NOMs Methodology Issue 16

Report demonstrating compliance with Direction

Summary

1. Manner of modification

The TOs have worked collaboratively to make modifications to the existing Methodology in line with the Direction. Ofgem have been regularly updated through weekly teleconferences, regular face to face meetings and 'working (draft) versions' of the Methodology for comment.

This productive way of working has resulted in the modifications to the Methodology as summarised in this report. Where further development is required, or development in line with the Direction has been conducted on a reasonable endeavours basis, this has been detailed in the Methodology.

The TOs consulted on the proposed modifications (13 March - 10 April 2017) including two stakeholder events (21 March, Glasgow and 23 March, London). To satisfy Special Licence Condition 2L.12, representations from our stakeholders have been included in the Methodology where applicable. A full set of stakeholder representations can be found in the appendix to this report.

2. Extent of modification

The Common Methodology outlines the fundamental approach to the calculation of Asset Risk through Failure Modes and Effects Analysis (FMEA). There are two accompanying Process Appendices that outline the NGET implementation and SPT/SHE-T implementation respectively. These Process Appendices will be updated following the successful completion of the Calibration, Testing and Validation process.

The Licensee Specific Appendices contain the sensitive data that is only relevant to each TO and will not be made available in the public domain. These Licensee Specific Appendices will be updated following the successful completion of the Calibration, Testing and Validation process.

The combination of the main methodology and Process Appendix is designed to enable a competent reader to arrive at a theoretical value for Asset Risk. It is not possible to determine the actual value of Asset Risk without consideration of the Licensee Specific Appendix.

Following the Calibration, Testing and Validation process, two competent independent assessors will be able to arrive at the same view of a licensee's performance if consideration is given to the Methodology, Process Appendices and Licensee Specific Appendices.

A. Common Methodology

1.1. General extent of modification

There are two separate Process Appendices (note that these are not the Licensee Specific Appendices) that detail the licensee specific approach to implementing the Common Methodology for NGET and SPT/SHE-T respectively.

The modifications focus on the evaluation of the network asset condition, network risk and network replacement outputs measures. The evaluation of network performance and network capability are included in Appendix I to the Common Methodology (Implementation for RIIO-T1) for completeness. There are no proposed modifications to the evaluation of the network performance and network capability measures.

A monetisation approach has been developed for all lead assets which calculates the monetised risk associated with an asset by multiplying the probability of failure by the monetised consequence of failure.

A significant amount of development for justification was carried out prior to the draft submission in December 2016. This section was removed at Ofgem's request and will be developed as part of the forthcoming cross sector working group initiated by Ofgem. The required associated reporting will be developed once a position has been reached on the implementation of the incentive mechanism.

The development work for justification has been included as an appendix to this report for reference.

1.2. Common and Licensee specific parameters

The Common Methodology contains the high level approach to adopting FMEA as the approach to evaluate the Probability of Failure and Consequence of Failure. Relevant parameters and formulae are explained in the Process Appendices. Gaps in data will be ascertained and collected during the Calibration, Testing and Validation stage. Assumptions are included in the Process Appendices where appropriate.

1.3. Treatment of uncertainty

The principles for uncertainty are given in Common Methodology. Further development is required in this area in conjunction with the Risk Trading Model. Uncertainty will be evaluated in line with Common Methodology, detailed in the Process Appendices and evident through the Risk Trading Model.

1.4. Asset Health

FMEA will be used to determine the Probability of Failure. This continuous output replaces the requirement for the discrete five asset health indices. The same factors used to evaluate the health indices (e.g. information collected related to the condition, operating environment) are considered as part of this approach in determining the probability of failure. The probability of failure assumes that routine maintenance will be carried out.

The detailed implementation of FMEA for each TO is outlined in the Process Appendices.

1.5. Assets requiring separate treatment

A significant amount of development for High Impact Low Probability (HILP) events was carried out prior to the draft submission in December 2016. This section considers whether HILP assets should be require separate treatment and was removed at Ofgem's request. This area is subject to further development through the forthcoming cross sector working group initiated by Ofgem.

The development work for HILP has been included as an appendix to this report for reference.

1.6. Implementation plan

There is a high level implementation plan included in Appendix I to the Common Methodology. As further development is required to fully develop the Common Methodology and ensure that Calibration, Testing and Validation is appropriately carried out, it is not possible at this stage to provide a detailed plan for implementation. TOs will need to update their existing internal documentation to align with a new approach.

B. Risk Trading Model

The Common Methodology includes the structure of the Risk Trading Model. Reasonable endeavours have been undertaken for the development of the Risk Trading Model. There is an excel version of the Risk Trading Model as part of the SPT/SHE-T Process Appendix. A full model will be developed that delivers consistent outputs between all TOs following the Calibration, Testing and Validation stage.

