Annex 10

RIIO-T3

Network Asset Management Strategy

National Grid Electricity Transmission's Business Plan

December 2024

Overview of this document

Purpose of this Annex

Our Network Asset Management Strategy annex describes the investments that we are proposing to make during RIIO-T3 to manage the risk of our assets failing over their lifecycle, ensuring that they contribute effectively to our overall goals of efficiently maintaining a safe, reliable, and resilient system through a period of growth and changing asset base.

This strategy encompasses the strategy, systems and policy of our asset management approach covering the inspection, maintenance, renewal, replacement and decommissioning of assets, with a focus on optimising performance, reducing costs and mitigating risks. This annex is particularly focussed on the non-load investments across our installed asset base and the associated interventions and investment decisions for the RIIO-T3 (T3) period (FY26 – FY31) linked to replacement and refurbishment.

It details how we have determined the optimal interventions to make, and the mechanisms we are putting in place to ensure consumers, both current and future, only pay for what is delivered. It also details how we will ensure our plans are developed and delivered on time and at efficient cost.

How to navigate this annex

The table below provides a short summary of each section and where information requested in the Business Plan Guidance (BPG) has been provided.

Section	Detail	BPG reference[1]
1	**Executive Summary**	-
2	**Our Asset Management Approach** – Details of our Asset Management Strategy, Asset Management Policy and Asset Management System and what we are doing to prepare for the future and ensure best in class asset stewardship.	5.2
3	**Achieving Long-Term Operational** Resilience – How we manage asset risk to ensure resilience and meet our environment outcomes.	5.3
4	**Methodology for using Asset Risk to Identify** Interventions – Our assessment methodology for asset risk, for both NARM and non-NARM assets	5.3
5	**Impact on Asset Risk from Our** – Assessment of risk levels at the start and end of the RIIO-T3 price control, with and without our planned interventions.	5.4 - 5.7
6	**Credibility and Deliverability of** Our Plan – Overview of the credibility and deliverability of our plan.	-

[1] These are the BPG requirements relevant to this annex. These requirements may also be addressed in other business plan submission documents.

Our RIIO-T3 objectives and commitments

Our plan is anchored around three, stakeholder-led ambitions, each underpinned by clear objectives, commitments and success measures for the RIIO-T3 period. These allow us to target stretching levels of performance and track progress. The specific ambitions, objectives and commitments that are most relevant to this annex are shown below:

Our Plan Objectives		Our Commitments: We will:		Success Measure / Target
A1	Maintain world class levels of network performance and resilience, and ensure that the new network we build is designed to reflect future security and climate challenges	A1.1	‣ Ensure our assets continue to provide a resilient network, delivering high quality and reliable electricity to consumers	‣ 99.9999% network reliability ‣ <135MWh per year Energy Not Supplied
		A1.2	‣ Not allow the overall risk of our network to increase, as we deliver across multiple drivers (network growth, safety, resilience and environment)	‣ Maintain asset risk at RIIO-T2 levels whilst the network grows more than in previous periods
B4	Play a leading role in accelerating net zero and driving a nature positive future, including by reducing our own emissions and environmental impact	B4.3	‣ Drive sustainable operations through reduction of SF6 emissions, energy use in our operational estate, and fleet vehicle emissions	‣ 50% reduction in SF6 emissions by 2030 from a 2018/19 baseline ‣ 20% reduction in substation energy use by 2031 ‣ 100% zero emission fleet purchases for light duty vehicles by 2031
C1	Transform our asset management, network development, network operation and telecoms capabilities to ensure we can deliver the step-up in work required during this period, and manage a larger, more complex, decarbonised network	C1.1	‣ Transform our asset management capabilities to efficiently manage a larger, more complex, network going forward	‣ Enhance our enterprise asset management suite of applications making best use of leading systems ‣ Work with other networks to align asset risk methodologies ‣ New framework developed for critical infrastructure assurance

Contents

1 Executive Summary

Our Network Asset Management Strategy is designed to maximise the performance of our assets over their lifecycle, ensuring that they contribute effectively to our overall goals of efficiently maintaining a safe, reliable and resilient system through a period of growth and changing asset base. This strategy encompasses the planning, construction, operation, maintenance, renewal, and decommissioning of assets, with a focus on optimising performance, reducing costs and mitigating risks. This annex is particularly focussed on the maintenance and renewal of the installed asset base and the associated interventions and investment decisions for the RIIO-T3 period (FY26 – FY31).

Objectives

Our asset management objectives are centred around optimising the balance of cost, risk and performance of our assets to ensure our network delivers a cost effective and high-quality service for our customers and consumers. In summary our asset management objectives cover:

- Risk Management - Identify and mitigate risks associated with asset management to ensure safety, reliability and environmental protection.
- Cost Efficiency - Implement cost-effective practices that ensure the optimal use of financial and physical resources.
- Performance Optimisation - Ensure that assets operate at required performance levels, minimising unplanned costs.
- Asset Integration - Ensure the successful integration of a high volume of new assets as well as new asset types to the network.

Further detail on our asset management objectives is contained in Section 0.

Key Components of our Approach

This annex describes how we will continue to manage risk on the network and ensure that we use asset insight (i.e. condition information) and whole-life cost considerations to make well-justified and transparent decisions. Our approach to asset lifecycle management involves a holistic view of assets from need identification to disposal. This encompasses:

- Planning - Developing a comprehensive understanding of asset needs and risks to inform our strategic long-term view of asset intervention.
- Operation and Maintenance - Implementation of best practices in operation and maintenance to ensure asset longevity and reliability.
- Renewal and Upgrade - Regular assessment of asset health and optioneering of intervention type e.g. maintain, refurbish or replace.
- Decommissioning - Managing end-of-life asset risk and timing the efficient removal of assets where the need has expired, or it is no longer technically feasible or cost effective to maintain the asset.

In developing our asset lifecycle interventions, we have co-optimised our load and non-load plans, ensuring better value for money for our consumers. Through regional blueprints (described in the A08: ET Load Strategy Annex), we have identified opportunities and aligned these with specific site and route strategies.

Performance Monitoring and Reporting

Continuous monitoring and reporting of asset performance are an essential part of asset management. We monitor a wide range of data to ensure that our network risks are being managed and we maintain high levels of service. These include:

- Asset-Related Performance Metrics - Including faults, failures, planned and unplanned circuit unavailability and overall network reliability.
- Maintenance and Inspections - Conducting regular audits and inspections to ensure compliance with maintenance policy, standards and regulations.
- Data Analytics - Leveraging data analytics to gain insights into asset performance and identify areas for improvement.

- Reporting - Transparent reporting of asset performance to Ofgem and stakeholders through the Regulatory Reporting Process and System Performance Reports (C17).
- Investment Delivery- Monitoring and reporting progress against intervention delivery.

Our network reliability for FY24 was 99.999998%. Underlying this is planned circuit unavailability of 4.62% across the RIIO-T2 period and unplanned circuit unavailability of 1.07%. The asset level reporting below this shows that fault and failure rates have remained constant throughout the period with no trends to indicate deteriorating performance.

Delivery of asset interventions in the RIIO-T2 period has been impacted by growth and volatility of the load-related plan as well as supply chain challenges. This means that we will not deliver all of our planned interventions; however, mechanisms within the RIIO-T2 price control will ensure that we complete the right interventions from a risk perspective and that consumers are financially protected from this change. We have learnt from this experience and have approached the planning of RIIO-T3 differently, which is explained in Section 0 of this annex.

As shown in Section 5 of this annex, the percentages of assets that are in the 'high' or 'very high' asset health brackets are relatively low across most asset groups. This reflects our robust asset management approach to date and enables strong focus areas for onward investment justification.

Risk Management

Our risk management framework focuses on identifying, assessing, and mitigating risks associated with asset management. This includes:

- Risk Identification: Systematic identification of potential risks that could impact asset performance from a safety, reliability, environmental or cost to consumer perspective.
- Risk Assessment: Comprehensive assessment of risks to determine their likelihood and potential impact.
- Mitigation Strategies: Development and implementation of strategies to mitigate identified risks, including contingency planning and insurance.
- Continuous Monitoring: Ongoing monitoring of risks to ensure timely response and adaptation to changing circumstances.

We have undertaken a comprehensive assessment of our entire asset base in preparation of our RIIO-T3 non-load related plan. Details on the risk identification and assessment process can be found in Section 0 of this annex.

Technology Integration and Improvement Plan

Leveraging technology is a key aspect of our asset management strategy. This includes:

- Asset Management Software: Replacement of legacy Enterprise Asset Management (EAM) System Ellipse with the Maximo Application Suite (MAS). This capability will make managing our assets easier, more transparent and empower our teams to make better decisions.
- Asset Information Improvements - Improving asset data essential to support our digital transformation, enabling the use of reliable data for the 'Internet of Things' (IoT), and Artificial Intelligence (AI), providing analytics-driven insights, predictive maintenance, and automation.
- Automation -The implementation of autonomous drone capability to collect asset visual inspection data, development of advanced AI-powered remote monitoring at scale and piloting our digital substation products.
- Decision Making - Consolidating a single value framework to provide a consistent service risk and value-based decision support tool that underpins all long-term asset decisions.
- Network Asset Risk Metric (NARM) - We will continue to evolve our NARM models, seeking further alignment with other networks and the application of NARM to a wider asset base, in line with Ofgem's expectations.

Our asset management improvement plan has been developed in response to feedback from Ofgem and in recognition of the need to transform for the challenge ahead. Its key components are detailed in Section 2.3 of this annex.

Our Proposed Investments

This plan proposes to invest £4.225bn in non-load related asset capex. As outlined in the tables below, the plan is split into 'baseline' (projects for which we are seeking funding as part of RIIO-T3 Final Determination) and 'pipeline' (listed on BPDT tab '10.5 ET Pipeline Log' and subject to a future determination or uncertainty mechanism). Further cost breakdown can be found in the non-load business plan data tables and associated narrative. All costs are in 2023/24 price base.

Table 1: Our RIIO-T3 non-load related capex plan cost summary (gross cost)

Plan element	Baseline	Pipeline
T3 NLR - T2 Crossover Forecast (Baseline)	168.4	
T3 NLR - Capex Forecast (Baseline)	1,733.4	
T3 NLR - Capex Forecast (Pipeline)		2,020.4
T3 NLR - (NOC) Capex Forecast	302.7	
Total	**2,204.5**	**2,020.4**

Table 2: Our non-load related capex investment plan summary (£m gross costs in RIIO-T3)

Engineering Justification Paper (EJP) Title	Type	NLR Baseline	NOC Baseline	NLR Pipeline
[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]		[redacted]
[redacted]	[redacted]	[redacted]		
[redacted]	[redacted]	[redacted]		[redacted]
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[redacted]	[redacted]	[redacted]		
[redacted]	[redacted]		[redacted]	

Engineering Justification Paper (EJP) Title	Type	NLR Baseline	NOC Baseline	NLR Pipeline
[redacted]	[redacted]	[redacted]		
[redacted]	[redacted]			[redacted]
[redacted]	[redacted]			[redacted]
Total		1,901.8	302.7	2,020.4

Table 3: Our non-load related Portfolio EJP capex breakdown (RIIO-T3 costs only)

	Portfolio EJP Asset Group	Baseline Volume	Baseline Gross Cost (T3)	Baseline Direct Cost (T3)	Pipeline Volume	Pipeline Gross Cost (T3)
Lead Assets	Super Grid Transformers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Circuit Breaker	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Reactors	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	OHL Conductor (km)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	OHL Fittings (km)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Underground Cable (km)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Total (Lead Assets)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Non-Lead Assets	Disconnectors & Earth Switches	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Through Wall Bushings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Instrument Transformers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Substation Cables	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Substation Overheads	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Surge Arresters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Earthing & auxiliary Transformers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Reactive Compensation	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Protection & Control	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
	Total (Non-lead Assets)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total (All Portfolio EJP Assets)		[redacted]	[redacted]	[redacted]	[redacted]	[redacted]

Conclusion

The landscape in which we operate and the constant evolution of our network and asset needs means our plan must be adaptive:

- Flexibility in our decision making is needed to ensure our asset replacement plans are optimised against our load plan and any changes that might arise (as noted in the A08: ET Load Strategy annex).
- We are planning an unprecedented increase in the scale of our load-related work, placing pressure on outage planning including project mobilisation (e.g. resource and supply chain) and the need to structure our asset replacement and refurbishment plan in this context to ensure we optimise timing of any interventions.

- As our consumers increasingly electrify their energy needs, they expect us to continue the very high level of service currently provided.

We understand that these challenges result in uncertainty, and that requesting baseline funding for investments when the optioneering stages are yet to be completed and there is therefore greater uncertainty would not be the right thing for consumers. As a result, the forecast costs for less certain asset interventions have been allocated to our ‘pipeline’ plan (10.5 ET Pipeline Log). We do however have a sufficient level of certainty that many of the pipeline investments have a high probability of being required prior to the end of the RIIO-T3 period. As a result, we are proposing uncertainty mechanisms (please see Appendix B) to allow for appropriate funding adjustments during the RIIO-T3 period.

Our asset management strategy is designed to ensure the optimal performance, cost-efficiency, and sustainability of our assets. By adopting a comprehensive approach that includes lifecycle management, performance monitoring, risk management, technology integration, and agility, we are well-positioned to achieve our strategic objectives and deliver long-term value for consumers. Through continuous improvement and innovation, we will maintain our commitment to excellence in asset management.

“Our asset management function is dedicated to enabling a safe, reliable and resilient electricity transmission network. By providing a robust framework and clear guardrails, we aim to maximise value derived from our infrastructure. This requires a proactive approach to maintaining and upgrading aging assets, integrating advanced technologies, and aligning with evolving regulatory expectations.

As we navigate a critical growth phase for electricity transmission, it is essential to manage the transition of our aging infrastructure to support a decarbonised network. This demands balancing cost, risk and performance of our assets, ensuring consumers continue to derive value from their bills. Our business plan is centred on delivering operational reliability, financial performance and sustainability in a rapidly changing environment.

A cornerstone of our approach is the investments in our digital and data capability during RIIO-T2 and -T3 to enhance our data-driven decision-making, leveraging predictive analytics and condition monitoring to optimise investments priorities and reduce unplanned outages. By focusing on efficiency and resilience, we ensure the organisation remains prepared to address the challenges posed by an increasingly complex energy landscape.

– Katie O’Hara, Asset Management Director

2 Our Asset Management Approach

2.1 Our Asset Management Strategy, Policy and Asset Management System

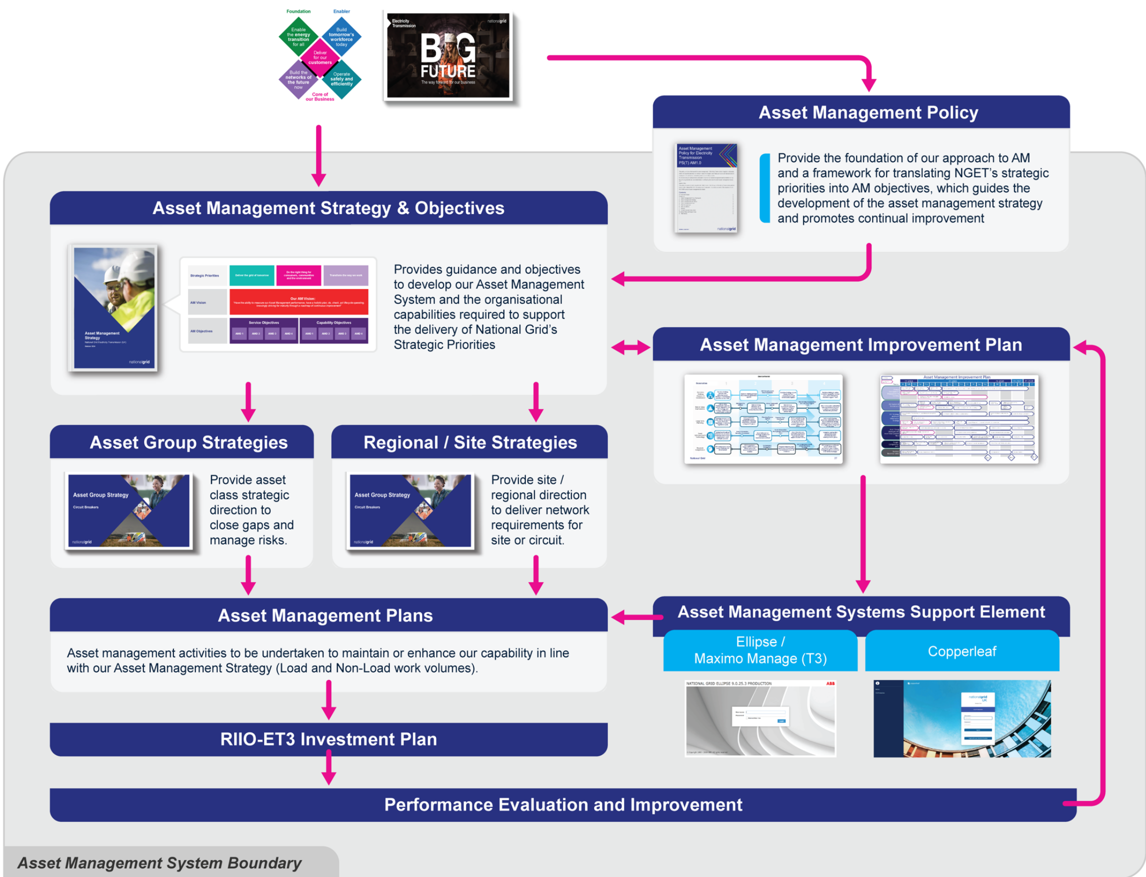
Our Asset Management Strategy sets out the guidelines and organisational capabilities required to support the delivery of our ambitions and objectives. Our Asset Management Strategy defines:

- The Asset Management Objectives and the plans for achieving them, provides direction on the management of our assets, clarity on why assets are managed in a certain way and how this supports the delivery of National Grid's Strategic Priorities and overall direction of the organisation.
- Our risk tolerance, performance targets, and desired outcomes related to failure risk management. It provides a high-level framework for decision-making and resource allocation to address failure risks.
- Our Asset Management Improvement plan, and how improvements in our asset data collection and management and risk methodologies will ensure we demonstrate robust asset stewardship and are considered best in class.
- Additionally, it guides the development of specific policies, plans, and procedures to realise our Strategic Priorities.

