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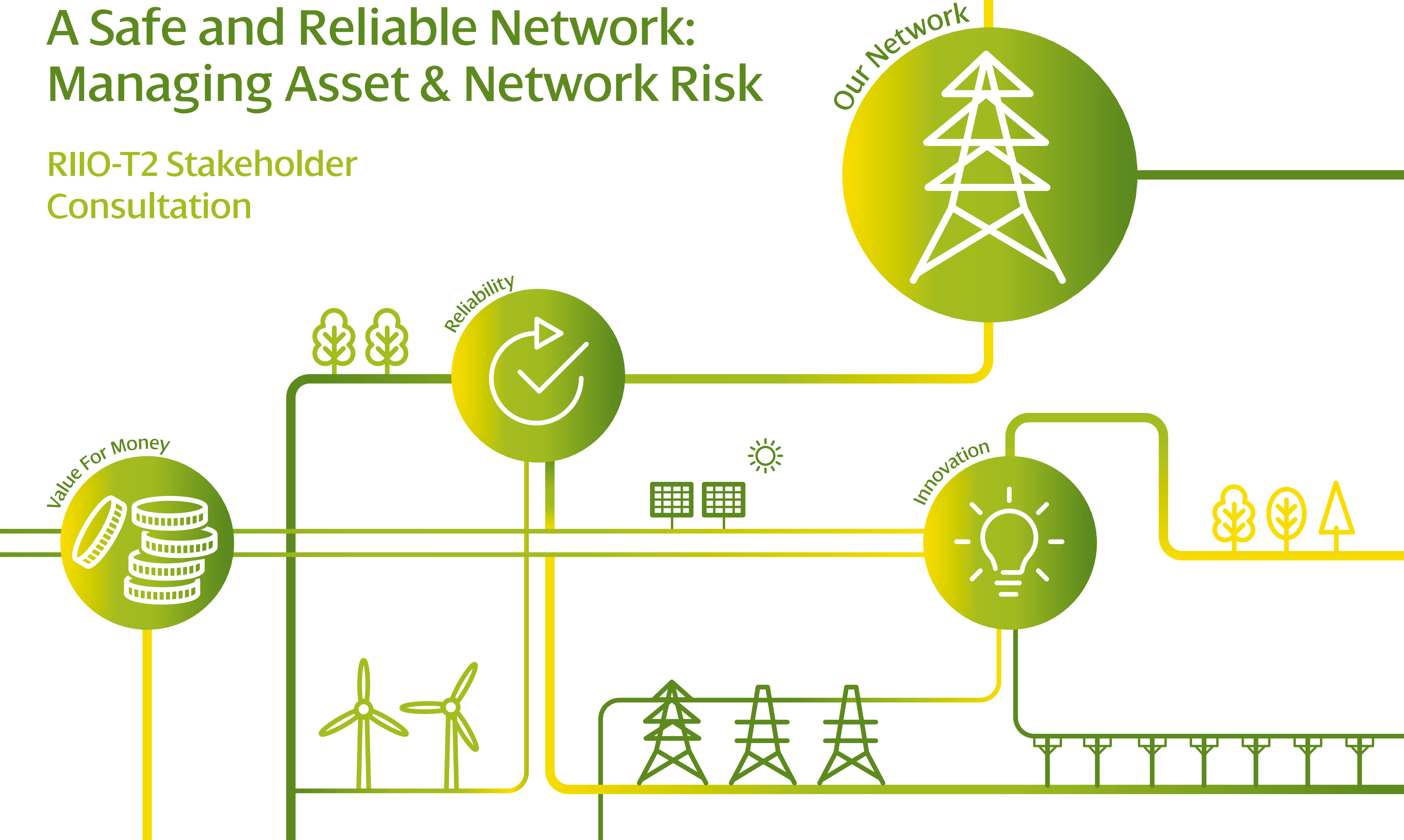
SP ENERGY NETWORKS

A Safe and Reliable Network: Managing Asset & Network Risk

RIIO-T2 Stakeholder Consultation



Foreword

The safe and reliable operation of our network is a priority for us, recognising the critical role that transmission infrastructure plays in all aspects of modern society.