Compliance Report

Direction Ref	Evidence
3	Ofgem have been provided updates on a weekly teleconference, monthly face to face meetings and provided with regular draft sections of the methodology for comment.
5a	Not fully compliant. Independent assessor with appropriate experience would be able to determine the theoretical asset risk. To formulate a generic assessment of performance additional data would be required. This is to be supplied as part of the implementation plan.
5b	The proposed methodology allows an independent assessor to arrive at a value for network risk. However, under and over delivery cannot be addressed until the principles of implementation of the incentive mechanism can be agreed with the Cross Sector Working Group.
7	All 5 NOMs are covered in the common methodology. The approach for all TOs is common. Process appendices detail the specific application of the methodology by each TO.
8	The common methodology only references Network Condition, Network Risk and Network Replacement Outputs. Appendix 1 to the common methodology details the common approach to Network Performance and Network Capability, there are no proposed modifications to these two measures.
9a	Clarification: Condition risk is referred to as Asset Risk. From a theoretical perspective Asset risk can be derived from the Risk trading model and combined with consequence will allow comparison as directed.
9b	Compliance cannot be demonstrated until calibration, testing and validation is complete.
9c	Compliance cannot be demonstrated until calibration, testing and validation is complete.
9d	The Risk Trading Model will facilitate scenario based investment planning. The methodology will contribute Asset Risk data on driver impact.
10	This is down to specific TO implementation.
11	The methodology meets the requirement for Network Performance and Network Capability. However, the RIGs will require modification to reflect the methodology following the output of the Cross Sector Working Group.
12	The process appendices reflect all parameter required to undertake evaluation including interim steps and formulae.
12a	All parameters are defined, however, at this stage are not evaluated.
12b	Formulae cover Network condition, Network Risk and Network Replacement Outputs.
12c	All modifiers are explained thin the process appendices
12d	Data required is identified, where gaps in NGET data is known a high level plan to collect is included in the process appendix.
13	Assumption logs are included in process appendices, all material assumptions are detailed with materiality assessed by the TOs.
14	NGET assumptions and biases are included in the assumptions logs in NGET process appendix.
16a	A theoretical approach to accounting for uncertainty is included in the common methodology. Process appendices detail variation in implementation for each TO.
16b	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach allows for this.
16c	Compliance cannot be demonstrated until calibration, testing and validation is complete.

17a	All existing parameters are included in the evaluation of probability of failure with some additions.
17b	All existing parameters are included in the evaluation of probability of failure with some additions.
18a	End of life modifiers for each asset have been evaluated as part of the methodology and included in the process appendices.
18b	Modifiers and differentiators have been included to account for environment and loading and are included in the process appendices.
19	The methodology adopts an alternative to the five discrete health indices. Methodology utilises continuous distribution functions.
20	Theoretically the Risk Trading Model will facilitate this assessment through a scenario based implementation detailed in the process appendices.
21	Condition is a contributor to probability of failure. Consequence is mapped to criticality in the process appendices.
22a	The System Consequence section details design and operation parameters including redundancy. Variables accurately reflect actual network topology and redundancy.
22b	Probability of Consequence is broken down into realistic event chains as determined by the TOs.
22c	Equations take account of prevailing system conditions such as demand, generations and planned outages.
22d	Probability is assessed independently.
22e	Compliance cannot be assessed without clarification from Ofgem.
22f	This is included with System Consequences with materiality deemed by the TOs.
22g	The duration of consequence is defined as the minimum functional restoration time including system operator actions.
22h	All monetised failure consequences are weighted averages of the full range of expected outcomes.
22i	System Consequence defines a single monetised consequence which is a combination of possible types and magnitudes of outcomes.
23	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach allows for this.
24	This is covered as part of the TO implementation.
25	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach allows for this.
26	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach allows for this.
27	The translation is explained in appendix 1.
28a	This is stated in appendix 1.
28b	This is stated in appendix 1.
29	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach has not been constrained.
30a	The Risk Trading Model will facilitate scenario based investment planning.
30b	The Risk Trading Model will facilitate scenario based investment planning.
31	Removed at Ofgem's request for December 2016 Submission.
32	Removed at Ofgem's request for December 2016 Submission.
33	Removed at Ofgem's request for December 2016 Submission.
34	Removed at Ofgem's request for December 2016 Submission.
35a	Currently non-compliant, activities have been identified but are not time bound.
35b	Currently no need for a phased requirement.
35c	Works have been identified and included in the common methodology.

35d	No measures are necessary.
36	All sensitive information is included in the company specific appendices.
37	Scottish TOs have included, however, NGET's compliant application is described in the process appendix.
37a	The Risk Trading Model will facilitate scenario based investment planning.
37b	Risk Trading Model can facilitate this.
37c	The model matches detail process.
37d	Risk scores are calculated by the Risk Trading Model.
38	Risk Model contains sensitive data.
39	Approach is defined in the common methodology.
40a	The approach is detailed in the common methodology.
40b	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach has not been constrained.
40c	Compliance cannot be assessed at this time as all input data has not been evaluated. However, the theoretical approach has not been constrained.
40d	Timeframes have not been included as plans have not been fully developed by the TOs.
41	Methodology defines these as outputs.
42	Parameters are unique and identifiable.
43	Plan is public available in the common methodology.
44	Models have not yet been developed.
46	Non sensitive information is included in the common methodology and process appendices.
47	All documentation is to be updated in line with the implementation plan.
48	TOs have collaborated on a single common methodology. Each TO has submitted a specific appendix.
49	Content is referenced in the common methodology and process appendices.

Appendix I – Stakeholder Representations

Stakeholder consultation sessions

1 Background

As part of the network output measures consultation, 2 stakeholder events were held:

- 21st March 2017 – The Grand Central Hotel (Glasgow)
- 23rd March 2017 – The Raddison Blu – Grafton (London)

These stakeholder events were an opportunity for the 3 TOs to present the proposed revision to the NOMs methodology, and to invite comments and feedback from stakeholders. Over a 1000 stakeholders have been notified about the consultation, with 4 choosing to attend the session in Glasgow, and 19 choosing to attend in London.

2 Purpose of this document

This document aims to relay the comments (both positive and negative) and questions that have been raised both at the consultation sessions, and through other correspondence. Efforts have been made to consolidate the feedback into themes where possible. References to the feedback in this document does not aim to make judgements about the feedback received (either the validity of the feedback or action required as a result of the feedback).

The various breakout sessions organised were organic in the nature of the conversation and discussion, as such it was not always possible to identify the specific individual who raised a point. All discussion has however been captured and included in this document.

3 High level Nature of feedback

The criticism of the methodology could be broadly considered as fitting into 5 categories:

1. We have received some miscellaneous feedback which includes where clarity could be added, or minor errors have been identified.
2. Some aspects of the document were considered as making spurious aims by stakeholders. This would include sections of the document which allude to maintenance interventions being included in the main methodology document.
3. Feedback around what it is we are trying to do and whether this is actually achievable or not, i.e. are we being too ambitious.
4. The incomplete nature of the NOMs methodology makes it difficult for stakeholders to comment was a consistent theme (For example the absence of a risk trading model).
5. Feedback around the nature of the 2 different approaches, that adopted by the Scottish TOs and that adopted by National Grid.

