacturer at the time. The following tests will be carried out in accordance with IEC 60794:

- Tensile performance
- Temperature Cycling
- Bend
- Torsion
- Crush and Impact
- Dissection and Dimensions
- UV

Assumptions

- There are 110 fibre-wrap routes. 20% of the network will be sampled (16 routes in T2, with 5 in T1). Samples will be collected from different geographical locations and environmental conditions and we believe that a 20% sample size is the minimum required to provide a representative view of fibre-wrap condition.

- Project to collect samples from five routes at the end of T1 to refine the process of gathering samples and policy for testing.

2 Development of the SSOF capability

Deliverable	Costs
Supplier Development, type registration	[redacted]
Development of Design Solution for each tower type (L2, L3, L8, L6, L12)	[redacted]
Procurement; Tension stringing machines and associated lifting equipment for pulling SSOF	[redacted]
Installation methodology, development of internal overhead line working procedures and training	[redacted]
Programme development	[redacted]
Programme implementation	[redacted]
Total Cost	[redacted]

3 Priority Fibre Replacement in T2

	Price per km	T2 km	Cost of Delivery
SSOF	[redacted]	[redacted]	[redacted]

Assumptions

- Technical development of SSOF is achievable
- Material pricing for SSOF taken from July 2020 RFI
- Delivery will be via regional overhead line teams
- Installation rate: [redacted]
- Run rate [redacted] per annum is required to complete the programme in 7 year

6. Appendices and Supporting Attachments

Appendix 1

Note the profile for Fibre-wrap replacement has been revised and is included in Section 4 – Implementation Plan and Costs of document NGET_A10.08_OpTel Refresh_DD Update_ Fibre.

The cost profile for Telecoms equipment replacement remains unchanged and is included in Section XX of document NGET_A10.08_OpTel Refresh_DDUpdate_Telecoms.

RIIO-T2 Business Plan Data Template
National Grid Electricity Transmission
Workbook C: Non Load
Version 1.9 - Submitted on 09 Dec 2019
Sheet: C2.25 Operational Protection Measures & Op IT Capex
Prices Base: 2018/19

By category type
Protection Communication Circuits - Replacement
Protection Operational Measures
Infrastructure enabling

The table below is an extract from BPDT C2.25 Operational Protection Measures & Op IT Capex

		RIIO T2					RIIO > T2						Total		
		2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	>2031	RIIO T1	RIIO T2	RIIO > T2
Operational IT & Telecoms Capex		£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m	£m
Scheme Referer	Comments														
Optel T2 Refresh	High Speed Bandwidth Overlay	1.000	10.000	8.800	-	8.000	4.000	-	-	-	-	-	-		
Optel T2 Refresh	Fibre Wrap Replacement	15.600	15.600	15.600	15.600	15.600	-	-	-	-	-	-	-	78.000	-
Optel T2 Refresh	Improved Comms Link	0.600	0.600	0.600	0.600	0.600	-	-	-	-	-	-	-	3.000	-
Optel T2 Refresh	Improved Physical Security	-	0.350	0.350	-	-	-	-	-	-	-	-	-	0.700	-
Optel T2 Refresh	Optel Network Refresh	1.000	6.400	30.000	20.000	20.000	10.000	7.600	-	-	-	-	-	77.400	17.600
n/a	T1 Project	-	-	-	-	-	-	-	-	-	-	-	18.435	-	-

Appendix 2

National Grid – Ofgem Bilateral Meeting on OpTel – 26 August 2020

A bilateral session attended by National Grid, Ofgem and Atkins was held to receive feedback from Ofgem on their Draft Determination and to discuss NGET's revised approach for fibre-wrap replacement and broader requirements for telecoms equipment replacement.

A number of clarification points were agreed, and whilst these have now been incorporated in this document as supplementary evidence, they are set-out below for ease of reference.

Fibre-wrap replacement:

i) Elaborate on the drivers for our revised proposal for fibre-wrap replacement

The revised proposal incorporates Ofgem's comments about deliverability and is based on a 3-point plan to carry out:

i. condition assessment on 16 representative fibre wrap routes
ii. develop a self-supporting optical fibre system
iii. prioritise fibre-wrap routes for replacement

ii) Describe the MASS solution

MASS (Metallic Aerial Self-Supporting) is 9mm in diameter and is designed to be used as a self-supporting fibre cable. MASS differs from OPGW in that it is lightweight and has a low conductivity value, due to its aluminium clad steel wires. It is light enough to be installed manually and tensioned up with a winch and can be installed at bottom cross arm level, through the centre of the tower body. MASS can be installed without a transmission system outage, which means that it can be installed all year round and is not subject to outage constraints. The attached file 'Fibre at bottom cross arm level' shows how a MASS SSOF fibre will be installed. Since MASS is bonded at each tower, it is not prone to dry band arcing issues like ADSS. However, MASS has not been installed at 400 kV before, so further testing is required in order to type register it. This design work has been scoped in attached file 'Work Required for T2 Wrap Replacement 18-06-2020'. MASS has been installed on 380 kV lines in Germany by companies including E.ON and Transnet.

iii) Explain what other options were considered and why they were discounted

The conventional approach for replacing old fibre-wrap requires the installation of a temporary fibre bypass to maintain the communication services prior to commencing earth-wire works. Once the temporary fibre bypass has been installed the old fibre-wrap can be removed and new OPGW installed. Once the new OPGW is installed and the optical services have been transferred onto it, the

temporary bypass can be removed. Having a temporary bypass is expensive so we have been assessing other options which would negate the requirement for a fibre by-pass.