Our Asset Management Policy provides a framework for our Asset Management Approach. It promotes continual improvement and is intended to provide us with focus in addressing our Asset Management risks and opportunities. The core of our Asset Management Policy is compliance with statutory obligations, safety, reliability, environmental performance and risk management.

We have reviewed our Asset Management Strategy, Policy and Improvement Plan to ensure that we continue to manage our network risk in this period of integration, working in collaboration with our Strategic Infrastructure business unit to ensure that our approach is suitable for our changing asset base. Both our Asset Management Strategy and our Asset Management Policy are key components of our Asset Management System (shown in Figure 1).

Figure 1: Our Asset Management System

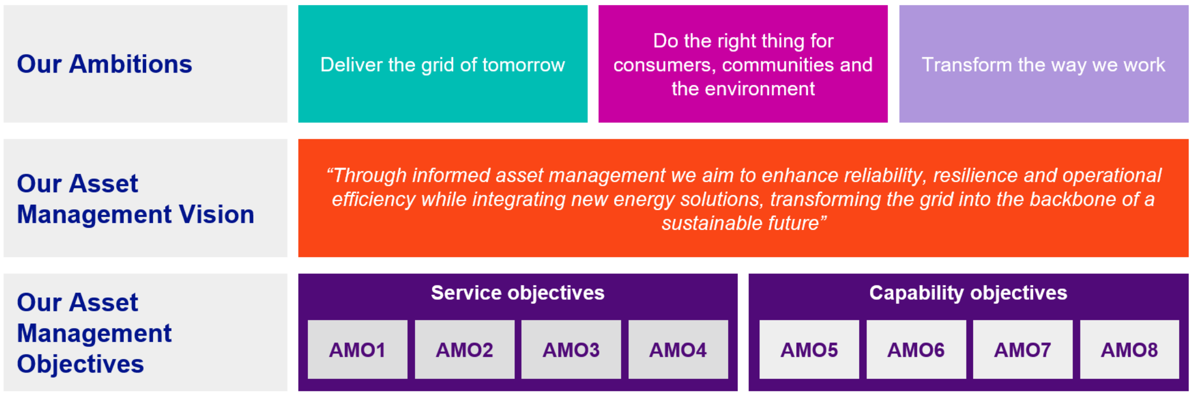


This system helps us to align our work and investment activities with our objectives and policies, ensuring that through informed asset management, we enhance the reliability, resilience and operational efficiency of our network while integrating new energy solutions, transforming the grid into the backbone of a sustainable future. To ensure we have a consistent, logical approach to our investments (allowing us to transparently trade-off between intervention options to achieve our commitments) we have a mature asset management system aligned to ISO 55001 that applies a plan-do-check-act approach across the full asset life cycle.

> **Our commitment**
>
> **C1.1**
>
> **Transform our asset management capabilities to efficiently manage a larger, more complex, network going forward**

Our Asset Management System is designed to support us in achieving our ambitions and commitments. Where these directly relate to our asset management activities, we have captured these within our eight Asset Management Objectives (AMOs). These AMOs are detailed within our Asset Management Strategy and will allow us to measure our progress against our ambitions at a more granular level. Figure 2 shows our Asset Management Objectives and the line of sight to our business plan ambitions.

Figure 2: Asset Management Objectives: Vertical Alignment



Our Asset Management Objectives have been split into Service Objectives and Capability Objectives. Table 4 shows each of these objectives and how they link to our RIIO-T3 plan ambitions and our commitments.

Table 4: Our Asset Management Objectives

AMO	Objective Type	Asset Management Objective	Our Ambition	RIIO-T3 Commitment
Service Objectives				
1	Risk Management	By December 2030, all asset management activities will have reduced Scope 1 & 2 Emissions by 50% against the annual emissions from a FY19 baseline.	Do the right thing for our consumers, communities and the environment	B4.3
2	Risk Management	Maintain a safety-first asset management approach by implementing our maintenance and asset replacement policies and conducting regular condition monitoring to reduce safety incidents and ensure regulatory compliance (HSE).	Deliver the grid of tomorrow	A1.2
3	Risk Management	During RIIO-T3, we maintain an agreed level of network asset risk and asset availability, and 99.9999% reliability.		A1.1 / A1.2

AMO	Objective Type	Asset Management Objective	Our Ambition	RIIO-T3 Commitment
4	Risk Management	During RIIO-T3, our network and assets are resilient to external events, including climate change impacts and cyber risks.		A1.1
Capability Objectives				
5	Period of Integration	We will have developed how we manage, plan and deliver interventions to connect 50GW of offshore wind by 2030.	Transform the way we work	C1.1
6	Cost Efficiency and Performance Optimisation	All decisions across NGET will be governed by a consistent decision-making framework and single value framework that considers both risk and whole life cost.		C1.1
7	Cost Efficiency	Total Cost of Ownership will drive efficient investment decisions across Asset Operations.		C1.1
8	Performance Optimisation	By the end of RIIO-T3, we will have an agile and digitally enabled workforce with the capability (knowledge, processes, tools and data) to generate insights into our existing and emerging asset base risks and make effective asset management decisions.		C1.1

Our Asset Group Strategies (AGSs) provide a structured approach to managing the key asset groups essential for maintaining network performance and reliability. By setting clear, targeted objectives for each asset group, these strategies ensure that each group's contribution aligns with our overarching Asset Management Objectives and supports our long-term vision and commitments. We have developed Asset Group Strategies for our primary asset groups, namely:

- Circuit Breakers
- Earth Switches & Disconnectors
- Earthing & Auxiliary Transformers
- Instrument Transformers
- Surge Arresters
- Through Wall & Floor Bushings
- Transformers & Reactors
- Air Systems
- Civils & Structures
- HV Busbar Infrastructure
- Site Supplies
- Reactive Compensation
- Overhead Lines
- Substation Cables
- Transmission Cables
- Light Current – Protection & Control
- Optel (Operational Telecoms)

Each AGS is tailored to the unique characteristics and requirements of each asset group. This enables proactive, data-driven decision-making that balances cost, risk, and performance and optimises asset performance over its entire lifecycle.

These Asset Group Strategies provide alternative scenarios for delivering our required performance levels across each of our Service Measures over the short (5 year), medium (5-10 years) and long-term (greater than 10 years). The scenarios have been developed on a 'bottom-up' basis from insights specific to the asset group and are therefore different for each, due to the differing nature and challenges associated with the asset group. These insights have been fed into the development of our RIIO-T3 plan, informing where further information has then been applied to refine the plan so that we can be confident that it meets our stakeholder needs whilst being deliverable and managing our network risk.

2.2 Demonstrating Asset Management Best Practice

Our Asset Management Strategy and system sets the best practice asset management principles for our business. Our plan has been built using this system, ensuring that we reduce the risk of asset failure through timely, cost-efficient interventions that meet our long-term ambitions and service commitments.

We hold ISO 55001: 2014 certification[2], which sets out the key requirements for establishing, maintaining and operating an Asset Management System. In addition, we are IAM (Institute of Asset Management) Patrons, a group whose role is to support the IAM in identifying relevant projects and knowledge that deliver the greatest progress for asset management both within the UK and globally. As IAM Patrons we are directly involved in the continual improvement of asset management best practice across the UK and globally.

Internally, we have a Business Management Standard for Asset Lifecycle Management which sets the expectations for each National Grid company to drive consistency and provide a view of our asset management maturity. We are assessed against this standard each year and by adhering to this standard, we are equipped to deliver safe, efficient, reliable and environmentally sound asset performance. We are committed to driving continuous improvement in our asset management approach across National Grid by frequently reviewing this standard against emerging asset management best practice and sharing asset management learnings across our National Grid Asset Management Community of Practice[3].

Our asset base always evolves and now more so than ever, with high voltage direct current assets and new offshore links in development which will bring new challenges and different risks. Therefore, it is imperative that we stay ahead of these changes and work with our major project teams to bring new strategies into our asset management system for these assets, maintaining our track record of a high performing network.

2.3 Our Asset Management Improvement Plan

We have an Asset Management Improvement Plan in place that is central to our Asset Management Strategy, enabling us to integrate a consistent approach and adopt cutting-edge digital tools and data management systems. Through this improvement plan, we are laying the foundation for a future-ready network that addresses emerging challenges in energy demand, renewables integration and infrastructure resilience. This improvement plan focuses on building capability that will ensure that business planning activity is embedded within our business, including the creation of a rolling asset management plan. This capability will allow us to be more agile and future ready to respond to emerging investment needs. To deliver our improvement plan and the enablers that support the embedding of these capabilities we have developed a structured, phased method. This method will ensure we will achieve our long-term Asset Management Objectives and enables us to set milestones for gradual capability development and ensuring alignment across our business. Our Asset Management Improvement Plan is shown in Figure 3, and covers the following themes:

- Decision making process and governance – to advance maturity in our decision making ensuring clear criteria and governance is in place.
- Risk and value frameworks – alignment of our risk and values with our ambitions, identifying data requirements to enhance our Asset Information Strategy and ultimately driving forward our strategic planning capability.
- Long-term planning – Modelling of potential future states to enable us to adapt our strategies dynamically, accounting for emerging industry trends, regulatory shifts, and our evolving asset needs.
- Asset information and technology – Our Asset Information Strategy will provide a roadmap for us to manage our asset-related information effectively, supporting decision making, optimising performance and driving operational excellence. The development of a Technology Strategy and associated roadmap will support our transition into a digital way of working, but we need to ensure that we have a clear information strategy before we begin to develop functional and technical requirements for systems.

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[2] Recertified in 2023

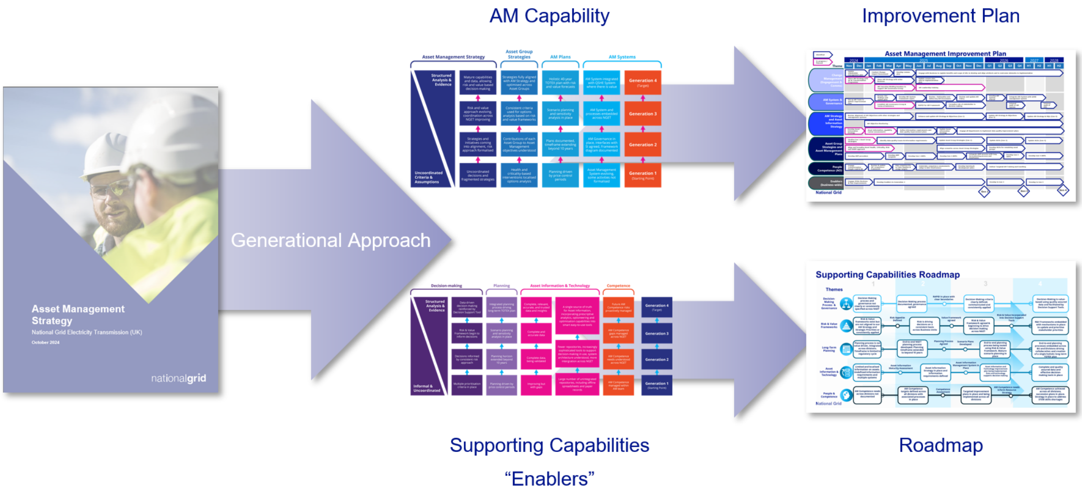
[3] The Asset Management Community of Practice is a network of National Grid's asset management champions that meet to share their learnings and drive continuous improvement of our asset management capability across the company.

- People and competence - It is critical that our people are competent and engaged in Asset Management in order to deliver the shift in capability that is required to deliver our Asset Management Objectives.

Our Asset Information Strategy is pivotal in transforming the way we work by seamlessly integrating technology and processes, which enhances our ability to make informed, data-driven decisions across the organisation. This leverages innovation, community collaboration, and robust governance to ensure high-quality, real-time data is accessible and reliable for all stakeholders.

Some of the initiatives contained within our Improvement Plan are already in progress, [redacted] our Asset Information Strategy and our move towards a total cost of ownership (TCO) modelling capability.

Figure 3: Our Asset Management Improvement Plan and Supporting Enablers



2.3.1 Improving our knowledge of our assets

Our ambition to have complete and accurate asset information underpins our Network Asset Management Strategy. With our asset base set to expand significantly in volume and complexity over the coming years, it is essential for us to adopt a more intelligent approach to optimise asset performance and reliability. A flexible Enterprise Asset Management (EAM) capability will make managing our assets easier and empower our teams to make better decisions, both now and as we expand our network. By the end of RIIO-T2, we will have replaced [redacted] (our historic EAM) with [redacted] This will encompass the rationalisation of several applications [redacted] including schedule and dispatch of work and conditioning monitoring, presenting an opportunity to make a step change in our asset management capability.

Our asset information requirements continue to evolve, resulting in a significant increase in the data held in our systems throughout RIIO-T2. This growth has primarily been driven by the collection and enrichment of data on our protection and control assets for cyber risk and vulnerability management. By the end of RIIO-T2, we will have also completed a civil data collection project, which will substantially enhance the granularity of information we have on this asset type. Our asset data processes are being reimagined to collect information earlier and align the physical and digital commissioning of assets.

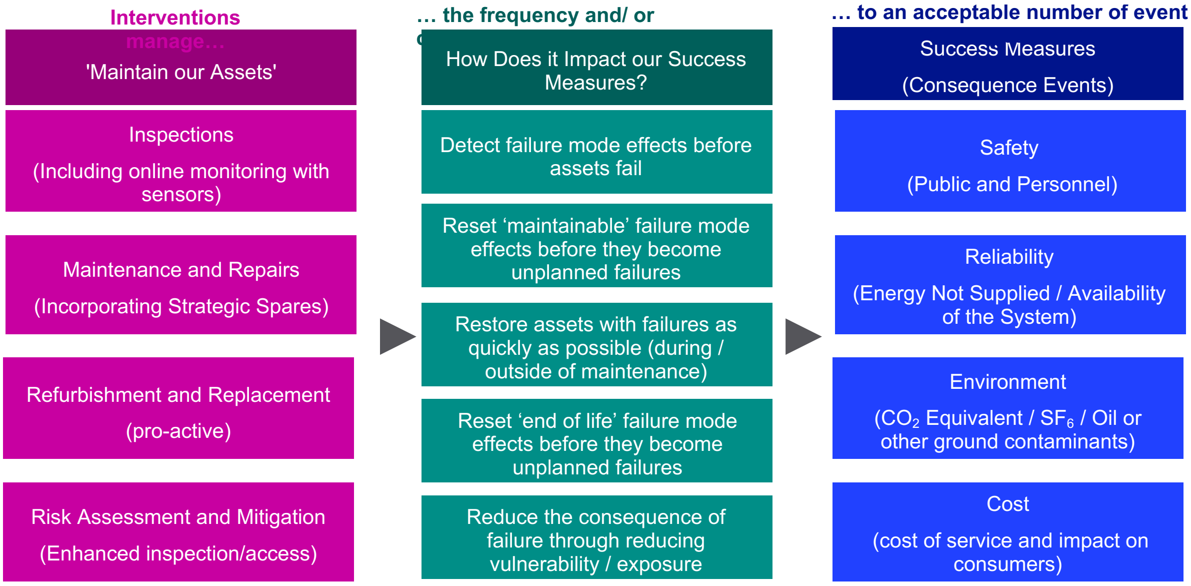
We are committed to ongoing transparency through the improvement of asset information within our EAM systems. During the RIIO-T3 period, a planned asset information improvement programme will support our digital strategy and the expansion of Network Asset Risk Metric (NARM) methodology to additional asset categories. Delivering our asset information strategy will ensure we continue to have the necessary evidence to support continuous improvement in our investment decisions.

3 Achieving Long-Term Operational Resilience

3.1 Drivers and Case for Action

The types of activity or ‘interventions’ of our plan along with the impact and consequence in terms of our success measures is shown in Figure 4. Interventions proactively manage and address the frequency (or likelihood) of asset failure, limiting the number of events that might ultimately give rise to a safety, environmental or reliability issue and therefore increasing our resilience. Targeting stable risk across our asset base is fundamental to the long-term resilience of the service we deliver to reduce operational failures and events through a robust and well-maintained network.