In addition to stakeholders being critical of the methodology, there were a number of complimentary points raised.

4 General Feedback on sessions:

Some feedback and commentary was provided during the introductory presentations and Q & A sections. These are contained in the section below (separate from breakout sessions which are contained in the subsequent sections):

Minor Feedback

- Not made clear whether this is done as a whole UK system or whether this is done independently for the TOS. It should be made clear earlier on that each TO has their own risk profile.
- Should network risk position start from the same position on the graph [high level NOMs presentation]?

- What does the star mean on the risk graphs? Is this different to the DNOs in that this is the risk left on the system as opposed to the risk taken off the system? Essentially the distribution approach gets rid of the problem for over investing and justification (point made by member) [high level NOMs presentation]

- Does the customer connection mean directly connected? Are these the same as demand and generation?

- It appears (from the methodology document) that the maximum of the repair or replacement costs is used, so the cost of repair would never be considered in comparison to the cost of replacement? Is this correct? It doesn't come out in the document that if this is zero.

- Will this costing information (in light of the transparency requirement) be made public?

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- Will this costing information (in light of the transparency requirement) be made public?

- is it a single consequence against each failure mode that that the methodology is considering? Are you working the consequences out differently for each type of intervention? In the financial section, it implies that you're taking the highest of the options, and doesn't appear as clear as the safety consequence information.

- Does the methodology reflect subsequent changes to monetised values in a systematic way? How will the methodology keep these up to date?

- regarding data exchange with the regulator: One of the objectives of the methodology is to set future price controls. This methodology suggests that individual assets will have a bespoke risk value. Will this require debate about all of these changes with Ofgem?

- Will the targets be in the 5x5 matrix for T1 or will this be in a risk target for T1 - there appears to be a general confusion about the clarity of the targets at the end of T1 and whether these will be converted or translated within T1 of for T2.

- DNO made observation that while Safety and Environmental Consequence severity categories selected appeared to be related to the Failure Mode Effect this was not evident for the System or Financial consequences.

Spurious aims identified in document

- Does the methodology consider looking at different aspects of age to determine the equivalent asset life? Does it use the age of the asset from the point of the intervention, or does this reset the age after the intervention? How does the maintenance affect the equivalent age.

Whether aim is achievable

- In this approach, are you applying this costing for each consequence to every single failure mode, or are you aggregating this up to a consequence associated with a mix of failure mode? At some point, all of this comes together, and you may have to ensure that there is alignment of the balance for the risks, for an intervention vs. a failure, so that you don't get too much risk from one particular category in comparison to the others. Is your approach on a cumulative failure mode, or is it on an individual failure mode?

Incomplete nature of NOMs methodology

- None

Confusion about the different methods adopted

- none

5 Breakout Sessions

This section of the document considers the breakout sessions organised at the stakeholder engagement events. Discussion at these events was organic in nature, and hence recording who had instigated points was problematic. All discussion has been recorded in the following sections:

Probability of Failure Breakout Table 1

Minor Feedback

- Are you gathering data from all 40 years, or is there anything specific that you're feeding into it?
- Curious about the impact of sharing failure data in the public domain? Is there a model on the aero industry for us to replicate? Is there a risk of sharing this data publicly?
- Can the methodology provide an example of how to work through a probability of failure?
- Because these networks are not run to failure, in order to reduce the uncertainty in the quantification, for each of these improvements in the methodology, and the more data that appears, we become better overall at making the decisions and assessments about what the impacts are. This is what we are driving for.
- The use and application of the electricity network/system is changing the way that the network is operated. Does the switching due to the intense operations in the changing landscape, imply that the consequences are appropriately considered?
- Is there a view on how to set the ranges of these failures: minor major etc, and should limits of where to stop be set, and what is classified as a 'minor'? Is there a threshold at which information is considered inconsequential?
- What data is going to be collected and how much is it going to collect to cost?
- Point made about the currency change potential in Scotland - could impact on conversion of 'common currency'.
- Worth noting that the spend may not directly correlate to the risk. The capital investment to mitigate the risk is not going to be the same.
- Will the methodology get to the position where you have an equivalent pound spent per pound of risk?
- Important to clarify that methodology considers the risk that remains on the system, as opposed to the risk that is removed.
- Are the assets categorised in the same way as the DNOs? They break it down as the asset type and voltage is this same thing in the transmission space?
- In the distribution methodology there is no encouraged to trade - the concept of trading was implicit but not clearly articulated in the methodology.

- The role of manufacturers, and industries, where they carefully design the solutions, is there something that the manufacturers can get involved in, in order to identify and contribute to the methodology in terms of the costing of risk mitigation? Is there a way of getting the manufacturers involved in an open forum to share their own failure data?

- Reference made to Rolls Royce and their pressure on sharing their absolute reliability and failure data, as this is the service that they offer, and what the customer pays for.

Spurious aims identified in document

- None

Whether aim is achievable

- How can you put certainty on the high impact events with a very low probability? Essentially these events haven't happened yet, but we have to accommodate for them?

- The methodology, by definition, needs to contain the assumptions that you believe in order to quantify this. One way around this in other industries is to share the data. Asset failure data is shared through ITOMs.

- The DNOs have agreed on a probability and likelihood of failure, is this something to do for the TOS? There was a lot of collaboration around this for the DNOs, which led to this position.

- How can an estimate of how a specific failure is attributed to a specific cause be made? We can apply a distribution of previous failure data in order to allow us to map this out. Utilising expert input through collaboration and workshops, we can use our asset management expertise in order to set these. Ultimately however, there has to be an element of engineering judgement in this, which needs to be explicitly called out in the methodology.

Incomplete nature of NOMs methodology

- Will there be visibility about these assumptions?