Self-Supporting Optic Fibre is a term used to describe a fibre-optic cable installed at the bottom cross arm level, through the centre of the tower body. There are a number of solutions which could be suitable for use on our network, such as Keziah OPGW, Horse OPGW or MASS.

ADSS (All-Dielectric Self-Supporting) is only approved for use on permanent installations up to 150 kV, as it can result in catastrophic failure due to dry band arcing. Therefore, since National Grid's high voltage electricity network operates at 275 kV and 400 kV it is not suitable for use.

Keziah OPGW is already type registered for use on National Grid's network and it has historically been used for a temporary bypass when the fibre wrap was being replaced during a conductor replacement scheme. However, Keziah OPGW is designed to be an earth-wire for fault current and lightening protection. It is a large, heavy conductor with an overall diameter of 20.6mm. It is therefore not suitable for installing on the towers as a by-pass or permanent fibre cable at bottom cross arm level.

Horse OPGW (13.95mm diameter) is smaller than Keziah OPGW, but it has not been type-registered for use on National Grid's network. Like Keziah OPGW, Horse OPGW is primarily used as an earth-wire for fault current and lightning strikes. It is therefore still not the most suitable solution as it is still relatively large and heavy.

iv) Explain the changes in fibre-wrap length to be replaced from BP Submission to updated proposal, including relationship to OHL programme

The December 2019 proposal for wrap replacement was based on an estimated span length which equated to 1856km. Further analysis using overhead line route schedules determined that the actual length was 1924km. T2 replacement volumes now recognise that 143km of fibre-wrap was installed as part of the BT21CN project and is less than 10 years old and does not require replacement. A further [redacted] of fibre-wrap will be replaced through the overhead-line asset replacement programme in T2 with a similar amount expected for T3. This results in a total of 1671km of fibre-wrap requiring replacement across the T2 and T3 periods.

Note – in 2017 the Wavestone Report – OpTel Strategic Review identified that up to 593km of fibre-wrap could be replaced through the overhead-line asset replacement programme in T2. In February 2020 we reviewed the potential opportunity for fibre-wrap replacement via overhead-line works based on our BP submission and found this to be around [redacted]. The reduction in overhead-line asset replacement work proposed in Draft Determination further reduces this to around [redacted].

v) Confirm outage v non-outage requirements

The installation of MASS at bottom cross-arm level through the tower body can be carried out without an electrical outage. This enables installation all year round, compared with the conventional electrical outage season. There is also no need for an optical outage during MASS installation. If old fibre-wrap is replaced with new fibre-wrap or old fibre-wrap is replaced with OPGW, an electrical and optical outage is required. Depending on the tower type (e.g. L3 towers), a double circuit outage will also be required.

vi) Propose a revised sampling rate for fibre condition assessment

Condition samples for fibre-wrap will be taken as described in the attached file: 'Focas_AFL Fibre Samples'. A similar process will be used for BICC fibre installations. The fibre samples will be sent to AFL in Swindon for forensic analysis. The analysis will include the tests listed in IEC-60794 to the performance levels specified by the manufacturer at the time. The following tests will be carried out in accordance with IEC 60794:

- Tensile performance
- Temperature Cycling
- Bend
- Torsion
- Crush and Impact
- Dissection and Dimensions
- UV

We are planning to undertake sample testing for 5 routes, but the results will not be available before December 2020. The fibre samples we are proposing to test are on the following routes:

[redacted]

There are a further 105 fibre wrap routes in total. We propose to target 20% of the network for condition assessment (21 routes, 5 in T1 and 16 in T2) based on geographic locations and environmental conditions. The results will determine if further condition assessment is required on the remaining routes. The results will provide data for wrap replacement prioritisation.

Telecoms equipment replacement:

Responses for Telecoms equipment are provided in the separate document - NGET_A10.08_OpTel Refresh_DD Update_Telecoms

vii) Confirm dates for last Telecoms equipment refresh

viii) Provide a simple timeline setting out replacement timeline, to include support milestones

ix) Provide a network topology overview, illustrating how components connect to provide systems and services

x) Outline how the programme will be delivered efficiently, including learning from prior experience

xi) For the HBO, explain the distinction between high and low bandwidth services and include drivers for increased demand for high bandwidth capacity

xii) For Control Telephony, reference volumes of equipment to be refreshed

Supporting Attachments

Provided separately