Electricity is becoming increasingly important in a digital economy which is decarbonising transport and heat, and our role in maintaining security of supply is an important aspect of our plans for RIIO-T2 and beyond.

Our network consists of assets of varying age and condition, dating from the early days of the construction of the original Grid system through the 1960s and 1970s when the Supergrid system was created, to the recent works to enable and connect renewable generation. As these assets approach and pass their design lives, their condition can deteriorate and the risk to the reliability of the network increases. Long term strategies which are underpinned by detailed knowledge of the condition of the assets and their deterioration mechanisms are essential to ensure that interventions to manage these risks are effective, timely and represent value for money for consumers.

We are now in the process of developing our business plan for the next price control period for transmission (RIIO-T2). Our business plan will be submitted to the GB energy regulator Ofgem by the end of 2019. A large proportion of our investments will be in the management of asset and network risk so that we continue to provide the same high standard of network performance during a period of rapid transition in the energy system. Our plan will be underpinned by our understanding of the condition of the assets and the role that they play in providing services to customers connected to our transmission network.

Our Managing Asset & Network Risk consultation therefore provides an overview of the processes and frameworks we use to understand condition and quantify risk. In it we explain how we decide what interventions are necessary and how we ensure that every individual network asset is considered in the process. We outline the basic principles to ensure that we only invest where it is needed and that our assessments consider the needs of all of our transmission customers, wherever they connect to our network.

We would like to hear from you regarding our approach to managing asset and network risk through the questions provided at the end of this document. Your feedback will greatly help us in the development of our business plan for RIIO-T2 and we will engage with you again before the submission of our plan to explain how your feedback has helped us to define our risk management activities and to seek your feedback on our proposals.

Jim Sutherland
RIIO-T2 Programme Director

Managing Asset Risk Lead Assets Glossary

Circuit Breakers

Circuit-breakers: make lines, cables and transformers live and disconnect them should short-circuit faults occur.

Transformers

Transformers: connect parts of the network which operate at different voltages and connect to the distribution system.

Reactors

Reactors: help to control system voltages from becoming too high.

Cable Systems

Cable systems comprise terminations, joints and the cables themselves.

Overhead Lines

Overhead Line Towers (sometimes known as pylons): support the wires which carry power above ground.

Overhead Line Conductors: are the wires carrying the power.

Overhead Line Fittings: connect the wires to the towers.

Defining Asset Risk

As a Transmission Owner (TO), one of SP Energy Networks' most important roles is to manage our overhead lines, cables and substations to make sure that our network is safe, resilient and provides the level of reliable service that our customers expect.

To do this effectively and efficiently we use our detailed understanding of the condition of our assets, their importance in the network and how they interact with each other.