- Is the methodology clear enough on the periodicity of these reviews of the data? Note that these assumptions are inherently required, then the timely review has to be included in order to demonstrate that this is considered.

- only collect the valuable data, as opposed to collecting all of the data possible. This should be reflected in the data gathering plans, and the implementations.

Confusion about the different methods adopted

- How are the risk figures going to be comparable across the TOS, given that the TOs are using different methods for calculating the PoF?

- Are challenges with the calibration with lots of inputs foreseen as a challenge? Not only is it the internal calibration, it must be calibrated against all of the TOS.

Second Breakout on PoF:

Minor Feedback

- At what point does the transition between the definition of a methodology and a process happen? What you don't want to get to is a place where the TOs become the delivery arm of entering the data, and the common tools, processes and procedures is all set by the regulator, and therefore they try to become the asset manager, not the regulator.

- The DNOs have a specific benchmarking requirement in their objectives, is there a reason/ benefit as to why the TOs do not have this?

- Does comparative analysis mean benchmarking?

- Can a little more detail on the equivalent age and how it is calculated be provided, as the presentation at the start was not clear.

- If you didn't have any condition information, could this potentially result in a high equivalent age?

- Within the DNO methodology, the age has a limiter on the impact on the age modifiers. At the moment, this methodology appears to be unconstrained, and therefore you just replace assets that just get old, as opposed to on any other metric, if there isn't a cap applied.

- The story of how the investment plan gets drawn together, for a replacement, should be drawn out better. How the asset management links to a risks, and then results in an investment plan.

Spurious aims identified in document

- None

Whether aim is achievable

- When you look at the DNO methodology, there are a set of ten inputs, and every single DNO has to input according to this, irrespective of whether they have the data or not. This achieves a common process, as opposed to a common methodology...

Incomplete nature of NOMs methodology

- Mention of the asset condition data that goes into the calculation of PoF - can more information be provided and detail about what this is, and what goes into it?

- Can the data be shared, providing it is sufficiently anonymised?

Confusion about the different methods adopted

- There is a lot of asset specific data that goes into the methodology. If there was a consistent methodology, then a common set of inputs then you can have a common 'calculation engine'. It appears that there are two separate calculation engines and different implementations of the same thing. Can it be clarified why this is, and if there is a reason for it?

- A common calculation engine could potentially lead to a point where you better facilitate the delivery of the outputs. This could mean that there is a greater benefit of one single calculation engine as opposed to what is proposed in the methodology.

- Subsequent question; is it going to be that one TO's data is used in the calculation undertaken by another TO, and see if the output yields the same result. A nuance to this could be to take a theoretical asset through the two approaches, and see how similar the results are that are produced.

- Interested to understand how optimistic the TOs are, to get two approaches that result in comparable outputs? Does this result in data sharing, running data through other models, and any further calibration requirements?

- For the DNOs, this common approach allowed them to identifying that one particular asset category was contributing significantly to the overall risk. This means that the methodology had to be retuned as a result.

Third Breakout on PoF:

Minor Feedback

- Are reviews of the methodology considered in the calibration, and shouldn't it be done in the next version? Will those calibrations then find their way into the document?

- Does this methodology have a prescribed set of inputs? And if not, now can it be prescribes that this methodology will result in a consistent impact on the outputs, in order to call this a common methodology. How can the calibration be done if you have different inputs?

- Aside from the lead asset categories that are listed, how are any other assets, such as aluminium structures, taken into account in the methodology?

- Is there an appetite to incorporate this analysis and methodology on the other non-lead assets?

- Observation that there seems to be a potential for the movement of the asset management function from the Network owners to the regulator due to the inferred scenario planning function that was identified as a benefit. Is this a desirable situation?

- Suggestion that to compare NG/SPEN/SHETL approaches that we swap data and run same data sets through each other's models.

- that there is a limit to the Age Related PoF Modifier- once a certain age is reached for some assets the PoF can level off and only condition data then will be used to modify the PoF e.g. DGA analysis.

- EoL related PoF Value.

- This is not clear in the Methodology.

- Is it specific asset or lead asset based?

Spurious aims identified in document

- If interventions other than replacement are undertaken, are the two methodologies configured so that they would both respond to the same set of interventions in the same way? If there are not common inputs, how will a common set of results be given that the benefits can be assessed against?

- Are you then going to be able to measure the exact same set of interventions, and have you done any alignment of that?

Whether aim is achievable

- None

Incomplete nature of NOMs methodology

- How are the calculations for probability and consequence checked on the same basis? The assumptions and calculations from the DNO perspective, it appeared that in the DNO remit, there was too high a consequence for a particular tower failure. How do you get the balance right between the probability of failure and the consequence, being appropriately weighted?

- There is a probability of failure, mapped to a probability of consequence. The examples however, give the consequences associated with the failure effect mode. Is there a terminology inconsistency, or is this incorrect? Can this be checked to ensure consistency?

- Are these failures are that you have considered defined, and where is it in the methodology? If

it is not in the main part of the methodology, but it is in the specific appendices this should be brought into the main methodology.

- What is the output of the methodology and what does the stakeholder see? The current output is a matrix and a process that demonstrates the risk. How does the methodology show that this is consistently aligned with the outputs, and that you are reporting on the right outputs? Essentially, it needs to make sure that the implementation exercise is demonstrating that the methodology delivers these outputs. At the moment, it looks like the outputs are not the principle function of this methodology, as the pathway of this transmission methodology to get to these outputs is not clear.

- It is difficult to prove the transparency of the approach when you cannot see this mapping to the outputs that you are trying to achieve. You could get to a point where the risk position is changing as a result of the methodology changes, as opposed to as a product of a clear methodology. Think about the levels of detail that you have to be considered. If it is difficult to scrutinise, then it is hard to justify.

- Has anything been done to consider if you took two comparable assets, and applied the two methodologies, would you get a consistent risk point result?