Figure 4: Interventions, impacts and success measures of the Asset Management Strategy



3.2 Asset Management Related Interventions

Table 5 lists the activities our network asset management strategy covers, what they deliver and where to find additional details on costing. These activities ensure our success measures and targets across safety, reliability and environment are met.

As each asset ages, they will enter a maintain / repair / refurbish programme until they are deemed to have reached end of life, after which they will undergo replacement or disposal. Interventions are timed to prevent failures from ‘unplanned’ events that might endanger people, harm the environment, disrupt our network service or result in excessive costs to consumers.

“Our refurbishment centres have been operational over the past decade, providing support to products that are impacted by obsolescence. For example, the diversity of switchgear products has considerably changed from RIIO-T1 to -T2, moving from breakers to disconnectors and earth switches. RIIO-T3 will see a ramp up in gas circuit breaker interventions. The committee design assets (disconnectors and earth) and ABCB have not been supported by the original equipment manufacturers (OEMs) for many years. [redacted] *n the last five years, refurbishment has reused over 475 tonnes of copper and aluminium. The CO_2 that would have been created in the production of this mass of new materials would have been in excess of 5,000,000 kg CO_2.”*

– Sri Rao, Head of Operational Readiness

Table 5: Asset Intervention Descriptions

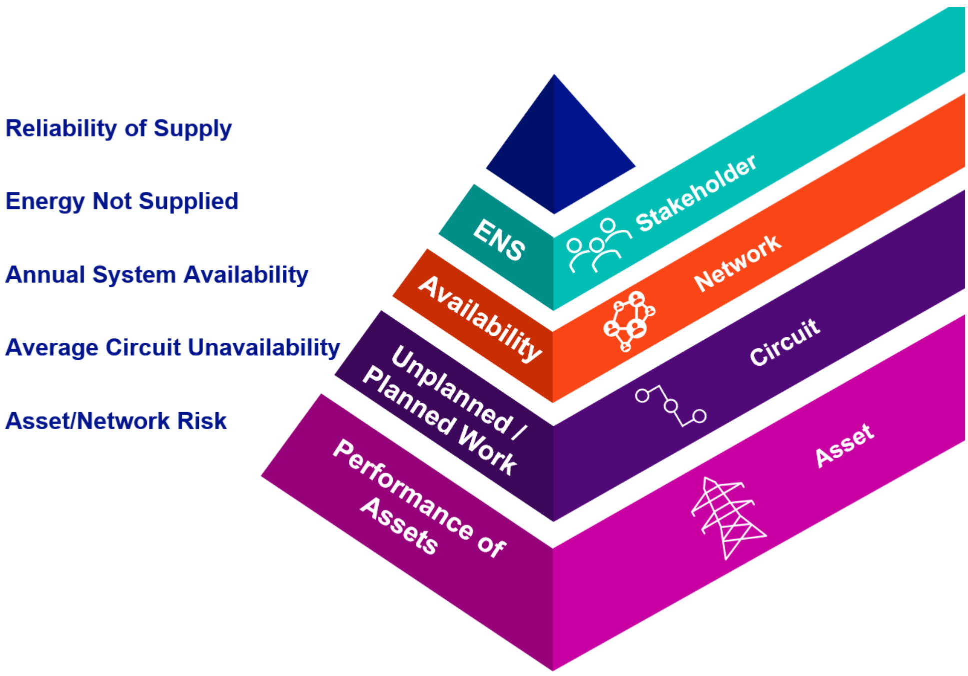
Intervention	Type	Description	What is it and what does it deliver?	Cross ref to costing details
Maintain/ Repair	Inspection	Examination, assessment and recording of information about the condition of the asset and its components. Inspection itself does not reduce the likelihood of failure of an asset but it detects failure mode effects that may go on to be addressed by corrective maintenance or repair.	Prevent asset failure through pro-active detection of failure mode effects (with assets in service) Meet our statutory obligations (e.g. PSSR, WSSE)	Network Operating Costs (Opex)
	Maintenance	Preventive - Pro-active interventions, using a prescribed set of activities, which prevent or control asset deterioration and retain its ability to operate to its defined function. Corrective - Reactive intervention restoring an item into a state in which it can perform its required function.	Prevent unplanned failure through pro-active detection of failure mode effects (with assets removed from service)	Network Operating Costs (Opex)
	Repair	Restoration of an asset's component(s) that no longer function, to specified requirements, to ensure that the asset can operate according to its defined function.	Repairs as a result of pro-active detection (inspection or maintenance) or reactive to an unplanned event.	Network Operating Costs (Opex / Capex)
'End of Life' (Focus of this annex)	Refurbishment	To achieve anticipated life (also known in PS (T) 131 as 'Reconditioning') Extend Anticipated Life.	Prevent unplanned failure through pro-active refurbishment or replacement of assets.	Lead Portfolio Assets Non-Lead Portfolio Assets Atypical Papers Major Project Papers
	Replacement	Replacement of the entire asset with an asset that delivers equivalent or improved functionality.		
	Disposal Only	No further need for the asset or a replacement.	n/a	
Other	Condition Monitoring	Linked to inspection (with assets in service – using handheld or semi-permanent remote sensing).	Prevent unplanned failure through pro-active detection of failure mode effects.	Atypical Papers
	Strategic Spares	Linked to Repairs (either detected through inspection and maintenance or reactive, unplanned).	Provision of whole assets or component assemblies for expected frequency of asset failures.	Atypical Paper

An overview on the assessment process used to determine interventions based on asset health presented in Section 4. Table 23 and Table 24 in Appendix C show the types of evidence driving the need for an intervention that is contained within ‘AH - T3 EJP Portfolio' and 'AH - T3 EJP Portfolio NL’ product for lead and non-lead assets respectively.

3.3 Success Measures and Targets

The relationship between asset level performance and the performance of our network as seen on a day-to-day basis is captured in Figure 5. Increasing asset risk leads to unplanned outages, reducing network availability, impacting the service our consumers expect, and driving inefficient cost. Our approach is to manage asset risk through active interventions and minimise unplanned network outages, helping maintain availability of the network and therefore maintaining service at lower cost. We are also looking to make the most of planned outages, for both load and non-load activities, to minimise unavailability and energy not supplied (ENS) to our customers. We also track and report reliability, a measure of the ENS relative to the energy supplied and expressed as a percentage value.

Figure 5: Network Performance Measures



3.3.1 Historical Performance

Throughout RIIO-T1 and into RIIO-T2, we have delivered a high level of network reliability, as shown by performance indicators on reliability, availability and energy not supplied (please see Figure 6 and Figure 7). There is an increasing reliance on the reliability of our network due to continued electrification, meaning network reliability is more critical than ever and our consumer research has validated this. Therefore, our objective for the RIIO-T3 period is to maintain reliability at better than 99.9999%, despite an increasing load and our work programme.

Our commitment

A1.1

Ensure our assets continue to provide a resilient network, delivering high quality and reliable electricity to consumers

With regard to Energy not Supplied (ENS), we are proposing a target of 135 MWh per year, down from our RIIO-T2 target of 147 MWh per year. Further details on the calculation and justification for this can be found in Appendix A of this annex.

Figure 6: Historical Network performance indicators: reliability and availability

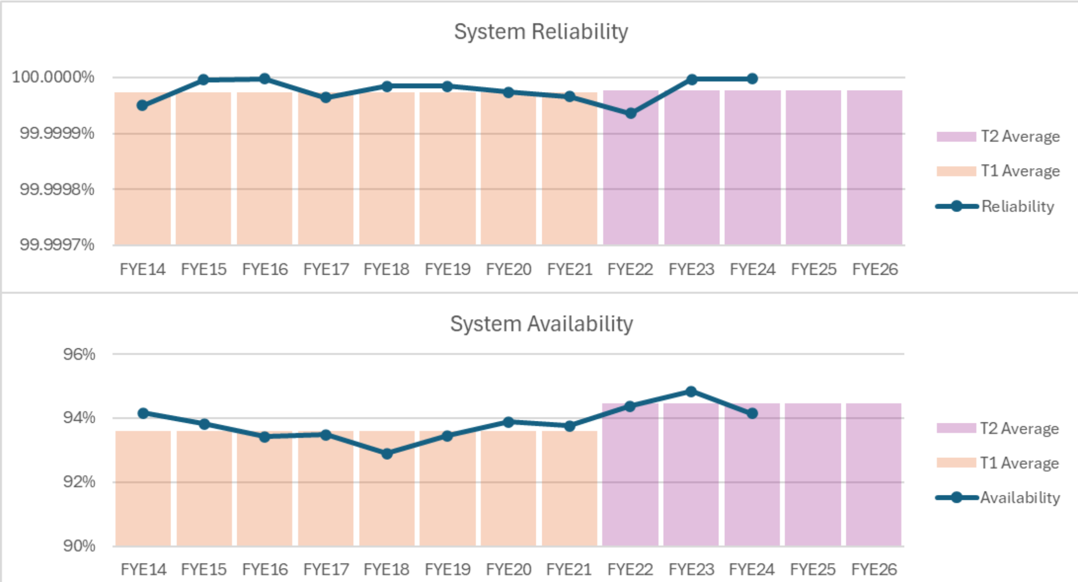
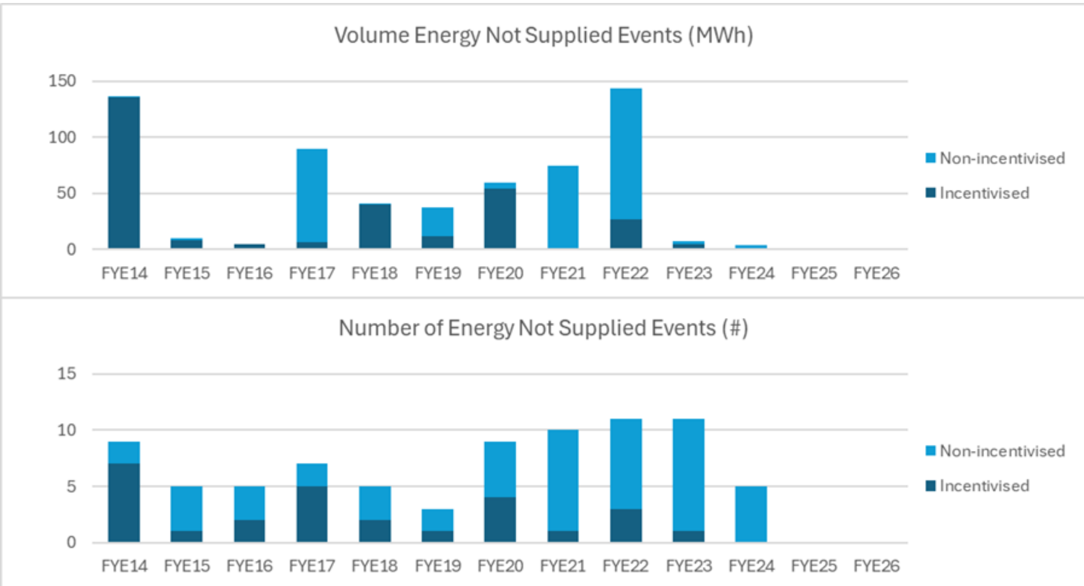


Figure 7: Historical Energy Not Supplied over the RIIO-T1 and T2 periods



3.4 Adopting an Agile Approach to Asset Risk

The landscape in which we are managing our assets has fundamentally shifted. Our consumers and interest group feedback demonstrates that they expect high levels of reliability from our system whilst we expand and transform our network. This requirement will continue into RIIO-T3 and beyond.

This means greater competition for system access, finance and a supply chain of personnel and equipment. We have considered how best to manage this situation and explored a number of options available for our non-load related business plan, as noted in Table 6. As a result, we have identified that the adoption of an agile approach to risk management is the best way to balance these competing needs.

Table 6: Summary of RIIO-T3 Asset Health Strategies

Scenario	Cost	Risk ∆	Deliverability	Stakeholder expectations	Summary
Be Risk Averse Increase our asset health investment and lower the overall network risk	Significant increase compared to T2	Bring risk levels down in line with RIIO-T1 levels	Volumes significantly increasing from T2 levels	Delivery risk is high & clashes with load-related investments inevitable	Cost increases and inevitable plan constraints, this strategy risks delivery of our stakeholders' expectations and national clean energy targets
Target Stable Risk A baseline RIIO-T3 plan that delivers a stable network risk	Increase compared to T2	Stabilise risk across the T3 period	Volumes increasing from T2 levels	Output delivery risk & clashes with load-related investment likely	During this period of increased load-related investment to achieve net zero, targeting risk stability drives cost increases and poses increased deliverability risks
Agile risk Management A baseline RIIO-T3 plan that targets known high risk assets and maintains optionality to manage risk as the landscape evolves	Baseline plan lower than T2 with an option to secure funding for work in our pipeline log (via UM)	Target risk stability, focus on highest risk assets & unlocking pipeline investment	Baseline volumes lower than T2. With pipeline volumes, similar to T2	Volumes consistent with T2, lower risk of clashes with load-related investments	Managing asset health risk by focussing on highest risk assets and taking outage opportunities to work around the load-related plan constraints
Increasing Risk Appetite Reduce our asset health investment and allow the overall network risk to rise	Lower than T2	Focus on fewer, (i.e. high-risk assets only)	Volumes significantly lower than T2	Further increases in network risk can drive down future system reliability	Allowing risk to rise without taking advantage of opportunistic outages is inefficient in the longer term

In the creation of our plan, we have identified the best value intervention option given the health and criticality of an asset and the potential for investment to be aligned with our load-related interventions.

Interventions for which we have high confidence in the need and a clear solution are included in our baseline plan. For interventions where the timing, costs or solutions are not as clear or certain, we have identified our best view and placed that project in our pipeline plan, where we can initiate action on receiving more information, dependent on the RIIO-T3 framework including an appropriate uncertainty mechanism (please see Appendix B).

This logical baseline / pipeline investment splitting process ensures that we:

- Provide the best value to our consumers.
- Prioritise well justified and well costed projects.
- Remain flexible and able to adapt to changes when the need arises.

3.5 Baseline, Pipeline or Deferment

Some of the key questions that we applied in our baseline / pipeline / deferment decision making are:

- What is the severity of the risk today?
- Is there an obsolescence concern?
- What is the expected growth in risk severity over the next 30 to 50 years?
  - How reasonable is it to believe the expected risk growth and does it burden future energy users with un-manageable risk? [redacted] Both populations have a large volume installed in the 1960s during the original construction of the 275kV and 400kV networks.
- What is the overall balance of risk across all asset groups by the end of 2031, 2036 and 2041? Does the RIIO-T3 plan burden future price control periods with unmanageable risk?
- Have we delivered this type of work previously in the RIIO-T1 or -T2 periods?
- Does the supply chain have capacity to support this workload?

Based on the output of this process, interventions have been allocated to the baseline, where:

- There is a clear need (based on asset risk or asset obsolescence).
- There is a proposed solution identified with known track record.
- There is opportunity to bundle work with other projects to reduce the need for additional outages.
- Established and known costs exist.
- They cannot be delayed to a subsequent price control period.

For interventions which do not make the baseline, there are the following options:

1.a Pipeline – where the urgency of need is lower but addresses the longer-term risk position to the end of the next price control period (referred to as 'RIIO-T4'), the pipeline log provides visibility to Ofgem of our longer-term plans and the facility to intervene in RIIO-T3 where system access, which we expect to be increasingly constrained, allows. This focus beyond the short-term also aligns with the feedback received from stakeholders.