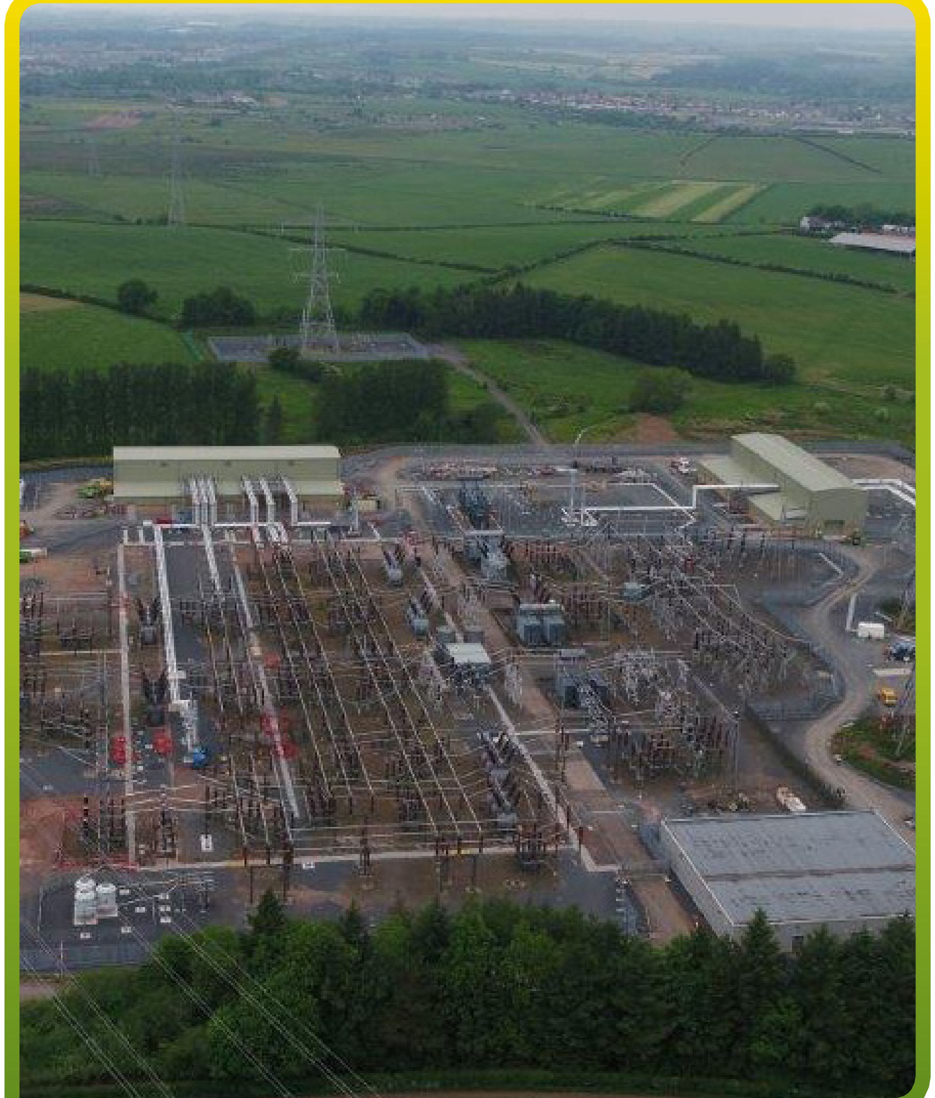
The knowledge of an asset's condition can be used to derive a measure of the likelihood, or probability, that it may fail. Assets' importance in the network and their interaction with each other allow us to quantify what the impacts would be in the event of their failure. The combination of likelihood and impact of failure is how we define the risk.

In regulatory language, investments in these types of assets are referred to as 'non-load-related', as they do not involve any network expansion or reinforcement works.

The principal objective in planning our investments is to intervene before assets fail.

In this consultation document, we describe how we use our knowledge of the risks represented by the network assets to define asset and network risk, to produce long-term strategies and to define our major asset capital investment plan for the RIIO-T2 period.

These processes apply best practice techniques developed internationally and across many infrastructure sectors.



Deriving Asset Risk

When assessing asset risk, we begin by estimating the risk associated with each and every one of our major assets, known as lead assets.

Each asset's **probability of failure** is estimated using mathematical models based on expected life-span and condition.

The **consequences of failure** are then assessed. We consider four key aspects:

(i) The direct financial cost of the failures, i.e. how much to repair/replace the asset

(ii) The consequential costs such as the impact of loss of supply to customers

(iii) Potential environmental impacts

(iv) Potential safety impacts

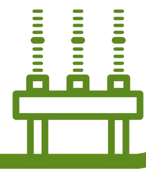
These are combined on a common, monetary basis to provide us with a consequence of failure measure for the asset.

By multiplying the probability of failure by its consequence, we derive a **probabilistic cost** which we call **monetised risk**. The use of these objective measurements, calculated on a common basis, provides us with a consistent measure of risk for our lead assets. This standardised approach aids comparison and decision-making for our Transmission business planning. Network risk, for lead assets as a whole, is then the sum of the individual monetised asset risks.

This way of deriving asset risk is captured in a formal methodology, known as **Network Output Measures**[1] and is the basis for prioritising and supporting any asset management decisions and interventions we make.