- Is the intent to populate a matrix against the common outputs? Is it anticipated that this reporting requirement to be changed in the future regulatory period?

Confusion about the different methods adopted

- Is there an expectation to get the CBRM and FMECA analysis to give the same answer?

First Consequence of Failure Breakout session:

Minor Feedback

- Would (the NGET) 'Alliance' delivery model have influenced the costs?
- Fault Rate data will be a TO specific input into the system consequence assessments. Why would there not be a GB based value?
- There is a need to define what variables are different (between TOs) and why these differences exist.
- Will each asset within each asset class have its own cost of recovery value?
- What level of granularity would the cost of recovery value be taken to? Is increasing the level of granularity worth the effort in calculating it?
- Sensitivity analysis would be needed to help determine level of granularity and to what cost?
- Should consequences be fixed?
- From DNO perspective they are fixed. It becomes very complex if consequence values change within the price control period.
- Perception that may be seen to be playing with the values. All inputs and variables need to be pulled out and explained.
- Does the CoF value need to change? Agree that the PoF can change for example due to better condition info from Inspections and maintenance. From DNO perspective, the consequence is fixed throughout the price control period.
- How does the methodology handle a sudden change (increase) in asset PoFs?
- Treatment of externally influenced PoF changes need to be considered (Dynamic consequences)

Spurious aims identified in document

- None

Whether aim is achievable

- none

Incomplete nature of NOMs methodology

- How are environmental consequence assigned to linear assets? There isn't any detail on how this is done within the methodology?

Confusion about the different methods adopted

- Costs associated with recovery of failure is different (between TOs) surely these should be comparable not different?

- It is difficult to understand why TOs can't agree to have one standard value. How do we assess which assets are the in low/medium/high categories? Would there be one cost per intervention type?

Second Consequence of Failure Breakout session:

Minor Feedback

- Are we trying to make values such VoLL common?

- But may have Vital Infrastructure as a separate identifier. {DNOs do not need to publish criticality of specific sites I their risk matrix}

- Separate justification for HILP but include transport hubs, COMAH sites (within a certain criteria) and EKPs. Need to ensure that consequences aren't double counted.
- VOLL is flexed by customer type

- Are we considering the risk of overload on adjacent circuits as part of the assessment

- Generation Loss – What basis are the TOs using for duration or is it a general assessment? Challenge for the DNOs is the need to explain the changes which have occurred as a result of a change in the data.

- Transparency vs Complexity challenge

Spurious aims identified in document

- None

Whether aim is achievable

- None

Incomplete nature of NOMs methodology

- Lack of details in parameter setting. How many parameters are going to be TO specific?

C**onfusion about the different methods adopted**

- none

Third Consequence of Failure Breakout session:

Minor Feedback

- Review periods for criticality – It was noted DNOs have a slow approach , where it set for the price control period but view from transmission was this could change quite radically and quickly.

- Why are costs associated with recovery different between TO companies? How to establish this?

- Note that the application of these costs may be specific to the Failure Mode Effect being considered.

- Discussions on how the impact of changes seen during subsequent iterations of the plan would be handled:

- Could create “Snapshots” of the inputs to allow that delta(s) associated risk variation to understand what risk variation has occurred not associated with asset replacement / refurbishment activity.

- Examples discussed were :
    - where a conductor exists and a new road is built underneath it so potentially changing the consequences or vice-versa an old road decommissioned :
    - Impact of newly identified failure mechanism or increase in instances’ of something expected to be low frequency e.g. 132kV XLPE CSE’s. Change to PoF AND PoC.

- System consequence is where the most exposure to this variability lies.

- How does the asset review periodicity impact these values? Expect that inspections may lead to changes to a subset of assets – either or both to the condition based PoF AND the Consequence values.

- What is the expected review cycle?

Spurious aims identified in document

- None

Whether aim is achievable

- None

Incomplete nature of NOMs methodology

- Failure modes – one to one mapping within CBRM, how is this done within the NGET FMEA process. May need further explanation with TO Specific appendix.

- Problem is defining values when failure data isn't present. Methodology should explain how this is done.

- How does the methodology show/assign consequence for Linear assets – e.g. are they at Circuit / Span / Km levels? It isn't clear in the Methodology. If it is at Span level how are Pof's & PoC's & Consequence values combined?

Confusion about the different methods adopted

- Would it not be possible to get TOs to agree to one method of calculating FMEA?

- Industry calibration and benchmarking – to what extent will this be undertaken. Need to avoid undertaking the 'easy' comparison rather than the accurate one.

Overarching Principles and Implementation within T1 table 1

Minor Feedback

- Why does the methodology not consider all assets? Will it in the future?

- Are Tower interventions reported?

- Reporting Framework; how will it be defined?

Spurious aims identified in document

- None

Whether aim is achievable

- None

Incomplete nature of NOMs methodology

- Reporting transparency; how will the methodology report changes over a period of time with the new methodology? How will we quantify risk – risk delta

- Justification; how can it be articulated why the risk has changed and what value an intervention will add?

Confusion about the different methods adopted

- Monetised risk; is this being calculated in pound risk or is it relative?

- Saw tooth diagram is not clear in the methodology document and requires work to ensure intentions can be understood.

- Does it translate in the reporting?

Breakout session 2

Minor Feedback

- Can this methodology account for OPEX solutions?

- Can the methodology be simplified, it appears that it is trying to cover too much so can some of the areas of complexity be parked e.g. Maintenance and Opex, Saw tooth – Perhaps

- What effect will the new methodology have on the supply chain? Will there be a step change in how we plan and spend money and will this need to be communicated to external stakeholders?

Spurious aims identified in document

- None

Whether aim is achievable

- None

Incomplete nature of NOMs methodology

- Opex is outside the scope of NOMs as NOMs is primarily dealing with Capex?

- It was suggested to split out the OPEX and CAPEX areas and agreed that we could remove some of the complexity regarding OPEX but add a note to say that it does not stop us from investigating the possibility in the future.