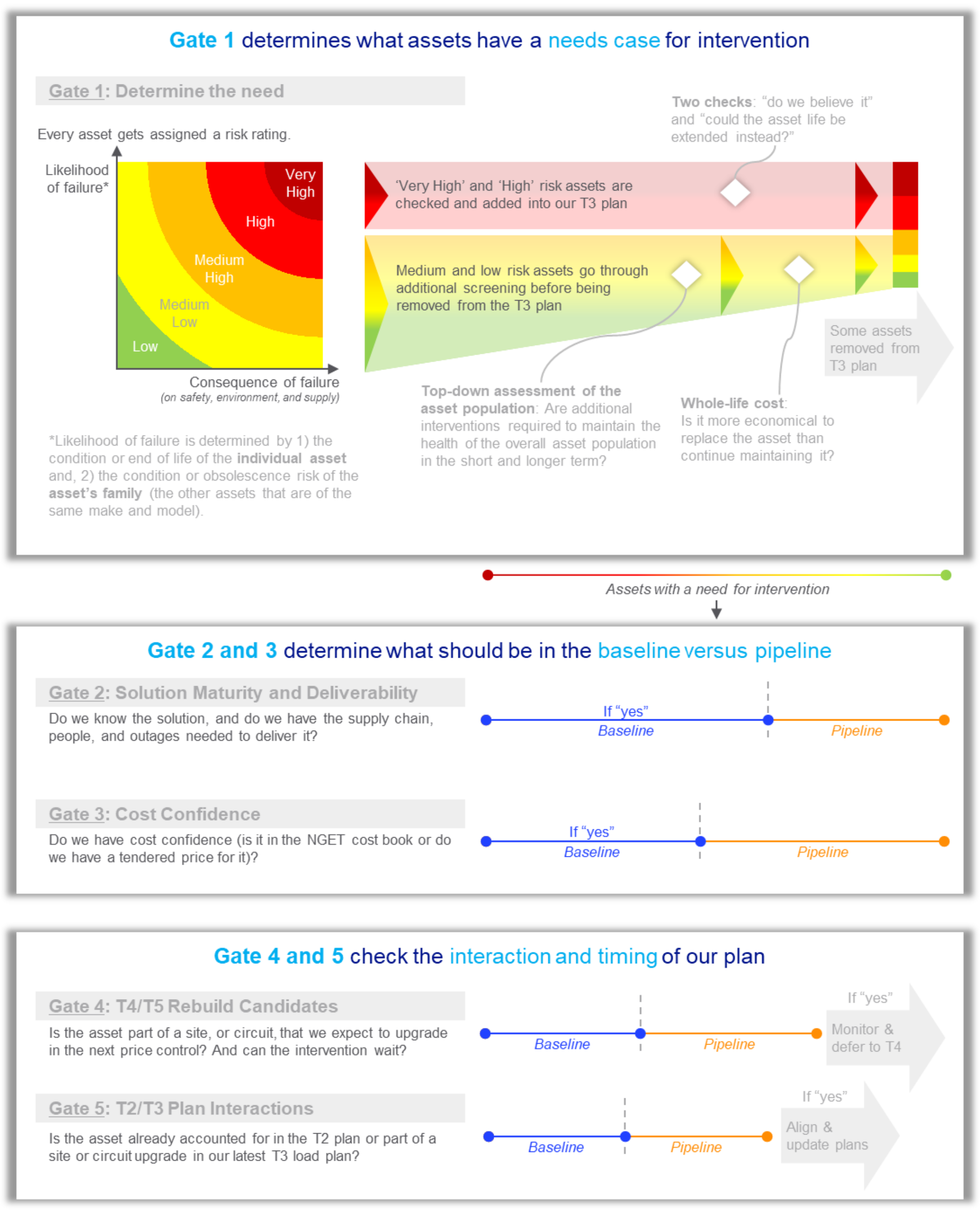
1.b Pipeline - Where costs and solution are unclear, interventions are allocated to our pipeline log, with provision to be delivered during RIIO-T3 (under a suitable uncertainty mechanism), once additional information is available that clarifies the need, outage opportunity, solution, or cost as appropriate.

2. Manage residual risk[4] - Where there is a view that risk can be actively managed, assets may be assessed for potential asset family lifetime extension and large capital intervention actions deferred. These interventions would not appear in either our baseline or pipeline plan but will contribute to our network operating costs (NOC) given ongoing inspections, repairs, maintenance, and any other required risk mitigations. Consideration of the long-term implications are factored into these decisions to ensure that unsustainable levels of asset risk do not develop.

Figure 8 is a summary of the gated approach that we have taken to determine if assets should be included in our baseline plan, pipeline log or removed entirely from our refurbishment/ replacement/ disposal plans and placed into active lifetime extension.

[4] When extending the life of an asset family, risk of failure, overall long-term costs, deployment of workforce and supply of equipment must be taken into account to ensure consumers benefit. Where there is a clear case, supported by asset risk and a plan of ongoing inspections, this option will be considered. Should an asset subsequently reach EoL before replacement, NGET bears the risk and impact to ENS and reliability.

Figure 8: Our approach to baseline and pipeline allocation



3.6 Upgrade Optionality and Interaction with Load-Related Projects

When managing asset risk, we consider load-related interventions and their impact on the network, and how they could impact the scope and timing of asset health interventions. For example, a large load-related intervention might require the upgrading of multiple substations to facilitate new connections. Aligning these upgrades to any asset replacement and refurbishment plans relating to asset health, allows us to co-optimise our load and non-load plans, ensuring better value for money for our consumers. Through regional blueprints (described in the A08: ET Load Strategy annex), we can identify opportunities and align these with specific site and route strategies.

However, the levels of uncertainty associated with the volume of load-related connections and system upgrades presents challenges. Often, we are forced to make trade-offs to allow additional flexibility in our planning. This impacts not only our RIIO-T3 plans, but also future price controls. Should load-related plans change significantly, we would need a mechanism to avoid exposing consumers to increasing risk from delaying asset replacement or finding post final determination that our asset replacement plans are no longer valid should large, unanticipated customer-driven changes arise.

Example Substations:

For assets where an intervention is required, there are a number of different solutions and interactions to consider. Table 7 shows the considerations for a high-risk substation that has been identified as requiring intervention to reduce the risk of failure.

Table 7: Options to consider for a substation asset intervention

Solution Option	Comments
In-situ solutions	Potentially less disruptive and quicker to action but need to consider whether the asset is refurbished given the location and future needs or is it better to replace the asset. Solutions may also be somewhat limited due to space and outage implications.
'Offline' complete build and connected to the system in stages	Potential trade-offs with cost and time – maybe required if outage constraints are significant or there are physical site limitations.
'Offline' incremental build and connection.	The new build substation may gradually consume the footprint of the existing site. Allows partial reuse of site.
Air Insulated Switchgear (AIS) or Gas Insulated Switchgear (GIS)	Key consideration, given the need to consider the trade-off between the space available on-site and carbon emissions.
At the same or a higher voltage	Projected system need for current carrying capacity and short circuit withstand is also factored into this decision. Applies to whole substation rebuilds only. Avoid operating at lower kV with higher kV rated equipment if the intent is to go to the higher kV. In this instance, operate from the higher kV from the beginning of the life of the substation. Mid-life voltage upratings are not practically feasible.

In addition to the considerations listed in Table 7, we must also assess the long-term impact of the option across different time periods[5] such as the impact on cost and decarbonisation targets[6].

Our approach in RIIO-T2 started from a default option of in-situ, incremental asset refurbishment and replacement, supported by cost and time to implement analysis. For RIIO-T3, we have taken a longer and wider view on what is best for consumers, given the increasing interaction with our load plan. This is now critical to ensuring the best value for customers (both now and into the future) given the large programmes and capacity increases planned, to ensure we do not lock ourselves into sub-optimal solutions in the long term and the requirement to revisit sites multiple times.

While the in-situ option is still valid as a starting point, we also consider the implications for a particular site. These are shaped through our regional strategies, described in the A08: ET Load Strategy annex and summarised in Section3.6.2.

3.6.1 Avoiding Future Regret

To provide confidence that our strategy for RIIO-T3 is flexible and can adapt in the future should changes arise, we have worked to develop a greater understanding of the likely longer-term future for our overhead lines, cable routes and substations.

Based on this work, we have identified situations where conditions might arise that would lead to "regret", i.e. where actions today could be sub-optimal given the most likely foreseeable future. In these situations, we seek to reduce the risk to consumers by adjusting our intervention, including moving away from a like-for-like replacement (i.e. with the same or modern-equivalent capability).

[5] A substation may have different approaches over the different time periods (e.g. 'Rebuild' then 'Do Nothing' then 'In situ' works).

[6] Ofgem CBA templates look out 50 years from the start of RIIO-T3 (2076) and we are presently doing asset health and risk forecasts to 50 years (2074).

3.6.2 Linking with our load plans and regional strategies

Our Regional and Circuit Strategies consider customer requirements (both now and into the future), infrastructure upgrades from our load plan, asset failure risk and SF_6 emissions goals. This allows us to take a holistic view when considering when to schedule interventions for our RIIO-T3 plan.

This involves considering the following investment scenarios shown in Table 8.

Table 8: Investment scenarios

Scenario	How it is represented in our RIIO-T3 Non-Load plan
OHL or Cable Route to be uprated in RIIO-T3	Upratings relating to the load-related plan can also provide Asset Failure Risk Benefit. Any OHL or Cable route work under consideration for the non-load plan is checked for corresponding load-related investment drivers. This is completed by one team reviewing the entire portfolio. Any indirect benefits of increasing the load-related capacity of the conductor (where there is not a specific customer or infrastructure upgrade driver now) through the non-load project are reviewed by consulting with the longer-term regional strategy. Any recommended upgrades (e.g. use of conductor types with -enhanced capacity) are included on a case-by case-basis.
Substation to be rebuilt in RIIO-T3	Upratings included in the load-related plan, including those delivering an Asset Failure Risk Benefit. As with routes, all substation drivers have been reviewed by a single team. There are very few site-rebuilds where the non-load drivers alone lead to rebuild [redacted] These exceptions form part of the non-load investment plan.
Asset to be decommissioned in RIIO-T3	Our RIIO-T3 plans have been adjusted to remove any in-situ asset refurbishment and replacement works where a substation is planned to be removed or decommissioned in the RIIO-T3 period.
Substation likely to be rebuilt / decommissioned in the ten years following RIIO-T3	Our plans have been adjusted to place in-situ asset refurbishment and replacement into the pipeline plan because of uncertainty that will not be addressed until these substations have gone through our full option selection process (scope and timing). Some exceptions have been included in our baseline plan where there is a clearer need to act in RIIO-T3 to address individual condition concerns or severe obsolescence issues identified via intrusive maintenance and repair.

3.7 Network Operating Costs - Inspections, Maintenance and Repair Activities

To ensure a safe and reliable transmission network, we need to assess our assets on a continuous basis to ensure they remain in a healthy condition. This includes an ongoing programme of inspection, fault investigation, repairs and maintenance - in addition to refurbishment and ultimately replacement when an asset is identified as reaching end of life.

These activities are covered by our direct opex cost base, referred to as Network Operating Costs (NOC), together with service agreements and vegetation management. These activities are underpinned by our asset policy, which drives the volumes, frequency and type of work to be carried out in the day-to-day operation of our transmission network.

Full details on NOC activities and associated costs are provided in the A14: Cost Assessment and Benchmarking Approach annex (section 3) and associated business plan data tables.

3.8 Maintaining Resilience - Strategic Spares

Maintaining an adequate level of spares is essential so that we do not cause significant delays in replacing an asset or returning an asset to service, which in turn can incur constraint and other system operation costs, delays to other projects and inconvenience to customers, up to potentially a loss of load. Conversely, an excess of Strategic Spares is not efficient and incurs additional costs for buying, holding, and maintaining these spares. A good strategic spares policy strikes a balance between these two extremes. [redacted]

Full details on our strategic spares approach is detailed in Atypical EJP: T3 - Strategic Spares.

3.9 Investments to Reduce SF_6 Emissions

Our commitment

B4.3

Drive sustainable operations through reduction of SF6 emissions, energy use in our operational estate, and fleet vehicle emissions

We are committed to reducing SF_6 emissions from our transmission network; it is a high priority for our business and is a key expectation of our customers and stakeholders. Our RIIO-T3 investment is driven by the need to reduce SF_6 emissions from our transmission network in both the short and long term, to meet the science-based targets:

- Short Term – 50% SF_6 emission reduction by December 2030 (based on 2018/19 baseline)
- Long Term – Net zero SF_6 emissions by 2050
    - Achieving net zero is based on reducing SF_6 emissions by at least 90% while offsetting up to 10% of SF_6 emissions.
- Long Term – Regulatory Compliance – Future Regulatory compliance with foreseeable changes to EU F-Gas regulations. Although this may not directly impact us, changes will impact our supply chain and will likely make SF_6 more expensive to procure.

Our RIIO-T3 investments will drive the following outputs:

- An estimated 40,354kg of SF_6 removal from our transmission network through asset replacement and retro-fill.
- An estimated ~7,576kg of forecast SF_6 emissions abatement in the RIIO-T3 period
- An estimated ~82,425kg of forecast SF_6 emissions abatement by 2050, contributing to stakeholder targets such as the Greater London Authority's Net Zero 2030 plan.
- Remotely accessible gas density monitoring capability at [redacted] substations and enhanced SF_6 emission forecasting utilising gas density monitoring data.
- [redacted]

Full details of our investments to reduce SF_6 emissions are detailed in Atypical EJP: T3 - SF_6.

4 Methodology for using Asset Risk to Identify Interventions

The assessment of asset health and how it changes over time is used to inform our investment decision making. We aim to intervene on assets at the right time to maximise asset performance (in terms of safety, system, environment and cost), manage risk of failure, and minimise cost to the consumer.

Asset health (detailed in Section 4.3) can be used to estimate the risk of failure associated with an asset as it approaches 'end of life'. An asset is considered to have reached 'end of life' (EoL) when it is no longer technically feasible or economically favourable to manage its failure modes with maintenance and/or repair interventions.

- Technical feasibility refers to whether an action is deliverable or will deliver the intended outcome.
- Economic favourability refers to the cost-effectiveness of an action when compared with other options. Considerations include the probability of failure (rate of change and any reductions due to intervention), the consequence of failure, and the ability to detect early indicators of failure, and cost of any action. The impact of obsolescence is also considered, in terms of replacement parts and spares and access to skills required to fault-find and maintain an asset.

Interventions to extend the life of an asset (e.g. a major refurbishment) can delay the onset of 'end of life', provided they are economically favourable. If it is no longer cost-effective or technically possible to maintain the performance of an asset, then by default it has reached 'end of life' necessitating further interventions (replace or dispose).

4.1 End-of-life Distributions

To ensure sustainable performance, it is important to have a long-term perspective on asset health over time. Therefore we undertake risk modelling to forecast increase in the likelihood of failure. This allows us to:

- Assess the health and level of risk and determine asset management actions over the short to medium term (1-5 years).
- Estimate refurbishment and replacement volumes for equipment groups over the long term (decades).

We model the expected behaviour of a population and end-of-life failure distributions show the ages at which 2.5%, 50% and 97.5% of 'end of life' type failures are expected to occur. Table 9 shows these stages and thresholds for the lifecycle of an asset.

Table 9: Stages in the lifecycle of an asset

Definition	Threshold
Earliest Onset of Significant Unreliability (EOSU)	2.5% of the equipment type population has reached a state where it requires replacement or refurbishment due to wear out or other deterioration or degradation in capability, that signals end of life.
Anticipated Asset Life (AAL)	50% (median) of the equipment type population has reached a state where it requires replacement or refurbishment due to wear out or other deterioration or degradation in capability, that signals end of life
Latest Onset of Significant Unreliability (LOSU)	97.5% of the equipment type population has reached a state where it requires replacement or refurbishment due to wear, deterioration or degradation in capability, that signals end of life

An end-of-life distribution is created for each asset based on actual observations where available, or based on theoretical predictions if the actual deterioration mechanism has not been observed in practice. These predictions are made using knowledge of asset design, operating experience and research into deterioration mechanisms.

Assets are assigned to family groupings based on similar factors that limit their lifespan. For each lead asset group, there are separate end-of-life distributions determined for different family groupings.

4.2 Calculating Asset Risk

Asset risk is closely related to asset health. It takes into consideration not only the probability of failure of an asset due to its age and condition, but also the impact of that failure. We have a number of approaches to categorising and determining asset risk:

- **NARM:** For lead assets only, asset risk is calculated as defined in the NARM methodology. It allows for calculation of monetised risk based on a set of failure modes.
- **Asset Heath / Likelihood of failure:** Uses observations on asset health to estimate end of life. This takes into consideration age, condition, and obsolescence and any actions taken to extend an asset life, to calculate the probability of failure. Asset heath is calculated at the asset level.
- **Common Risk Classification:** Developed in RIIO-T1 and refined through RIIO-T2, we use a consistent method across both lead and non-lead assets, assigning each asset to a discrete risk category based on its asset health and criticality. This uses the same principles for calculating asset risk as for NARM but applied at an asset level.
- **Time based:** This is the simplest approach, based on the age of an asset and its expected probability of failure based on the end-of-life distribution for the asset.

Together, these approaches provide a tool kit from which to derive asset risk relating to end-of-life failure at asset group level and for individual assets to help identify and justify the best intervention to apply to our asset base. The risk measure used for each asset type is shown in Table 10.

Table 10: Risk Measures by Asset Group

Asset Type	Asset Group	Risk Measure
Substation Primary Equipment	Lead Assets • Super Grid Transformers (SGTs) • Quad Boosters • Shunt / Series Reactors • Circuit Breakers	NARM (monetised risk) and Common Risk Classification
	Non-Lead Assets • Reactive Compensation • Instrument Transformers • Disconnectors and Earth Switches • Earth Switches	Common Risk Classification (+ check against obsolescence issues)
Substation Secondary and Station Level Equipment	Other • Light Current (Protection and Control) • Low Voltage Alternating Current (LVAC) and Standby Generation • Air Systems • Civils (HV Support Structures)	Asset Health / Likelihood
	• Batteries	Time Based
Overhead Line Equipment	Lead Assets • OHL Conductor • OHL Fittings	NARM (monetised risk) / Common Risk Classification
	Non-Lead Assets	Common Risk Classification
Cables	Lead Assets • Underground Cables	NARM (monetised risk) / Common Risk Classification

Further work is required to develop the scoring systems for other non-lead assets, beyond our RIIO-T3 submission. Ofgem have stated in their Sector Specific Methodology Decision (SSMD) their intent to drive consistency between the transmission companies; all scoring methodologies are likely to be impacted as a result. We will work with Ofgem and other TOs to determine how best to advance this goal, reviewing our techniques and others to align and extend to more asset types in RIIO-T3 and enable Ofgem to benchmark performance across the TOs.