[1] https://www.ofgem.gov.uk/publications-and-updates/decision-not-reject-modified-electricity-transmission-network-output-measures-noms-methodology-issue-18

Asset failures – can take a number of forms. This might include an inability of the asset to perform its function. For example a circuit-breaker mechanism could fail such that the asset is not damaged but can no longer be operated without some kind of intervention. Other failures could cause damage to the asset or other assets close by. All of the significant types of asset failures are accounted for in the measurement of monetised risk.



Interventions on assets – range from routine maintenance to refurbishment and eventually replacement. Maintenance is regarded as the activity to ensure the asset remains functional for its design life. Refurbishment of some assets, such as certain transformers and designs of circuit-breaker, is possible and will extend the asset's useful life beyond its design life. Assets are replaced when refurbishment is not possible, for example with overhead line conductor, or where replacement is more economical than refurbishment. We explain the decision process later in the document.

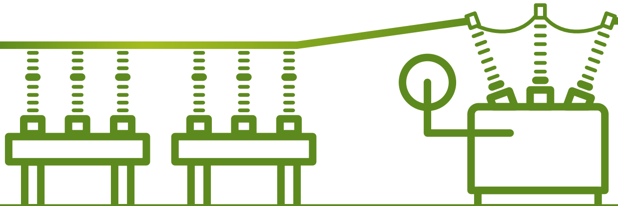
SP Energy Networks' Assets

The lead assets which are classified by monetised risk are those which have historically been the most significant in terms of the consequences of their failure and the highest value. These comprise circuit-breakers, transformers and reactors, underground cables and overhead line towers, conductors and fittings.

Assets deteriorate due to the stresses that they are exposed to. These can be mechanical, such as the vibration experienced by overhead line components; thermal, for example as experienced by transformers and cables; or, electrical, such as those experienced by circuit-breakers. While longer exposure to stresses leads to greater deterioration, not all assets are subject to the same degree of stress and there is also variability in the ability of individual assets and families of assets to withstand stresses.

Our decision to intervene is therefore not solely based on the age of the asset even though time is a factor. Variance in deterioration places importance on having condition data in the mathematical model used to derive the probability of failure.

This information is entered in our assert management system which model the asset risk, health and consequences of failure.



We collect condition data in a number of different ways such as:

Visual inspection

Chemical analysis

Forensic analysis

Intervention Decisions

Condition data also provides the information necessary to determine what component or characteristic of the asset is driving its probability of failure and hence the associated size of risk.

We have defined two key guiding principles for intervention when using monetised risk as an input into the decision-making process:

We will not intervene on good condition assets with high consequence values despite the high risk value.

We will still consider poor condition assets for intervention despite low consequence values driving low risk values.

An example of this approach is explained in the box on the right. There may be, however, enhanced surveillance and inspection regimes implemented for the highest consequence assets.

Detailed knowledge of the asset and its ageing and deterioration characteristics will determine what types of intervention are possible.

Refurbishments extend the life of the existing asset. The benefits of refurbishment usually last for a shorter time than replacing the asset altogether and further intervention will generally be required at a subsequent time. Additionally, the refurbishment will only improve the condition of the components being upgraded or replaced so the remaining elements of the asset will continue to deteriorate from their existing condition. The costs of refurbishment are generally lower than for replacement however.

Case Study:

Transformers

The condition issues affecting transformers can be categorised in four ways:

External condition relates to the corrosion of the main tank, the deterioration of seals and gaskets and the condition of ancillary components.

Bushings (which transition the high voltage connections from air to oil) can deteriorate due to moisture ingress and electrical activity.

Tapchangers (which allow control of the transformer voltage) deteriorate mechanically and wear due to electrical duty.

Active part: the condition of the main windings' insulation deteriorates due to thermal and electrical stresses and contaminants in the insulating oil.

Because risk = probability x consequence, there are two factors influencing the overall risk number.

Asset 1 A 132kV transformer in a deteriorated condition but with relatively low consequence of failure has a risk value of £r150,000.

Asset 2 132kV transformer in very good condition but with a relatively high consequence of failure has a risk value of £r280,000.

Deciding to intervene only by the size of the monetised risk value would wrongly focus on the good condition asset, ignoring the poor condition transformer. This would not result in any network improvement and would not represent value for money. Therefore, we need to consider the condition of every asset when making our intervention decisions.