Confusion about the different methods adopted

- none

Breakout session 3

Minor Feedback

- How will monitoring changes and business decisions for audit and change management be achieved? Could it be done via intervention?

- How will the methodology translate current AH approach to the risk approach? Will it be volume based; how will we deal with risk points in methodology? It will need to be explained in the document for price control.

- Has new data requirements come about or do we have all of the data needed to support the new methodology?

- Does the methodology consider what the impact will be with regards to what we have previously reported prior to having access to the new data and the difference it will have on our future reporting when trying to cross check?

- What does / will the regulator deem acceptable levels for Risk? Level? Change? Any other multidimensional targets/hurdle rates required to drive scenario changes?

- Issue of turning all to Network risk value and potential to then loose visibility of material changes to the individual assets. – what reports are possible/required?

- Is the new methodology a reasonable way of identifying risk?

- What is the biggest benefit by changing the methodology? Is it just financial benefit for the TO's?

- How often is the risk value going to be reviewed? What will be the process?

- Financial values- who has been consulted in agreeing them?

- How does the new methodology cater for special cases? How are they taken in to account?

Spurious aims identified in document

- none

Whether aim is achievable

- none

Incomplete nature of NOMs methodology

- In the current 4 by 5 matrix, movement is clear and can easily monitor and identify change; however, in the new methodology it is not clear.
- What is going to be the approach for reporting and how will we manage the change in the level of risk?
- Risk trading model; will there be more detail provided within in the methodology?
- High amounts of data are/will be required. What about calculating cost of getting this detail vs. the benefit that the data will help to deliver.
- Assumptions log omission was raised.
- Risk Trading Model: What will it look like?
- Request/suggestion for a web based simple model to demonstrate what might happen if all replacement was made to one particular Lead asset type v another (to demonstrate the interconnected nature of the network?).
- This might be made available/developed to test changes ?

Confusion about the different methods adopted

- none

Appendix II – HILP

High Impact Low Probability (HILP) events are events whose likelihood of occurrence is historically, or predictably negligible, but with significant consequences. Negligible can be considered as an event occurring less than once-in-one-hundred years, and significant as an event that prevents the delivery of a key output, or to have a profound societal effect[1]. A HILP event is not defined by its probability. The event merely needs to be possible and the significant outcome credible.[2] For electricity transmission this includes events such as a widespread blackout[3][4]. Although, with the benefit of hindsight, actions can be identified that would have prevented the initial incident occurring. By nature if a HILP event can be identified, actions can be taken to mitigate the risk. Thus, it would be neither high impact nor low probability, so would no longer be a HILP event. Hence, HILP events only occur under unforeseen circumstances.

HILP events are cascade failures, where there is a combination of failures which led to the incident. They often cross organisations and sectors, and affect a wide range of stakeholders. Due to their high interdependence it is difficult to attribute blame to one failure or body. Taleb (2007) refers to HILP events as Black Swans[5]. He argues that Black Swans by nature are impossible to predict yet they have catastrophic consequences. If we could predict them, we would be able to mitigate the size of the risk and it would no longer be a high consequence event, or may not even occur.

Limitations of Conventional Asset Risk Methodologies

Conventional risk methodologies require likelihood and consequence to be identified, resulting in;

$$Risk = Likelihood \times Consequence$$

This approach works on a portfolio basis, where there is historical data or detailed knowledge to accurately calculate an average likelihood and consequence for the associated event. In terms of the NOMs Methodology, this works for asset failures, which occur throughout the year on the UK network. As well as being able to relate to asset failures from other countries, when applicable. Thus, the risk of calculating the asset failure works with sufficient historical data or detailed knowledge about the asset and its response to an event.

When there is not enough historical data about an assets response to an event, the risk cannot be accurately evaluated. Because there are too many possibilities that the average is influenced by anomalies, which cannot be identified without a large enough population of results for comparison. Similarly, asset risk cannot capture unknown unknown events, scenarios that are not yet apparent

[1] Ernst and Young (2016). *High Impact, Low Probability events.* (Report for TOs). London : EY
[2] EA Technology Ltd (2016). *National Grid Transmission Approach to HILP events.* (Report). Chester: EA Technology Ltd
[3] Government Office for Science (2011). *Blackett Review of High Impact Low Probability Events.* [pdf] Available at: <https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/278526/12-519-blackett-review-high-impact-low-probability-risks.pdf> [Last accessed 1st December 2016]
[4] Chatham House (2012). *Preparing for High Impact Low Probability Events. Lessons from Eyjafjallajökull.* [pdf] Available at: <https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/r0112_highimpact.pdf> [Last accessed 1st December 2016]
[5] Taleb N.N. (2007). *The Black Swan.* London: Penguin Random House

such as failure modes. This can be due to new assets on the system of a different model, family or manufacturer to previous commissioned assets, where there is limited knowledge about the new assets. As new scenarios become evident the calculations for likelihood of failure will need to be re-evaluated to take these into account. HILP events are also unknown unknown events, which cannot be taken into account within an asset risk calculation, due to the lack of historical data or detailed knowledge about the assets response to an event to calculate an average likelihood or consequence of an identified HILP event.

Why Normal Treatment will lead to Incorrect Results

Due to the nature of HILP events, there is not enough historical data or detailed knowledge about the assets response to an event to accurately assess the likelihood or consequence of an event occurring. Thus, it is not possible to assess the risk on a portfolio basis. Each HILP event that has occurred in the past cannot be directly compared to a feasible future HILP event. In terms of HILP events that the UK TOs can influence through asset management, this is due to differences in countries infrastructure, approach to supplying electricity and asset management.

Chapman and Ward (2003), Hubbard (2009) and Wideman (1992) all emphasise the importance of taking into account HILP events within risk management[6][7][8]. Without these being taken into consideration the contingencies prove inadequate, and an organisation is likely to fail under these circumstances. HILP events should therefore be taken into account when considering how to manage the network risk.