4.3 Asset Health

Asset Health is an assessment of the likelihood of asset failure. It is made of two parts:

1. A review of present asset health (at a reference date).
   - A score between 0 and 100, known as an 'End of Life' (EoL) Modifier is calculated for each asset[7]. This depicts an asset's state requiring refurbishment, replacement or disposal - all classed as 'end of life' type activities.
   - A mapping between of the EoL Modifier to five discrete bands of 'Very High' to 'Low' simplifies the classification of health.
2. A forecast of the expected asset health over time.
   - We have developed a method for lead assets (under the NARM 'Monetised Risk' development programme in RIIO-T1) to adjust the likelihood of end-of-life failure based on assessment of an asset's present health (EoL Modifier). This allows life estimates to be decoupled from age/time in service metrics.
   - For lead assets, the forecast of discrete health classifications employs the same degradation forecasts as the NARM Monetised Risk methodology.
   - For Non-Lead Assets, a simple linear deterioration based on an asset's Latest Onset of Significant Unreliability (LOSU) has been developed to forecast changes in asset health over time. This is when 97.5% of the population is expected to reach end of life.[8]
   - EoL Modifier scoring methodologies have been developed for our non-lead assets so that the same language may be employed to describe the health of the full asset base[9].

The aspects driving our assessment of the health of each asset are the condition of the individual asset (primary) and the family level (secondary) covering known weaknesses and obsolescence. An asset's degree of obsolescence is either:

- Technical obsolescence, which reflects our ability to respond to functional failures in-service or found on inspection and maintenance; or
- Legislative obsolescence, for example Pressure Systems Safety Regulations (2000) driving a need to replace pressure vessels ahead of an insurance inspection.

The key factors and information considered in an asset health review is shown below in Table 11.

Table 11: Asset Health Review Factors

Item	Description
Failure Mode and effect	The ways in which the asset can fail (Failure Mode) and ways in which these failure modes may be observed or measured (Failure mode effect)
Asset Specific *Primary Considerations (included in Asset Health Rating)*	**Condition of asset:** (Observed/ Measured) • Dynamic – response to movement (e.g. vibration and sound) • Particle – wear or erosion products, foreign material • Chemical – changes in composition of solids, liquids and gases • Physical – changes in dimension and structure of materials • Temperature – heat response to duty (e.g. high resistance 'hot' joint) • Electrical – within acceptable limits (e.g. resistance, capacitance) **Susceptibility to failure:** (Experience / History) • Frequency of defect/functional failure **Operating attributes**: • How hard is the asset working (thermal loading, fault interruptions) • How harsh is its operational environment (exposure to weather) • Health expectations (time in service versus anticipated life)

7 This is a requirement of the NARM ('Monetised Risk') methodology.

8 It is important to continually review asset life modelling to adjust expectations for the number of assets expected to reach 'end of life' as this impacts longer-term capital investment planning.

9 NGET's Technical Guidance Note 'TGN337 A Condition Classification System' supports the development of these, as well as the classification of condition states that impact maintain and repair decisions.

Item	Description
	Cost to own: • Cost of defect/ functional failure • Cost of Inspection and Maintenance
Family Level *Secondary Considerations (captured in Asset Health Reviews)*	**Design Weaknesses: (Failure Susceptibility)** • These may be declared by the manufacturer or discovered after some functional or disruptive failure **Obsolescence**[10] • Family type trait that does not reflect an asset's present condition • Impacts how repairable/maintainable an asset is should a functional failure arise. It may be overcome with increased investment in human capital and spares, which will impact cost of ownership.

We have moved to make obsolescence factors explicit in an asset's overall health assessment. Some asset health interventions [redacted] are largely based on obsolescence given the impact on costs and maintainability. We also note that condition can remain hidden until the asset is called upon to operate, making spares and expertise support (impacted by obsolescence) more critical to this asset type.

4.4 Hidden Failure Modes

Whilst we can detect many condition states that inform the need for refurbishment and replacement of an individual asset, it is not possible to detect all condition states for all failure modes without:

- Proactive, intrusive maintenance, requiring a circuit outage – components are generally repaired (temporarily or permanently) or replaced on these outages if a defective condition state is found, rather than remaining out of service until the next price control period.
- Destructive assessment of an asset/assembly/component removed from service.
- Re-active response to alarms and functional failures.

Our RIIO-T3 plan is for proactive interventions to prevent faults and failures identified by:

- Inspection and maintenance – the detection of condition states requiring an unplanned outage or unplanned extensions to an existing maintenance outage.
- In-service alarms requiring an asset to be switched out of service or to have limitations placed on its operation.
- In-service failure to function, causing an asset to be switched out of service by human action or automatically by the protection system.

This requires us to identify asset families that have hidden failure modes, the likelihood those failure modes will occur and their consequences so that proactive interventions can be prioritised on higher risk assets. If we don't do this and rely only on the condition we can readily observe and measure today, then we will see an increase in unplanned circuit outages and outage events with associated impacts.

Table 23 and Table 24 in Appendix C list the intervention criteria and hidden failure modes and obsolescence considerations taken into consideration for each asset group.

4.5 Common Risk Classification

We have developed a common system to classify asset risk, extended for both lead and non-lead assets, based on how likely they are to happen (linked to an assessment of asset health) and how severe the consequence of this failure would be (determined from asset criticality).

Common risk classification Asset Failure Risk is a function of:

- The Likelihood of Asset Failure (Asset Health)
- The Consequences of Asset Failure (Criticality)

[10] There are degrees and types of obsolescence defined in PS (T) 135.

This complements the Monetised Risk methodology employed by the Network Asset Risk Metric (NARM) and first developed in RIIO-T1. It offers discrete categories of risk and a simpler form of analysis when compared with Monetised Risk which offers continuous values of 'Risk £' for each lead asset (but lacks meaning for any individual asset, without the context of the whole population). Table 12 details our common asset risk classification, which uses a discrete risk system to describe the level of asset risk, ranging from 'Low' to 'Very High'. Different options have been tested, calibrated, and validated to establish the boundaries that best represent the risk based on health and criticality.

Table 12: Asset Failure Risk vs Asset Health and Criticality

Common Asset Failure Risk Classification						
Likelihood/ Asset Health		Consequence/ Criticality				
End of Life Score Range	Likelihood (Health) Categorisation	Low (1)	Medium Low (2)	Medium High (3)	High (4)	Very High (5)
0-<35	Low (1)	Low	Low	Low	Low	Low
35-<60	Medium Low (2)	Low	Low	Low	Low	Medium Low
60-<80	Medium High (3)	Low	Medium Low	Medium Low	Medium High	High
80-<95	High (4)	Medium Low	Medium High	High	High	Very High
95-100	Very High (5)	Medium High	High	Very High	Very High	Very High

4.5.1 Asset Criticality

Asset Criticality is an assessment of the consequences of failure. When an asset fails there are a range of typical events. Each of those events may have a consequence.

Safety and Environment – based on vulnerability (likelihood of harm) and exposure (proximity)

- Safety: proximity of people to potential harm
- Environment: proximity of environmentally sensitive areas to harm

Table 13: Safety and Environmental Criticality Matrix

Criticality					
Exposure	Vulnerability				
	Low	Medium Low	Medium High	High	Very High
Low	Low	Low	Low	Low	Low
Medium Low	Low	Medium Low	Medium Low	Medium Low	Medium Low
Medium High	Low	Medium Low	Medium High	Medium High	Medium High
High	Low	Medium Low	Medium High	High	High
Very High	Low	Medium Low	Medium High	High	Very High

Financial – Based on the cost of replacement of the asset.

- High: >£5,000,000
- Medium High: £500,000 - £5,000,000
- Medium Low: £50,000 - £500,000
- Low: <£50,000

System – based on the Network Asset Risk Metric (NARM) calculation for lead assets (SGTs, QBs, Series and Shunt Reactors, Circuit Breakers, Cables and OHL Conductor and Fittings). The system criticality of assets is determined based on three different methods, depending on the type of asset.

- Lead assets have their system consequence calculated individually using the method outlined in NARM (specifically in the 'NARA' or Network Asset Risk Annex document). The consequence values are combined with average event probabilities to calculate the system asset risk. The asset risk values are then analysed to determine the median, upper quartile, and upper fence (upper quartile plus two times the interquartile range).

- For Non-Lead assets associated with a single Outage Equipment List (OEL), the risk values of Lead assets sharing the same OEL are averaged, and the system criticality is assigned based on the same method and boundaries as above.
- For assets that impact multiple OELs across a site, the maximum risk value of any lead asset on the site is determined. The analysis is then carried out to calculate the median, upper quartile, and upper fence, and then ranking from High to Low (with no very high as this only applies to safety) as noted in Table 14.

Table 14: System Criticality Thresholds

Definition	System Criticality Definition
Any Asset that is Above or Equal to the Upper Fence	High
Any Asset that is Above or Equal to the Upper Quartile but Below the Upper Fence	Medium High
Any Asset that is Above or Equal to the Median but Below the Upper Quartile	Medium Low
Any Asset Below the Median	Low

Combining Criticality Scores:

A robust analysis identified that the most suitable formula to achieve overall best distribution of risk when combining criticality scores is the 'weakest link in chain with added weightings' approach. Multiple trials were also undertaken to assess the impact of the weighting, to validate our view of asset risk.

The weightings place extra weighting on safety and reducing environmental harm when calculating criticality, resulting in a score between 0-100. This score has been converted to a 'Low' to 'Very High' equivalent criticality category shown in Table 15.

Table 15: Combined Criticality Score category mapping

Criticality Score	Criticality Category
0-10	Low (1)
10-35	Medium Low (2)
35-75	Medium High (3)
75-90	High (4)
90-100	Very High (5)

4.6 Approach to NARM Monetised Risk

In RIIO-T2, a selection of asset types have been classified using the Network Asset Risk Methodology (NARM), which uses a common approach to identify risk on a monetised basis in order to evaluate the four criticality categories on a level playing field, and to show relative movements in risk profile with and without intervention. (Note that the monetisation is not directly comparable to the cost of the intervention option; the decision to follow a particular solution is based on the relative risk reduction.)

The same principles, where proportionate, can be applied to non-NARM assets (with the exclusion of calculating monetisation of risk as this is not yet defined for all asset classes).

In the meantime, as the NARM methodology is limited to a subset of assets, it does not provide a holistic methodology for asset risk across our entire network. Therefore, we use our common risk classification approach to identify the need to act on our assets and select the most appropriate solution that manages asset risk at the network level. This aligns with NARM and also manages risk on non-NARM assets, ensuring consistency in our decision making.

4.7 Developing the EJPs - Optioneering

In developing the broader suite of non-load related EJPs, we have undertaken rigorous assessment of needs and options to ensure that we propose only the necessary interventions with the most cost-effective solution. Our Asset Group Strategies have been developed to support the high-level strategic options for each major asset group. These strategies look forwards over an extended period of time with the intent of optimising the balance of cost and risk.

'AH - T3 EJP Portfolio', 'AH - T3 EJP Portfolio NL' and the separate (Atypical and Major) EJPs have content developed by senior engineers from the relevant fields. Each EJP and its associated investments have been through an extensive series of challenge and review sessions before gaining approval from the senior leadership team and directors, ensuing a wide array of challenge has taken place to keep the focus on delivering our ambitions whilst maintaining a cost-effective and high-performing service for our customers. Details on all option assessments can be found in the relevant EJPs.

5 Impact on Asset Risk from Our Plan

Robust management of asset risks is imperative to ensure we continue to maintain the levels of service and performance our customers and stakeholders require and expect of our network. The management of asset health is a long-term endeavour and therefore this performance will be a result of our work to date in RIIO-T1 and RIIO-T2, as well as our programme of spend and activity in RIIO-T3, which will in turn underpin performance in future price control periods.

For RIIO-T3, we are proposing a programme of investments comprised of:

- End of Life type interventions,
- Network Operating Costs (related to inspections, maintenance and repairs),
- Supporting investments (e.g. providing Strategic Spares and Condition Monitoring)

Our risk modelling calculated the risk at the start of the RIIO-T3 period, and then at the end of the RIIO-T3 period without any interventions, and progressively built up the impact from load and non-load projects from the baseline plan and the pipeline plan. Site rebuilds (listed on our pipeline tab) were also added for completeness.

5.1 Criticality, asset health and asset risk level at the start of RIIO-T3

The condition of assets across our network is stored in our asset management system. This incorporates information relating to asset health, inspection and maintenance and any activities to extend end of life. Using this information, we can provide details on asset health, asset risk and NARM monetarised risk[11].

Asset Criticality Distribution (Start of RIIO-T3)

- Asset criticality is based on the principles for NARM, applied across all assets. Lead assets follow NARM, while for non-lead we apply a similar principle allowing us to assess asset criticality across the five bands ranging from Very High to Low. Figure 9 indicates the distribution of assets into the five bands for our asset base at the start of RIIO-T3. Very high criticality relates to safety risks only, applicable to key substation assets. Most NARM (lead) assets have populations of high to very high criticality reflecting their importance in maintaining network availability.

Asset Health Distribution (Start of RIIO-T3)

- Our view of Asset health for network assets is based on our Annual Asset Health Review, assessing each asset individually and assigning it discrete ratings. As an asset ages, its health migrates towards high (80% EoL) and very high (95% EoL). The distribution of all assets is presented in Figure 10 for the end of RIIO-T2 / start of RIIO-T3.

[11] NARM only covers some (lead) assets, while our Common Risk Classification covers all assets.

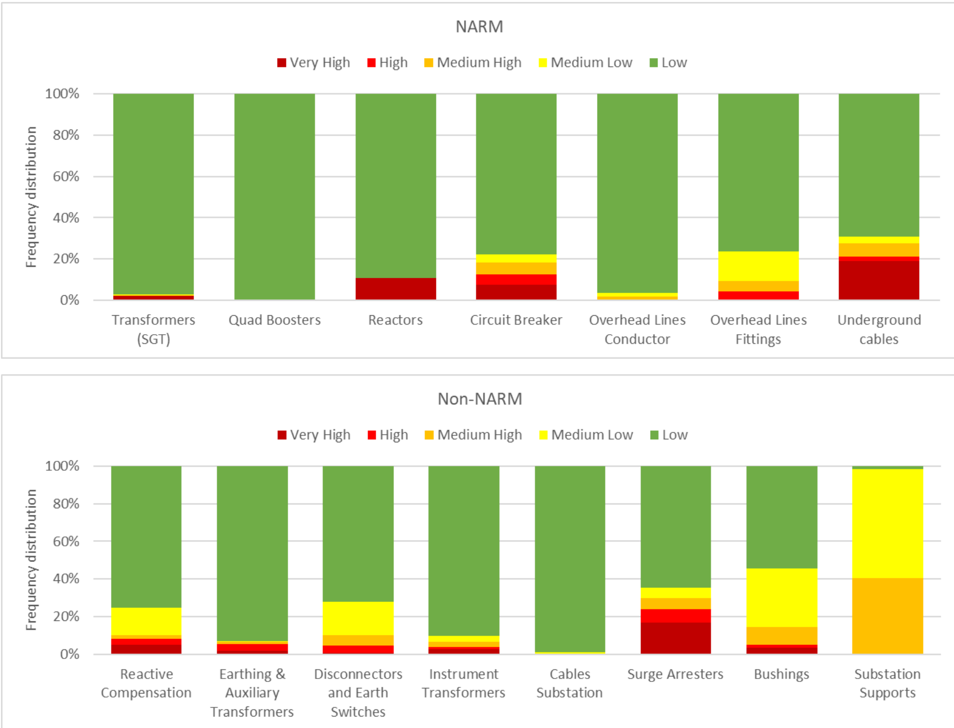
[redacted]

The percentage of assets that are in the high or very high asset health brackets are relatively low across most asset groups. This reflects the robust asset management to date and enables strong focus areas for onward investment justification. Please note that Substation Supports are a new addition to the asset risk measure in the last year and therefore have an immature asset health review process.

Asset Risk Distribution (Start of RIIO-T3)

- Using the common risk classification methodology outlined previously, we have calculated the asset risk across our assets. This is a combination of asset health and criticality.
- Asset Risk modifies the asset health based on criticality, highlighting assets that have both increased risk of reaching end-of-life and impact on operation of the network. Overall, there are a limited number of assets in the high and very high-risk category as indicated in Figure 11.

Figure 11: Estimated Asset Risk across our asset base (start of RIIO-T3)



5.2 Impact on risk of our proposed RIIO-T3 non-load related investment plan

Our 'End of Life' plan manages asset failure risk and SF_6 emissions through pro-active interventions (refurbishment, replacement, and disposal). We have used the following metrics from our asset management toolkit to devise our plan:

- Monetised Risk Values - R£m risk reduction for £m investment, presented from the start of T3 through to the end of T3.
- Common "Discrete" Risk Classifications (% of population across risk bands) movements over the same period.

We have forecast risk beyond RIIO-T3 and into the next price control period to understand 'peaks' and rapid changes in population deterioration, helping to inform what we need to address in RIIO-T3 to ensure we do not create an unmanageable spike in workload in future.

Our commitment

A1.2

Not allow the overall risk of our network to increase, as we deliver across multiple drivers (network growth, safety, resilience and environment)

5.2.1 Monetised Risk (Over RIIO-T3)

For our NARM assets, the total monetised risk is indicated Figure 12, calculated in accordance with NARM methodology and using the recently updated NARA tables[12]. Data is shown in R£m with the RIIO-T3 stable risk line shown in red. In summary:

- Across the RIIO-T3 period, our NARM model indicates a 97% increase in monetised risk with no intervention for our lead asset groups.