Building an Investment Plan

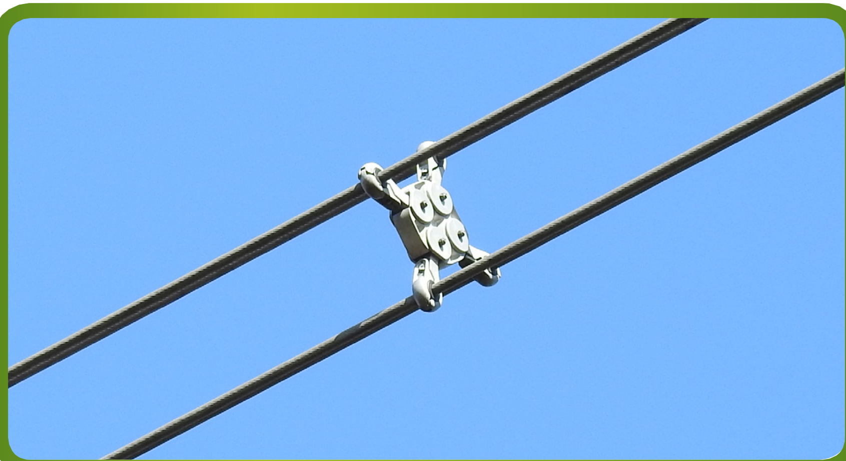
When compiling the investment plan for our RIIO-T2 Business Plan, we draw on our strategic asset plans. For all of our asset types, we have long term strategies for managing known issues and managing forecast deterioration effects.

Another important consideration is the interactions between assets as part of a network. We need to balance the priorities driven by individual assets with a wider view of our whole network when determining priorities.

Case Study:

ACSR Overhead Line Conductor

Aluminium conductor with a steel reinforcing core (ACSR) was (exclusively) installed from the 1950s to the 1980s and comprises 55% of our overhead line conductors. A major deterioration mode of this type of conductor is corrosion of the steel core causing loss of strength. We therefore test and examine the conductors periodically to determine their condition and a programme commenced in RIIO-T1 to replace the poorest condition and highest risk conductors. The long term plan is defined for each overhead line route and takes account of current condition and remaining life as well as the constraints of delivering the intervention plan, such as system access.



The strategic asset plans are used to develop a roadmap for the network and we compile the set of economic intervention options which we have determined to be justified within the RIIO-T2 period. This forms the starting point for the definition of our RIIO-T2 investment plan. At this point we have a number of considerations that influence the initial plan.

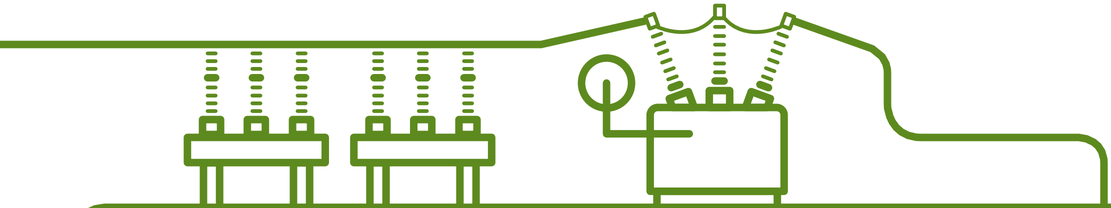
System Access: Transmission networks are designed to allow sections to be taken out of service for necessary works. However, this requires careful co-ordination to maintain electricity supply security and places limitations on what works can be undertaken at the same time. As the generation landscape continues to change rapidly over the next few years, these restrictions are likely to become increasingly complex.