However, the current methodology relies on the risks fitting a portfolio to allow for asset risk to be calculated. This involves averaging data to inform on an appropriate likelihood and consequence. However, HILP events cannot be evaluated due to a lack of data. Thus, they do not fit a risk portfolio. Hence, other considerations need to occur to account for the risks which are not captured within the asset risk.

Asset Management

As mentioned previously HILP events are a result of cascade failures. This can be down to an asset failure triggering instability within a network, or an asset failing to operate as expected when re-energising an area. Therefore, asset management of this kind falls into two categories: resilience and recovery. The three TOs can influence the risk of a HILP event by affecting either the likelihood of it happening, through resilience, or the consequence of the event, through recovery.

Ensuring assets are of good health will mean that the likelihood of a catastrophic event occurring from asset failure almost diminishes, other than for unknown failure modes. Likewise, assets should be fully operational when they are required for return to service. Historically assets have been known to fail through system events; faults, switching or re-energisation. Effective asset management reduces the likelihood of their failure as part of resilience and recovery for events.

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[6] Chapman C. and Ward S. (2003). *Project Risk Management. Processes, Techniques and Insights.* 2nd Ed. Chichester: John Wiley & Sons

[7] Hubbard D.W. (2009). *The Failure of Risk Management. Why It's Broken and How To Fix It.* New Hoboken, New Jersey: John Wiley & Sons

[8] Wideman R.M. (1992). *Project & Program Risk Management: A Guide to Managing Project Risks & Opportunities.* Newton Square, Pennsylvania: Project Management Institute

HILP Assets

HILP assets require identification to ensure acknowledgement that they hold an extra risk that cannot be quantified within asset risk. This enables TOs to ensure that any asset with this designation, when identified for replacement, is not deferred from delivery due to any emergent issues. Unless that emergent issue is to change the assets classified as being HILP assets.

A HILP asset is identified as an asset that has a potential effect on the risk of a HILP event occurring, or recovery from that event. Within Transmission Ownership there is a scale of what can be considered. The assets on substations feeding the following sites have in previous iterations of the NOMs Methodology been considered as HILP assets:

- Nuclear sites
- Substations with Blackstart contracts
- COMAH sites
- Economic Key Points
- Transport Hubs
- National Security Sites
- Sites identified as Critical National Infrastructure

Nuclear and Blackstart sites differ from the other five sites in that the TOs have a legal obligation to ensure that they fulfil their obligations. For Nuclear sites this is in the Nuclear Site Licence Provisions Agreement (NSLPA) and a legal obligation to ensure that a Nuclear site remains connected. This is to reduce the likelihood of an excursion or emergency shutdown that may have a high societal cost. This is one of the control measures in place to reduce the likelihood of a Nuclear site becoming unstable, of which the TOs are contractually obliged to uphold in the interest of public safety.

In relation to Nuclear sites, HILP assets are identified as assets on coloured circuits, which directly feed a Nuclear site. The N-2 principle is clearly understood and valued by TOs customers and stakeholders, hence it would be a reasonable basis on which to consider which assets should be considered as HILP assets within that substation. This ensures stability of the site, should one of the assets on the main or reserve bars on the substation fail in service. This is a requirement within the NSLPA, to ensure the Nuclear site is connected, and the N-2 principle is consistent with the Security and Quality of Supply Standard (SQSS)[9].

Similarly, the three TOs have legal obligations to ensure that Blackstart sites are able to restore local supply following a widespread power outage. This is in line with the obligations under OC9 in the Grid Code. This requirement extends to the TOs to ensure restoration of the Total System and associated Demand in the shortest possible time. To enable the Blackstart generator to energise a Local Joint Restoration Plan the assets on the relevant substation need to be fully operational, to

[9] National Grid (2014) *National Electricity Transmission System Security and Quality of Supply Standard.* V 2.2, 5th March 2012-Current. [pdf] Available at: < http://www2.nationalgrid.com/uk/industry-information/electricity-codes/sqss/the-sqss/> [Last accessed 22nd November 2016]

allow for a route out of the substation, and connect the surrounding area. This in turn will allow for the Power Islands to expand leading to Total System energisation[10]. To meet legal obligations the sites with Blackstart contracts shall be considered as HILP sites, where the HILP assets will be identified under the N-2 principle, consistent with the SQSS. This allows for local restoration should one of the assets on the main or reserve bars fail to re-energise.

COMAH sites include a range of sites with hazardous materials such as whiskey distilleries as well as large petrochemical plants. The worst case scenario for COMAH sites, explosion of site, is significant. However, the COMAH sites will have controls in place in the case of a loss of supply as part of their Major Accident Prevention Plans in line with COMAH legislation. The TOs do not have a legal obligation to act as a safety mechanism for COMAH sites. Moreover, the consequence of a loss of supply event relating to COMAH sites is incorporated into system consequence, and will be included within the overall asset risk.

Similarly, with Economic Key Points, Transport Hubs and sites of Critical National Infrastructure, the consequence of loss of supply will be incorporated into system consequence and already incorporated into an asset's risk calculation.

The TOs do not have a legal obligation to ensure supply to National Security Sites, which will have back-up supplies and contingency plans should they lose supply. However, the only HILP event related to loss of National Security Sites involves a nationwide blackout, where all National Security Sites are without supply. This risk is incorporated into the Blackstart scenario. Losing one site would not be considered HILP. Thus, losing a single National Security Site will be incorporated into the system consequence.

Trading Mechanism

The three TOs each have a target network risk that they need to achieve. This can be achieved through identifying interventions to reach the target network risk. The assets identified will include a combination of HILP assets and non-HILP assets. HILP assets, as mentioned above, are identified as assets carrying a greater risk than can be quantified within the asset risk.

The methodology for the management of HILP assets is covered by the Justification section of this methodology document, section **Error! Reference source not found.**.