[12] https://www.nationalgrid.com/electricity-transmission/network-asset-risk-methodology-document-consultation

- We have assessed the impact of all plan elements that deliver interventions on existing assets for both non-load related and load-related investments, and both the baseline and pipeline elements of the plan.
- With all elements of the plan combined, these collectively stabilise the monetised risk to levels expected at the start of RIIO-T3 in line with our business plan target.
- Delivering only the baseline element of the plan (load- and non-load related) will give rise to a significant increase in monetised risk (46%, R£433.8m) across the period, demonstrating the need to access pipeline interventions to manage risk as we progress through RIIO-T3.
- An overview of Monetised Risk movement across RIIO-T3 for lead assets is shown in Table 16.

Figure 12: NARM Monetised Risk across our asset base (R£m)

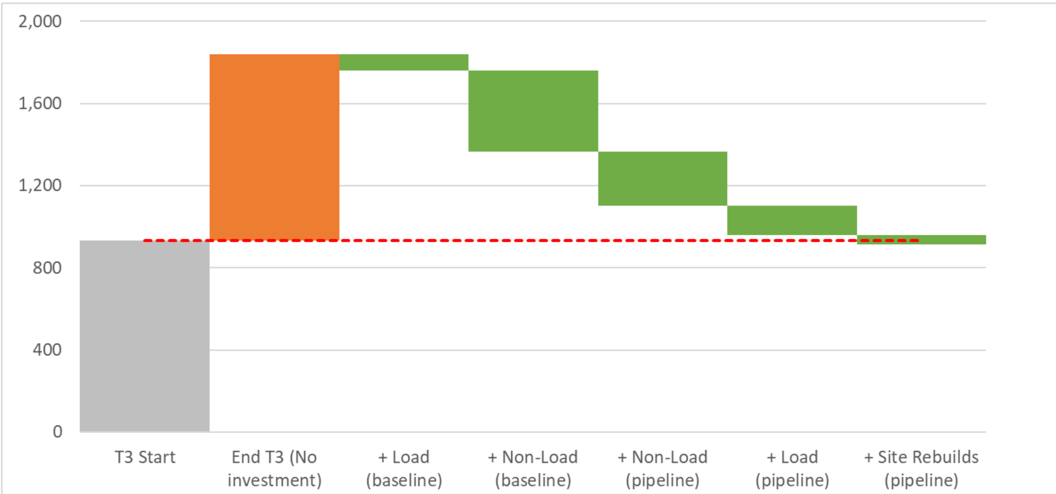


Table 16: Monetised Risk Across RIIO-T3 (R£m)

Lead Asset Group	T3 Start	End T3: No investment	+ Load (baseline)	+ Non load (baseline)	+Non-load (pipeline)	+ Load (pipeline)	+ Site Rebuilds (pipeline)
Circuit Breaker	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
OHL Conductor	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
OHL Fittings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Reactor	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transformer	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Underground Cable	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	**933.0**	**1840.0**	**1760.5**	**1366.8**	**1104.4**	**959.4**	**915.7**
Change in R£M	**0.0**	**907.0**	**827.5**	**433.8**	**171.4**	**26.4**	**-17.3**
Change %	**0%**	**97%**	**89%**	**46%**	**18%**	**3%**	**-2%**

5.3 Risk impacts of our RIIO-T3 plan (Lead Assets)

This section outlines the risk movement for all lead assets associated with the various elements of the overall business plan for both load and non-load risk impacts. The lead assets include:

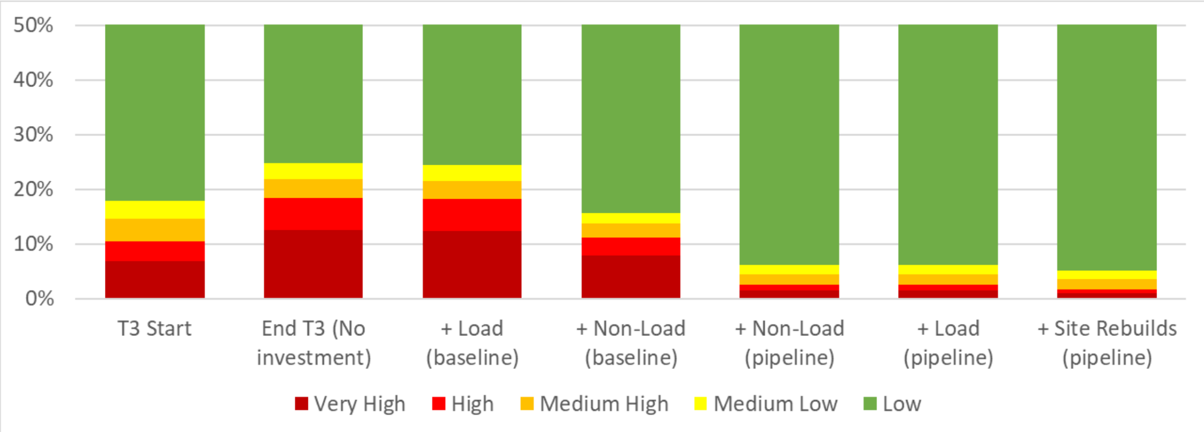
- Transformers (SGTs) (units)
- Quad Boosters (units)
- Reactors (units)
- Circuit Breaker (units)
- OHL Conductor (length in km)
- OHL Fittings (length in km)
- Underground cables (length in km)

These assets are included in the NARM modelling as well as our common discrete asset risk assessments. Both methods for assessing risk have been used in assessing interventions for our plan, ensuring we target the higher risk assets as outlined in the method summary in Section 0. When assessing discrete risk for these assets, we have split the asset categories into two groups: one is based on an asset count (Transformers, Quad Boosters, Reactors and Circuit Breakers) and the other is based on a length measure (km) (OHL Conductors, OHL Fittings and Underground cables). This is to ensure that length and count are separated.

5.3.1 Risk impacts of our RIIO-T3 plan (Lead Assets – Substations)

This section provides the risk summary for Transformers, Quad Boosters, Reactors and Circuit Breakers. Totals for these assets are based on asset count (number of units).

Figure 13: Common risk categories for lead assets (% of units)



Substation Commentary:

- Transformer and Reactor RIIO-T3 baseline candidates have clear indicators of end-of-life condition, but the wider population is not expected to deteriorate and add to this number of high and very high-risk assets within period. This is why the overall number of high and very high-risk assets falls over the period. There are a few clear individuals that present themselves as strong RIIO-T4 replacement candidates, driving a smaller pipeline plan as there is a higher individual spend regret and a need to see clearer signs of deterioration ahead of investment.
- The increase in high and very risk classifications for circuit breakers is driven by [redacted]
- There is a large volume of [redacted] with lower risks today that are expected to reach high or very high by the end of RIIO-T4. These are included in our RIIO-T3 plan so that we can proactively manage our network across both price control periods.

[redacted]

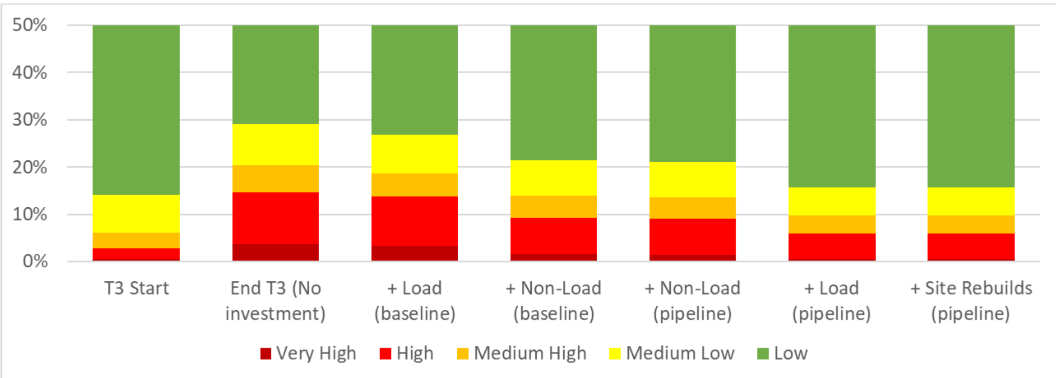
Table 17: High and Very High common risk category volumes for lead assets (units)

Asset Groups	T3 Start	End T3: No investment	+ Load (baseline)	+ Non load (baseline)	+Non-load (pipeline)	+ Load (pipeline)	+ Site Rebuilds (pipeline)
Circuit Breaker	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Quad Boosters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Reactors	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Transformers (SGT)	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change Volume	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change %	**0%**	**76%**	**73%**	**6%**	**-77%**	**-77%**	**-84%**

5.3.2 Risk impacts of our RIIO-T3 plan (Lead Assets – OHL and Cables)

This section provides the risk summary for OHL Conductors, OHL Fittings and Underground cables. Totals for these assets are based on length (km).

Figure 15: Common risk categories for lead assets (% km)



[redacted]

OHL commentary:

- There is a projected increase in OHL conductor risk but, due to the potential within this asset category for further life extensions, this projected rise in risk is manageable.
- All conductor candidates nominated for a RIIO-T3 intervention meet a strict condition threshold based on physical samples from those routes. The sizing of the RIIO-T3 programme has been completed using a range of replacement run-rate projections [redacted] to ensure no undeliverable peaks in future workload.
- There is a high degree of interaction between load-related projects and the OHL fittings programme. If all the load-related projects (Baseline and Pipeline) come to fruition, we return close to RIIO-T2 risk levels without any separate asset health interventions.

Cables commentary:

- Most of the underground cables non-load plan delivers within the RIIO-T4 period due to the length of time required to develop and deliver these types of projects (RIIO-T4 delivery marked as RIIO-T3 pipeline for pre-construction funding).
- Risk levels return to between RIIO-T1 and -T2 levels by the end of RIIO-T4 based on baseline and pipeline projects.

Table 18: High and Very High common risk category volumes for lead assets (km)

Asset Groups	T3 Start	End T3: No investment	+ Load (baseline)	+ Non load (baseline)	+Non-load (pipeline)	+ Load (pipeline)	+ Site Rebuilds (pipeline)
Underground cables	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
OHL Fittings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
OHL Conductor	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change Volume	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change %	**0%**	**441%**	**75%**	**48%**	**67%**	**36%**	**54%**

5.4 Common discrete asset risk over RIIO-T3 (Non-Lead Assets)

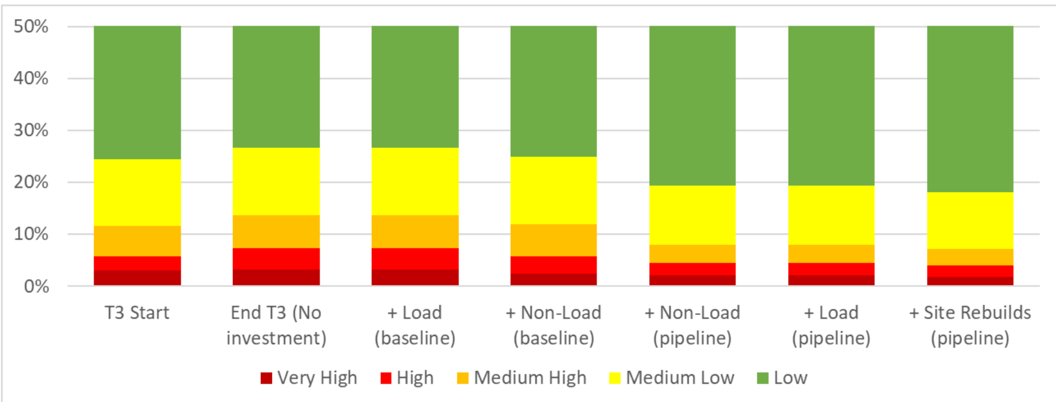
This section outlines the risk movement for all non-lead assets associated with the various elements of the overall business plan for both load and non-load risk impacts.

The non-lead assets are:

- Bushings
- Substation Cables
- Disconnectors and Earth Switches
- Earthing and Auxiliary Transformers
- Protection & Control
- Instrument Transformers
- Reactive Compensation
- Substation Supports
- Surge Arresters

These assets are not included in NARM modelling. These assets are included in our common discrete asset risk assessments which have been used to ensure we target the higher risk assets as outlined in the method summary in Section 0. Totals for these assets are based on volume (number of units).

Figure 17: Common risk categories for non-lead assets (% units)



Non-lead Asset Risk Commentary:

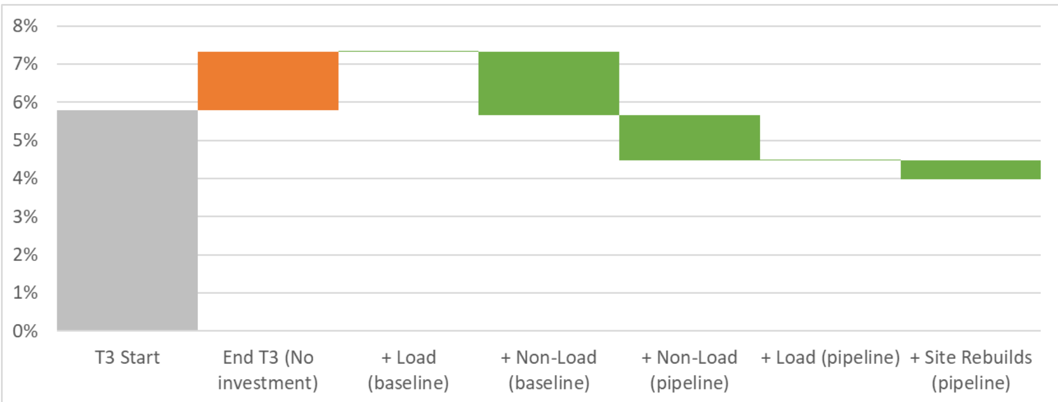
- This is a diverse group of assets encompassing high volume, low complexity assets such as disconnectors and instrument transformers, to through-wall bushings (increasing in complexity because of their proximity issues and bespoke designs and low volume), and high expenditure Flexible Alternating Current Transmission System (FACTS) devices.
- For Bushings (through-wall and floor), the risk will increase if only the baseline plan is implemented. [redacted]

- For Substation Cables and Earthing and Auxiliary Transformers, a small number of assets has been included in our baseline plan where there are clear indicators of poor condition.
- For Disconnectors and Earth Switches, the focus of the replacement plans is assets with condition and technical limitation issues categorised as high or very high risk. The pipeline plan investment contains some assets where we are still developing specifications but mostly assets that are currently RIIO-T4 priorities. We plan to manage the longer-term risk position over the RIIO-T3 and subsequent price control period and will draw interventions from our pipeline plan where system access and resources can be aligned in RIIO-T3.
- For Instrument Transformers, the focus of investment is on three-phase sets with at least one phase in poor individual condition at high or very high risk. We have also included assets that belong to a family with a design susceptible to failure. This sees the risk fall as these families are removed. Our pipeline plan enables management of longer term, RIIO-T4 risk in RIIO-T3 where system access allows. Any asset intervention not completed will form part of our RIIO-T4 plan.
- For Reactive Compensation [redacted] baseline projects cover assets where there is no longer a system need and will therefore be dismantled. Our pipeline plan includes replacements [redacted] where system need, technology type and location require further study. There is an increased focus from NESO on the availability of voltage control equipment (capacitive) after a fall in its use in the 2010s. More work will be required to reduce the current risk level and bring more assets back into service.
- Substation Supports presently have an immature asset health review process and are a new addition to the asset risk measure in the last year. We expect the risk in this category to grow over the next 10 to 15 years based on the levels of corrosion, wear and insulator degradation evidenced in the population. Our RIIO-T3 baseline plan features [redacted]. There is a high volume of these assets in our pipeline plan; the intention is to build a track record of delivering this type of replacement work at scale, which we have never done before, prior to initiating any requests to fund pipeline plan interventions.
- The risk associated with Surge Arresters is expected to grow based on current life expectations but there isn't clear evidence of degradation in most of the population[13]. The RIIO-T3 plan focuses on a type of Surge Arrester [redacted] based on numerous condition assessments.

Assets that do not feature in the above risk measures but have health measures developed:

- Light Current (Protection and Control) – our plan focuses on families that require replacement [redacted]
- LVAC and Standby Generation – our plan focuses on assets measured to be in poor condition and/or obsolete.

Figure 18: Change in High and Very High common risk categories for non-lead assets (%)



[13] Based on routine thermography and destructive assessment of a sample of assets replaced in RIIO-T2.

Table 19: High and Very High common risk category volumes for non-lead assets (units)

Asset Groups	T3 Start	End T3: No investment	+ Load (baseline)	+ Non load (baseline)	+Non-load (pipeline)	+ Load (pipeline)	+ Site Rebuilds (pipeline)
Bushings	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Substation Cables	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Disconnectors and Earth Switches	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Earthing & Auxiliary Transformers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Instrument Transformers	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Reactive Compensation	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Substation Supports	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Surge Arresters	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Total	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change Volume	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Change %	**0%**	**27%**	**27%**	**-2%**	**-23%**	**-23%**	**-31%**

5.5 Overall Impact of our plan on Risk (Monetised and Common)

The overall impact of our RIIO-T3 plan on asset risk is summarised in Figure 19, split for lead assets by substation assets and linear assets (OHL and cables). Non-lead assets are shown for comparison, although monetised risk does not apply for these assets.