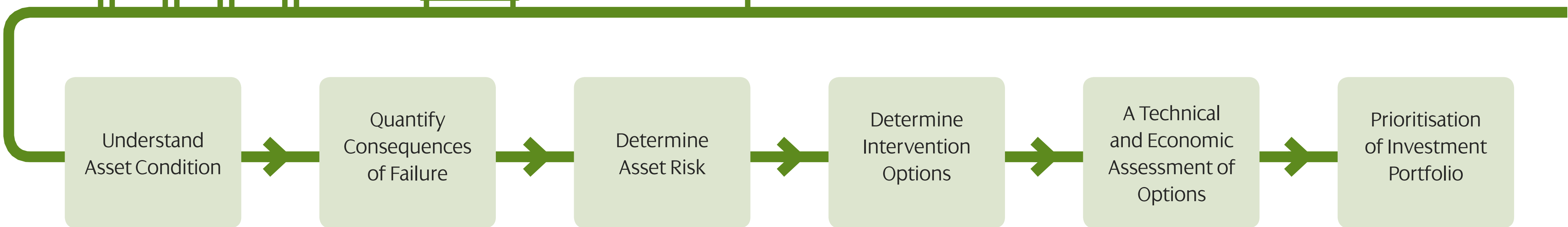
Resources: We work very closely with our supply chain to co-ordinate our work programmes and we take account of capacity both in terms of the availability of equipment and suitably skilled people when determining our plans. We also have finite internal capability to deliver major capital programmes. These elements are carefully considered in our investment plan.

Risk: In preparing our investment plan for RIIO-T2, a key consideration is to determine the level of risk that is being removed from the network and that which would remain when we complete the work associated with the business/investment plan. We therefore consider if we are able to manage the risk of each asset if we were to defer the intervention to a future price control period, when deciding which of the interventions to include in the RIIO-T2 business plan. We then adjust the plan to work within the constraints of system access and resources with the aim of having a prioritised set of interventions such that we are confident that we can manage the risk of the remaining individual assets. For our lead assets, the monetised risk framework we have described in this consultation document is a key element in understanding the relative risks of each of the assets and helps us to quantify and articulate network risk.

Long Term Plan: We also need keep the long term impact in mind when preparing our RIIO-T2 investment plan. As a large number of assets dating from the original network construction in 1950s and 1960s reach the end of their service lives in very similar timescales, we need to be mindful of deferring too much work. This would be difficult and costly to deliver in later price control periods and impact on risk even if we were able to manage the network and asset risks in the meantime.

Cost: At the heart of all of our activities is ensuring our interventions and investment plan represent value for money for our customers and consumers across Great Britain. We always consider whether the level of expenditure we plan for is supported by our stakeholders. We obtain this feedback through a number of formal and informal channels. For example, we are working with all GB Transmission Owners to deliver a nationwide 'Willingness-to-Pay' research project to inform our plans based on how stakeholders view and value the various services we provide and areas we plan to invest in. We are also creating a number of Transmission-focused events and workshops to increase opportunities for both information provision and discussion so that individuals feel suitably informed and empowered to **#ChallengeOurPlan**. The group is there to represent the wide-ranging needs and requirements of our multiple network users, customers and stakeholders via their 'access-all-areas' pass to our Transmission business. Every month the members of the User Group review various sections of our RIIO-T2 Business Plan face-to-face with the relevant individuals and teams at SP Energy Networks who are responsible for producing them.





Consultation Questions

1. Do you agree with our approach to building an investment plan to manage asset risk by using our detailed knowledge of the condition of our assets? Please provide any comments you may have.

2. Have we adequately identified the issues that affect our assets and the types of interventions that we should consider? Please provide any comments you may have.

3. Do you agree with our first guiding principle that we should not intervene on assets which are in good condition, even if the size of the risk benefit that would result is large compared to other assets? Please provide any comments you may have.

4. Do you agree with our second guiding principle that we should intervene on assets where necessary to ensure safety and good quality of service to all our consumers, even if the size of the risk value is small compared to other assets? Please provide any comments you may have.

5. Have we identified all of the factors that determine which interventions should be in our investment plan? Have we given adequate consideration to these factors? Please provide any comments you may have.

6. Is there anything else you would like to tell us in relation to our approach to Managing Asset & Risk for RIIO-T2?

Please complete this document and return it to:
riio_t2@spenergynetworks.co.uk

If you would prefer to submit your feedback online, you can complete the Managing Asset & Network Risk RIIO-T2 Stakeholder Consultation Online Form here