Monetised Risk:

- Overall Monetised risk at the end of RIIO-T3 is in alignment with that expected at the start (-2%), although Substation risk is slightly higher, and linear assets lower based on delivery of both baseline and pipeline.

Common Discrete Risk[14]:

- Overall substation asset population risk (for assets classified as high and very risk) are maintained at the level seen at the start of RIIO-T3 within the baseline plan alone. Pipeline plan interventions further reduce the level of high and very assets risk substation assets.
- For linear asset population risk, the baseline plan deals with the assets most at risk. The pipeline further reduces the number of high and very high-risk assets but not back to the level at the start of the RIIO-T3 period. This results in a higher risk profile heading into RIIO-T4 but is expected to be managed given the timing of projects and their delivery dates, as well as exploring the potential for asset life extensions.

Long-Term Risk Benefit:

- The Long-term Risk Benefit (LTRB) for each asset intervention demonstrates the cumulative monetised risk reduction for a defined period of time. This measure of benefit ensures we focus on asset interventions that deliver the best value in the long term for consumers. Our baseline

[14] Comparison across assets groups requires a method to group assets. For simplicity, this has been calculated summing across units (for substations) and by length (for linear assets, i.e. OHL and cables).

non-load related plan delivers a total Long-Term Risk Benefit of R£25,622m (A1 and A3 value combined) as shown in Figure 19 and Table 20.

Figure 19: Summary of our plan impact on Asset Risk Failure

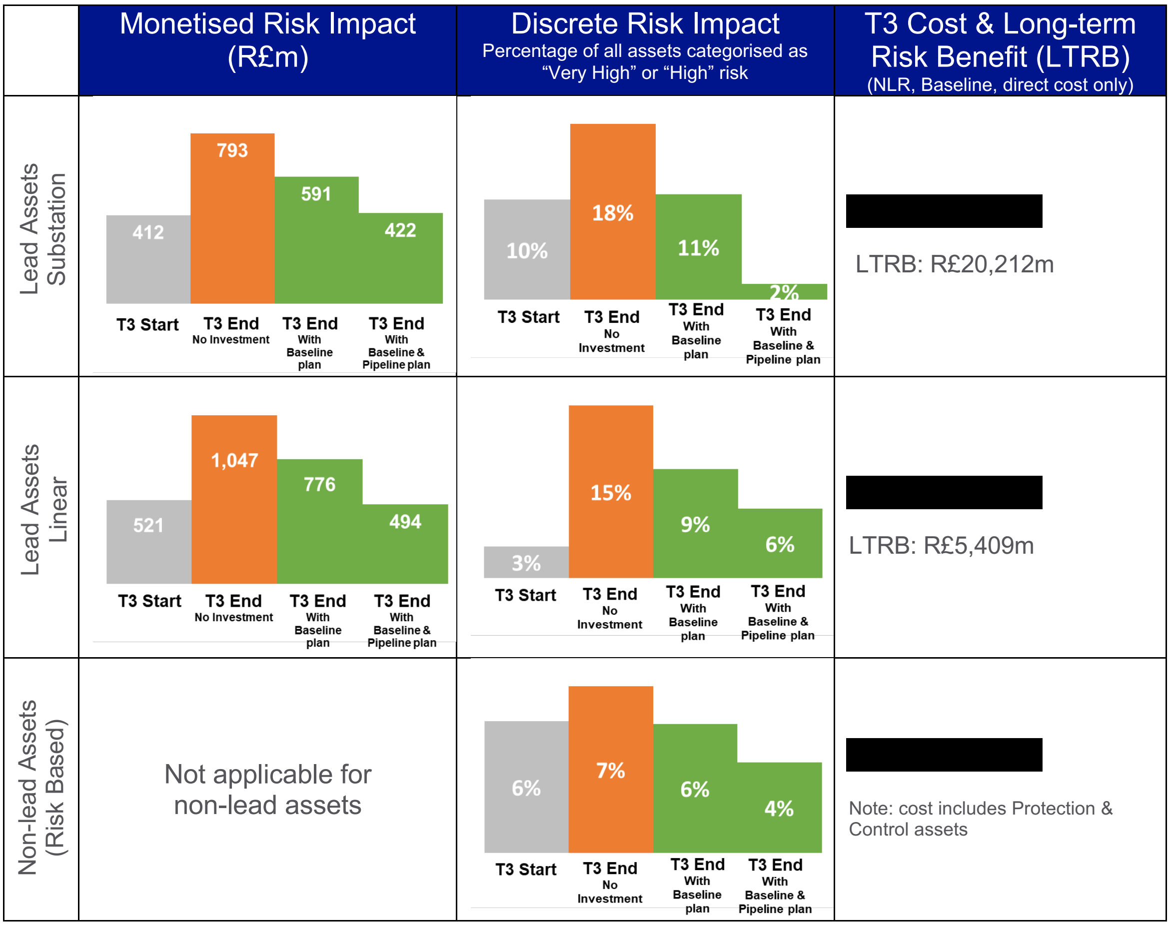


Table 20: Long-term risk benefits for all NLR NARM assets

	RIIO-T3 Output							
Funding Category	**All**		**A1**		**A2**		**A3**	
	Volume	LTRB R£m	Volume	LTRB R£m	Volume	LTRB R£m	Volume	LTRB R£m
Circuit Breaker	[redacted]	9,647.8	[redacted]	9,448.9	[redacted]	198.8	[redacted]	0.0
OHL Conductor	[redacted]	10,277.9	[redacted]	4,412.9	[redacted]	5,865.1	[redacted]	0.0
OHL Fittings	[redacted]	9,202.5	[redacted]	6,350.7	[redacted]	2,851.8	[redacted]	0.0
OHL Tower	[redacted]	0.0	[redacted]	0.0	[redacted]	0.0	[redacted]	0.0
Reactor	[redacted]	1,892.7	[redacted]	1,892.7	[redacted]	0.0	[redacted]	0.0
Transformer	[redacted]	2,878.1	[redacted]	2,613.6	[redacted]	264.4	[redacted]	0.0
Underground Cable	[redacted]	1,364.4	[redacted]	0.0	[redacted]	461.4	[redacted]	903.0
Grand Total	[redacted]	**35,263.4**	[redacted]	**24,718.8**	[redacted]	**9,641.6**	[redacted]	**903.0**

6 Credibility and Deliverability of Our Plan

As noted at the start of the annex, we have a number of key success measures we are targeting for the RIIO-T3 period. We have discussed:

- Enhancing our asset management approach in Section 0
- Network reliability and energy not supplied targets in Section 0
- Reduction of SF_6 emissions in Section 0
- Our asset risk framework and impact of the RIIO-T3 plan in Sections 0 and 5

We are prioritising baseline investment where the risk from failure (end of life score and criticality) is high and where we have confidence in the scope and cost of deliverable work. We have also identified interventions where risk is expected to be high by the end of RIIO-T4, so that we can proactively manage our network across both price control periods. This approach ensures that we are managing short- and longer-term risks efficiently and with certainty, in line with the feedback we have received from our customers and stakeholders.

'Our operations function is accountable for safely managing the asset health and compliance of our transmission assets, operational sites and associated equipment. To achieve our excellent levels of performance requires a combination of planning and prioritisation in both long- and short-term timescales and effective management of resources and underlying competence and capability throughout our operational workforce. An effective asset management strategy underpins the combination of our inspection and maintenance activities, defect resolution and capital asset health interventions. This ensures that we take the appropriate action to deliver the critical reliability and resilience service levels that our customers expect.

The most significant and evolving risk to meeting this expectation is balancing our resource and system access requirements that we need to deliver our asset management strategy driven plan against the other work required to meet our statutory and policy defined compliance levels, whilst supporting network development, delivering customer connections and enabling our physical and cyber security programmes. With the level of customer connection and network development at previously unseen levels, this is becoming increasingly challenging, even when we have included increasing our level of resource through our strategic workforce plan. With system access, resources and supply chain capability at an increasing premium, the need for flexibility within both our asset management strategy and the process for delivering against it is critical.

Whilst we must continue to ensure that the highest risk issues are addressed, there is an opportunity to flex our asset level decisions to meet our overall strategy outcomes. Fixing specific assets to specific timescales for intervention will be increasingly counterproductive and undeliverable as the drivers of customer connection requirements and network development delivery increase even further.'

– Paul Gallagher, Operations Director

In addition to this annex, additional information is provided in the EJPs linked to asset management (listed in Table 2). Our portfolio EJP for lead assets (AH - T3 EJP Portfolio) has been developed bottom up and is based on several key criteria via a gated decision process as outlined in Section 0. This approach gives certainty that we are tackling the right assets for the right reasons. Individual Atypical EJPs contain a separate Cost Benefit Analysis (CBA) relevant to the specific intervention plans proposed to demonstrate the most cost-effective option has been chosen to justify the investment.

6.1 Confidence in our Plan

We have confidence in our baseline plan [redacted] Irrespective of what happens in the load-related plan, these assets will still need to be intervened on. We continue to enable the supply of energy, keep our assets and people safe, and protect the environment from our assets. To deliver in these areas, we:

- Manage asset condition to reduce the likelihood of safety, environmental and energy supply consequences from asset failures.
- Manage our speed of recovery (e.g. winter preparedness to increase resilience) to decrease the environmental and energy supply consequences of asset failures.

Asset health activity is an ongoing programme of investment. We have taken care to ensure our baseline plan is robust, evidenced and data driven. Asset condition is a constantly evolving picture and therefore it is important that we recognise this. Our pipeline plan captures less certain projects that will require reassessment on an ongoing basis as new information or opportunities become available. Together, our baseline and pipeline plans ensure we have provision to cover expected RIIO-T3 asset health investments.

Overall, our combined non-load related cost profile (baseline + pipeline) for the RIIO-T3 period is presented below.

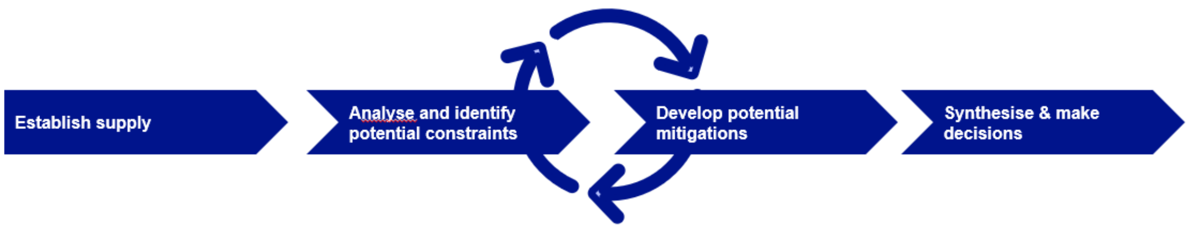
[redacted]

6.2 Confidence in Delivery

To ensure our asset health plan is delivered, we need to address issues arising from across our supply chain (e.g. a delay in the arrival of key assets when they are needed), and ensure we have the workforce in place to inspect, monitor, repair and maintain our assets, and refurbish and replace as required. To address this challenge, our assessment of the deliverability of our RIIO-T3 business plan focussed on three potential constraints: system access, workforce and supply chain.

We discuss our transformation plans for the workforce and supply chain in our A03: Workforce and Supply Chain Resilience Strategy annex. We discuss system access in our A08: ET Load Strategy annex, detailing our iterative assessment process (see Figure 21) that combines load and non-load projects and system access constraints that need to be mitigated.

Figure 21: Iterative process used to analyse deliverability



Our baseline plan for RIIO-T3 contains our high confidence interventions, and has volume levels that are comparable to or less than the volumes forecast to be delivered in RIIO-T2. We anticipate that a high proportion of the pipeline plan will need to be delivered to manage asset risk but, given the lower confidence (with respect to cost and timing of delivery), these investments have been appropriately included in our pipeline plan.

Figure 22 shows that most of our baseline plan (and also in some cases the total pipeline plan) is well within the volumes that we are delivering in RIIO-T2 which supports our confidence in delivery.

[redacted]

SGT volumes are lower because of a plateauing in the number of assets expected to reach 'high' or 'very high' risk. There are not enough clear candidates based on the condition we can measure today. With higher cost and resource intensity for these assets, we have placed a smaller volume in the plan. There is also some interaction with the load-related plan, which will have a secondary benefit of contributing to replacement run rates[15].

Conversely, Circuit Breaker intervention volumes have increased because [redacted] We have a higher volume of work because we have a higher population of assets belonging to the same design family. We can view our plan to the end of T4 with more confidence in the overall volume of work required to be achieved. Our pipeline includes that forward view to T4, giving us the facility to manage system access to complete these interventions over a longer period.

Reactor volumes are similar to RIIO-T2, with each individual intervention driven by specific condition assessment information. Pipeline investments which are less certain are located at substations that are being considered for a major rebuild, therefore the size and location of a replacement reactor is dependent on optioneering of the wider site investment.

Our non-load programme for OHL conductor and fittings is much smaller than in RIIO-T2 because there is far more interaction with the load-related plan, i.e. OHL routes are being uprated rather than undergoing a modern equivalent asset replacement.

The underground cables volume to be delivered in RIIO-T3 is similar to RIIO-T2, ramping up to a larger volume of projects which will complete in the next price control period.

[15] 'Run rates' refer to the average annual volume of replacement required to keep the number of assets reaching a state requiring replacement manageable over the long term.

Other high-volume substation asset groups (e.g. disconnectors, earth switches and instrument transformers) see a reduction in volume where we have prioritised assets with individual condition and noted family design vulnerabilities (to inform our pipeline log).

In reactive compensation, there is greater focus on [redacted] as system need rapidly evolves. We are disposing of assets where there is no longer a requirement for them, and are undertaking further studies to identify the location and technologies for future assets.

Protection and Control volumes have decreased [redacted]

We have noted the increasing difficulty in forecasting load-related interventions at asset level but, when combined with the optionality included in our pipeline plans, we are confident we have the flexibility to meet our ambition of managing network risk in a network growth phase. (Note: The uncertainty mechanisms for our pipeline are presented in Appendix B)

6.3 Confidence in Managing Outages

We have entered a growth phase for electricity transmission, whereby it is critical we manage the transition of our ageing infrastructure to enable our contribution to a decarbonised network. We recognise the ongoing need to balance the cost, risk and performance of our assets to ensure consumers continue to get value from their bills whilst we enable this energy transition. We will have to make decisions in an agile manner by responding to the latest insight on our assets. As we grow our capabilities during RIIO-T3, we will use whole lifecycle costing to enhance our decision-making framework to demonstrate that we make good choices for all our asset related activities ensuring we are doing the right work, at the right time.

- Winter outages: As we deliver an increasing number of interventions, we are maintaining our policy of reducing unplanned outages during winter, increasing the resilience of the network for consumers by making the network as available as possible. It is essential that we manage our network in this way during the winter period as there is a greater reliance on electricity during winter (for heating, and light when there is less daylight) and the system has the potential to see more stress (e.g. storms, ice loading). Making the network more available means we can 'accommodate' unplanned events whilst minimising the impact on overall reliability.
- Unplanned Outages and Recovery: We have a proven track record in responding to events, by ensuring that our network recovers quickly and is winter and storm prepared. We are delivering our RIIO-T2 plan in a way that has ensured that the network is available over the winter period so that it is resilient to storms, and we will continue to do that. We are performing more load-related investment year on year whilst maintaining the resilience of the network. Although our asset base is ageing, we are effectively managing risk, observing fewer unplanned outages year on year.
- Coordination with load plans: To deliver work safely on the transmission system, we need to take parts of it out of service to allow us to physically access and connect to the existing network. However, as the network must always provide electricity to meet demand, access to the network must be limited to ensure it can continue to be operated within the parameters set by the Security and Quality of Supply Standards (SQSS).

To assess system access, we gathered the outage requirements associated with the investments included in our RIIO-T3 business plan for comparison against system access availability. We used an optimisation tool [redacted] to analyse the business plan outage requirements and optimise delivery though 'bundling' work that can be conducted during the same outage so that the opportunity is maximised.[16] Further detail on managing system access and interaction with our load plan is provide in our A08: ET Load Strategy annex.

[16] Note that this is not 'booking' the system access with NESO, but viability testing of the outage levels.

‘Demand for work on the OHL network is increasing significantly over the course of the next regulatory period, and our ability to deliver this work and deliver it safely is absolutely key. Recognising the execution of work is dependent on having a skilled and competent internal workforce, but also a healthy and compliant supply chain consisting of key skills and competence, I have been working with the supply chain to ensure we can grow the skills we need across the OHL sector to safely deliver this work. This collaboration falls into three key areas – safety, training and attraction:

- *Safety - Cross-sector standardisation of working procedures will allow us to standardise our training of all UK lineworkers, removing opportunity for compliance to working practice being unique to each employer. We are working as a sector with* [redacted] *to develop accredited and standardised products that will be recognised and accredited by Skills England.*
- *Training - Consistency of working practice opens up the opportunity for training collaboration. Discussions are ongoing with supply chain partners about sharing of technical training and available training facilities. Our intention is to ensure we have shared access to training facilities across the collective, understanding the changing technologies and the need to invest in these facilities to accommodate the required scaling of overhead line skills.*
- *Attraction - We need more entrants to the sector, and we need to raise awareness of the career opportunities it can bring and remove barriers to entry. We have an OHL-specific campaign with our GridforGood initiative, which we are now broadening out to be sector-wide, where we are working collaboratively to improve social mobility. We are creating a new entry-level role, removing GCSEs as a barrier to entry, which will allow people to train and then develop onto our apprenticeship scheme.’*

– Kathryn Fairhurst, Overhead Lines Operations Director

Appendices

Appendix A: Approach for calibration of Energy Not Supplied ODI for RIIO-T3

The Energy Not Supplied (ENS) financial Output Delivery Incentive (ODI) provides an incentive to maintain, and where cost effective improve, reliability. It encourages management of short-term operational risk by driving actions that reduce both the likelihood and length of a loss of supply resulting from faults on the network.

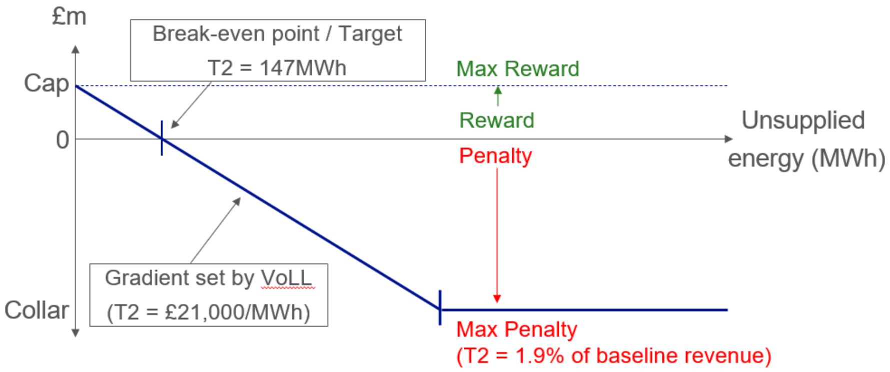
Maintaining the health of our assets is a core outcome that we deliver. Allowances provided by a price control framework allow us to recover the costs of maintaining our assets to manage risks of deterioration that could ultimately lead to faults. This incentive seeks to reward actions that improve on the high level of reliability expected as 'business as usual' and penalise where reliability falls short.

Given the high level of reliability expected as business as usual, the scope for earning a financial reward is limited, whereas the scale of penalty that could be incurred is material. The incentive is therefore skewed towards penalising poor performance over rewarding improving performance beyond what is expected, and is highly sensitive to a single large event. Given the number of near misses we have experienced in the past, this sensitivity could influence and restrict our ability to optimise work during planned outages where the impact from unplanned outages is increased.

ENS structure

There are four aspects to the incentive:

- Target: sets the break-even point of the incentive, measured in mega-Watt hours (MWh) and has previously been based on historic performance
- Cap / Collar: sets the maximum reward / penalty for the ODI, with the collar currently set to 1.9% of ex-ante revenue (and cap at c. 1/30 of this).
- VoLL: is used to set the gradient of the incentive (i.e. how fast you move from risk to reward, set by Ofgem. (For RIIO-T2, this was £21,000/MWh.)
- Exemptions: certain events are exempt from the target / incentive as they are out of the control of the TO. This list is set by Ofgem.



Outlook for future ENS calibration

We understand that one of consumers' top priorities is ensuring secure and resilient supplies of energy and as part of this we must maintain a highly reliable network, minimising periods of loss of supply. At the same time, stakeholders (including Government and Ofgem) are expecting us to deliver an unprecedented expansion of the electricity transmission system during the RIIO-T3 period. As we have described throughout our business plan, this will deliver significant value for consumers. Achieving this expansion of the system will require an increase in the number of circuit outages as we deliver our investments.

The ENS incentive needs careful calibration so that it reflects the RIIO-T3 operating environment, for it to continue to strike the right balance and achieve the best outcomes for consumers; Ofgem needs to take account of consumer benefits that will come from expansion of the transmission system.

The calibration of the ENS incentive influences Transmission Owners' actions, in particular because there is a significant downside risk where large penalties can be easily triggered through single events. As such, setting the break-even point at too low a level would have the unintended consequence of driving a risk appetite amongst Transmission Owners which hinders the delivery of the work planned to expand the capacity of the network.

The break-even point is already set at a very low level (147 MWh per year), which is the equivalent of charging ~2,500 electric vehicles. Meeting this will be more challenging than in the past given the increase in requirements for system outages.

The impact of faults will also change as society changes with the decarbonisation of heat and transport through electrification. For example, historically a fault overnight could have had a low impact however, with the rise in EV smart charging, this is a time when you can have relatively high domestic load. Grid Supply Points and distribution networks are also expanding. These compounding effects reduce the likelihood of a Distribution Network Operator having the ability to transfer demand in their networks, which increases the risk exposure to Transmission Owners to the ENS incentive.

In addition, there are several changes which have been endorsed in principle by Government through the Transmission Acceleration Action Plan (TAAP) that are designed to support delivery of network expansion[17]. These will affect the way in which the system is operated and risks relevant for the design of the ENS incentive. These reforms are being developed by industry and the details are not yet known.

One example of this is taking more system access in the winter to carry out work, when demand and therefore potential downside risk is greatest. We support these changes as important dependencies for us to be able to deliver our whole plan, but they may affect network risk. When the detail of the TAAP becomes clear, it is likely to impact planning assumptions for our network, how we operate our network and the level of risk we take, resulting in a situation different from the past. This could result in occasions where we operate our network differently, should changes impact design standards set in the Security and Quality of Supply Standard (SQSS).

We support the incentive rate being set in line with the value of lost load (VoLL), to reflect an estimate of the benefit that having a reliable service has to an average consumer. This is a figure set by Ofgem and is currently £21,000 per MWh (in 2018/19 prices) but is subject to review by Ofgem in 2025. This will affect the risk exposure if it is retrospectively applied to the ENS ODI for RIIO-T3. The VoLL has a significant impact on how networks will respond to the ENS incentive: if the value is increased, there is likely to be increased sensitivity amongst Transmission Owners to the incentive.

Together, these factors mean that it would be premature to fully determine the design of the ENS now. We would like to work with Ofgem in the coming months on calibration of the incentive.

Setting a break-even point for RIIO-T3

To support this engagement, we have made an initial proposal in our business plan as a basis for these discussions:

- *The break-even methodology needs to reflect the past and the future:* the target methodology for RIIO-T2 was based on historical performance. Given the significant difference in type and volume of work in RIIO-T3, we believe both historical performance and future expansion should be considered. Where historic performance is being considered, it needs to cover a sufficient time series to be representative.
- *As energy demand increases, the incentive will intrinsically become more powerful:* unplanned outages, while infrequent, have the potential to be large. As the network expands and greater demand is met, the total energy not supplied would increase for the same or similar event of today. Ofgem needs to take this into account when making calibration decisions.
- *Ultimately, the final decision on the break-even point needs to be taken alongside all calibration decisions (i.e. cap and collar, VoLL and exemptions).* We propose that the financial exposure should remain at the same level with cap and collar in place to manage the overall risk and reward balance of the price control. This would also limit the financial impact of actions that affect performance but are beyond our reasonable control. The economic value of this incentive should be preserved over the price control period by adjusting for inflation.

[17] https://www.gov.uk/government/publications/electricity-networks-transmission-acceleration-action-plan

Reflecting the ambitious approach to our RIIO-T3 business plan, we have proposed a break-even of 135 MWh for each year of RIIO-T3. This is a stretching target compared with the RIIO-T2 break-even point of 147 MWh given the network changes discussed above. We have used the following methodology to set this break-even point:

- Reviewed historical performance and, using a similar method to RIIO-T2, calculated a weighted average of past performance as 93 MWh. This is based on 50% weighting to TPCR4, 25% weighting to RIIO-T2 and 25% weighting to the first three years of RIIO-T3.
- Applied Future Energy Scenarios 2024 data on installed electricity supply capacity as a proxy for the growing complexity of the network and the impact this will have on maintaining the current level of performance. Comparing average installed electricity supply capacity over RIIO-T2 years (124 MW) against RIIO-T3 years (181 MW) results in a 46% uplift to be applied to the average historical performance. This results in a target of 135 MWh.

Table 21 shows the evolution of ENS since the introduction of the RIIO framework.

Table 21: ENS Targets over time

Period	ENS (MWh)	Comments
RIIO-T1	316	This reflects the prevailing level of outages at the time. It was effective in improving Transmission Owner performance in reducing energy not supplied.
RIIO-T2	147	Target set at 147MWh, which although met to date has been challenging at times with periods of reduced redundancy across the network that could have resulted in significant ENS events.
RIIO-T3 (proposed)	135	Higher requirement for planned outages given load plan. Need to optimise outages and manage for increased productivity.

Our proposed change in the break-even point reflects the following factors:

- We are striving to continually improve our performance which means there is limited potential to go further than the current 147 MWh. We have factored in recent good performance in adding stretch to the current target. Our network will need to transmit an increasing volume of electricity over the price control period from a more diverse mix of supply locations. This carries with it additional complexity in system and outage planning. This means that meeting the existing target will already be an additional stretch compared to RIIO-T2.
- A recognition that we currently have a very high level of reliability and therefore the scope to cost effectively improve further is limited and should be reflected in the target set. Reliability on our network in 2023/24 was 99.999998%.
- An appreciation that our network is getting more complex and there are risks of unintended consequences for the delivery of Transmission Owners' RIIO-T3 plans from any increases to the break-even point. They need to be carefully considered and will need to be revisited "in the round" when there is more certainty on VoLL and when the caps and collars and exemptions are set.

We have assumed in developing this position that the exceptions and exclusions that currently apply continue, i.e. the definitions of Incentivised Loss of Supply Event and ENS Exceptional Event in the Licence are not changed or narrowed. In addition, there may need to be additional exceptions once conclusions from the TAAP are clearer and the risks can be reassessed. If events that occur when our network is requested to be operated outside of design standards set in the Security and Quality of Supply Standard (SQSS), these should always be excluded.

Appendix B: Non-Load Related Uncertainty Mechanisms for RIIO-T3

Uncertainty mechanisms are needed to provide funding during the RIIO-T3 period for projects submitted in our non-load related pipeline and therefore not considered for baseline funding. We believe that a mix of NARM, volume drivers and a non-load related re-opener could adjust our allowances appropriately, but the design of these mechanisms has yet to be confirmed.

- NARM: For lead asset volume changes covered by NARM, the framework allows over-delivery as well as adjusting allowances for under-delivery. However, the RIIO-T2 mechanism needs to change to simplify the process due to the Unit Cost Ratio approach not being cost-reflective.
- Volume driver for non-NARM assets: Standard, repeatable interventions to be funded through a symmetrical volume driver that allows volume increases as well as adjusting allowances to reflect volume decreases. The majority of these are aligned with existing RIIO-T2 volume drivers.
- Non-load related re-opener: Site or asset-specific solutions not covered by the above would need to be funded through a non-load-related reopener. This is needed when the costs of the project are bespoke (not suitably represented by a volume driver) and/or high value.

A summary of the activity outlined in our pipeline log (BPDT tab '10.5 ET Pipeline Log') and a potential mechanism is outlined Table 22.

Table 22: Potential Mechanism for Pipeline Plan Investment

Area	Potential Mechanism	Indicative Gross Cost (£m)
Bay Assets (Disconnectors, Earth Switches and Surge Arresters)	Volume Driver	[redacted]
Bushings	NLR Reopener	[redacted]
Cable	NLR Reopener	[redacted]
Substation Cables	NLR Reopener	[redacted]
Circuit Breakers	NARM	[redacted]
Earthing & Auxiliary Transformers	Volume driver	[redacted]
Instrument Transformers	Volume driver	[redacted]
Reactive Compensation	NLR Reopener	[redacted]
Shunt Reactors	NARM	[redacted]
SF_6	NLR Reopener	[redacted]
Substation Auxiliary	NLR Reopener	[redacted]
Substation Supports	NLR Reopener	[redacted]
SGTs	NARM	[redacted]
Protection & Control	Volume Driver	[redacted]
[redacted]	NLR Reopener	[redacted]
[redacted]	NLR Reopener	[redacted]
[redacted]	NLR Reopener	[redacted]
Total		**2,020.4**

Appendix C: List of Intervention Criteria

Table 23: Lead asset intervention criteria

Asset Type	Individual Condition Assessments Possible	Design Family Assessments of Expected Condition Required (Hidden Failure Modes)	Obsolescence
Transformers[18]	**Primary driver for T3 interventions** • In-service Oil Analysis – presence of furanic compounds & dissolved, combustible gases	• Assets are dismantled and forensically assessed when replaced. The learning is applied to the interpretation of oil analysis results of assets from the same family.	• Tap changer obsolescence impacts a smaller part of the overall health score.
Circuit Breakers	• Duty – Number of Operations and accumulated Fault Current • SF_6 Top Ups identify assets with significant SF_6 leaks.	**Primary driver for most T3 interventions** • Learnings within the design family discovered by inspection, maintenance, refurbishment, and in-service failure. Assessment of 'End of Life' state is based on condition we expect to encounter in future inspection, maintenance or in-service failure.	• Significant bearing on the families prioritised for replacement in RIIO-T3 (identified in 'AH - T3 EJP Portfolio'). • Covers both technical and legislative obsolescence.
Overhead Lines Conductor and Fittings	**Primary driver for T3 interventions** • Physical samples of OHL conductor taken under circuit outage from clamping positions to show the impact of spacer and damper wear and corrosion • OHL Fittings are assessed with high-definition cameras in-service (this forms the vast majority of condition data) and more limited out-of-service condition assessment such as insulator resistance testing.	• The 'run rate' of replacement required for different families of conductor has been determined, [redacted] 'Run rate' refers to amount that should be replaced each year to avoid a large population being left until after expected wear out range. However, this view is continually informed by condition assessment. • Conductor sample and corrosion survey evidence collected over time can lead to asset life extensions for different families of conductor. This impacts part of the health score for OHL conductor that is superseded by individual condition assessment. It has the biggest influence on the forecast risk measurement. • Preliminary OHL conductor and fittings assessment (in the absence of route-specific condition data) is based on time in service versus expected life of the design family. These scores are capped so that only route-specific condition evidence can drive the highest scores and investment priorities.	• Not relevant to this asset type
Underground Cables	**Primary driver for T3 interventions** • Faults & defects including oil loss in the last ten years. Tape corrosion,	• A multiplier for the design family and its susceptibility to the issues scored in individual assessment is applied to the individual assessment score.	• Not relevant to this asset type (with the exception of cable sealing ends – but these do not inform

[18] Includes Supergrid Transformers (SGTs) and Quad Boosters, Series and Shunt Reactors (and relevant to Earthing and Auxiliary Transformers)

Asset Type	Individual Condition Assessments Possible	Design Family Assessments of Expected Condition Required (Hidden Failure Modes)	Obsolescence
	oversheath insulation & laying environment also captured		decision to replace the cable itself, only its terminations)

Table 24: Non-lead asset intervention criteria

Supporting Evidence	Asset Types
Individual Condition Assessments Possible	• **Compensation -** [redacted] this is driven largely by equipment that has been 'faulted' and is out of service. Condition of multiple component assemblies through external visual assessment or out-of-service testing - capacitor units, discharge resistors, reactors, thyristors, harmonic filters and cooling systems. • **Bushings and Instrument Transformers** – Oil analysis and SF_6 inventory (SF_6-filled ITs are being replaced in RIIO-[redacted] • **Disconnectors and Earth Switches** – In-service and Out-of-Service combination of external visual, close visual assessment of primary contacts, insulation integrity, functional checks of operation) and Technical Limitations (e.g. Remote Operation not possible due to stiffness) • **Standby Generation** – Combination of visual assessments, electrical testing, and functional checks • **Civils HV Support Structures** – External Visual Condition Assessment of Reinforced Concrete and Steel Structures • **Light Current (Protection and Control systems)** – specific bays with a higher failure rate (these are exceptions and most spend in this category is driven by obsolescence, followed by design family failure rates).
Design Family Assessments of Expected Condition Required (Hidden Failure Modes)	• **Bushings and Instrument Transformers** – based on historic failures and instances of abnormally poor condition. • **Disconnectors and Earth Switches** – some assets have been proposed based on their time in service and the expected failure modes brought about by expected condition [redacted] This is supported by the condition assessment sample within the families proposed. • **Substation Supports** – Overhead and Busbar Post Fittings and Insulation [redacted] Assets belonging to these families prioritised for investment with further development of asset health review planned, based on an individual assessment of a whole substation. • **Surge Arresters** – A type of surge arresters have been targeted [redacted] during RIIO-T1 and -T2 through thermography. Has led to in-service failure in the past. • **Light Current (Protection and Control systems)** – relay types with higher failure rate
Obsolescence	• **Compensation -** [redacted] – third party support and access to spare parts • **Disconnectors and Earth Switches** – [redacted] • **Light Current (Protection and Control systems)** – [redacted] • **LVAC Distribution Systems and Standby Generation** [redacted]

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