[10] National Grid (2012) *Operating Code No. 9 (OC9) Contingency Planning.* Issue 5 Rev 0. 17th August 2012. [pdf] Available at: < https://www.nationalgrid.com/NR/rdonlyres/8858D1A7-ACD5-4635-B85F-91985205F611/56332/16_OPERATING_CODE_9_I5R1.pdf> [Last accessed 22nd November 2016]

Appendix III – Justification

This section to outline the specific treatment of interventions that are deemed to be over- or under-delivered against the Network Replacement Output (NRO) targets set at the start of the RIIO-T1 price control. The NRO targets outlined in Table 1 of Special Licence Condition 2M.2 are in place to ensure that at the end of the RIIO-T1 price control period, 31 March 2021, the level of Network Risk is kept at the same level due to the interventions carried out within the 8 year period.

In order to achieve this level of Network Risk, interventions must be performed throughout the price control period. The NRO targets state the specific replacement priorities of the assets remaining on the system at the end of the price control period, categorised by lead assets and broken down by voltage.

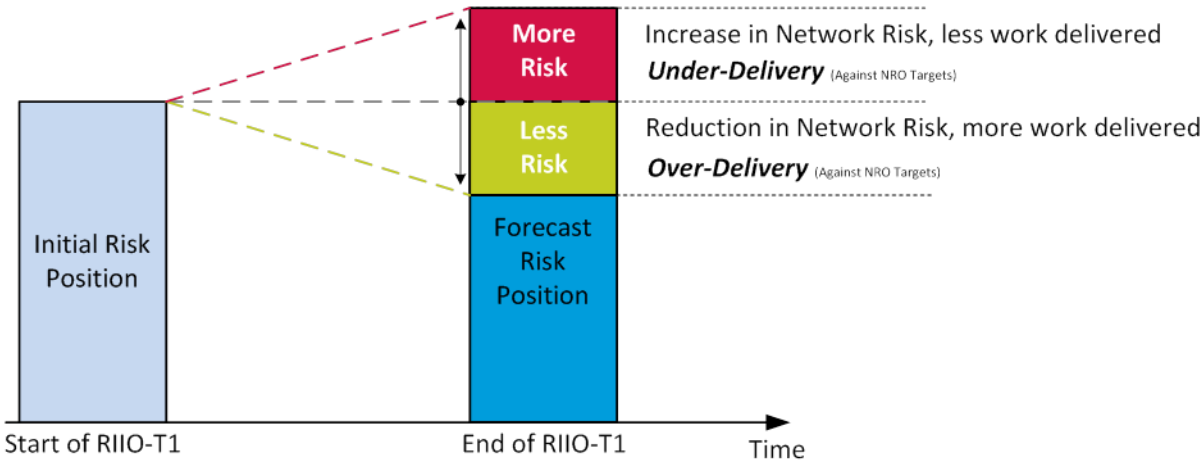
As these targets were set at the start of the price control period, due to the nature of the assets on the system, it is to be expected that the exact number of assets in each category may not be achieved, due to reasons such as changing asset management decisions, or to deterioration occurring at a rate faster or slower than forecast. This gives rise to the need for a mechanism to determine if the Transmission Owner (TO) is in a position of over- or under-delivery against the NRO targets, and whether it is either justified, or not justified.

Special condition 2M.9 states the current treatment for material over- and under-delivery within the RIIO-T1 price control period, and outlines the associated financial treatment if the actual replacement output targets are different.

Incentives	**Justified**	**Unjustified**
Over-delivery	Cost of over-delivery shall be included in the second price control period allowances. The financing cost incurred by the licensee in advancing the investment shall be reimbursed. Reward of 2.5% (per cent) of the additional costs associated with the material over-delivery.	Cost of over-delivery shall be included in the second price control period allowances. The licensee shall incur the financing cost of the earlier investment.
Under-delivery	Cost of under-delivery shall be excluded from the second price control period allowances. The licensee shall benefit from the financing cost of the	Cost of under-delivery shall be excluded from the second price control period allowances. The benefit arising to the licensee from the financing

	delayed investment.	costs of delayed investment shall be clawed back. Penalty of 2.5% (per cent) of the avoided costs associated with the material under-delivery.

In order to determine whether the NRO targets have been achieved at the end of the price control, it must first be determined whether this has adversely impacted the overall Network Risk. This view should be taken initially against the target level for a specific lead asset type, before any determination can be made as to whether the over- or under-delivery against the target is justified, or not justified. This is shown in **Error! Reference source not found.**.



From this, it is clear that in order for the TOs to be in a position of over-delivery, the level of Network Risk at the end of RIIO-T1 will be lower than originally forecast, and assuming other factors remain as forecast (e.g. no changes in forecast rates of deterioration, or identification of data errors) more interventions have been delivered during RIIO-T1 than necessary to achieve the target position. Conversely, if the level of Network Risk at the end of RIIO-T1 is higher than forecast, then the TO has delivered fewer interventions, and has under-delivered against the NRO target position.

Categorisation

In line with the Direction, an objective assessment of over- or under-delivery must then be performed, as well as identifying the material factors contributing to the over- or under-delivery. The position against the targets must then be assessed, to determine whether the delivery is over or under the target level of network risk, and whether the delivery is justified.

Whether considering the targets at the end of RIIO-T1, or monetised targets in future regulatory periods, justification of over- and under-delivery can be applied to:

1. Each specific asset category (i.e. 400kV Circuit breakers, 275kV Circuit Breakers, and 132kV Circuit Breakers)

2. Each voltage category (i.e. All assets at 400kV, 275kV and 132kV)

3. The overall aggregated target (i.e. All assets, at all voltages as a single target)

4. Aggregated asset categories, at an aggregated voltage level (i.e. All circuit breakers, including 400kV, 275kV and 132kV)

Option 4 presents the most straight forward assessment, in line with the existing NRO targets for RIIO-T1, and allows the groupings of similar interventions for an asset category to be made.

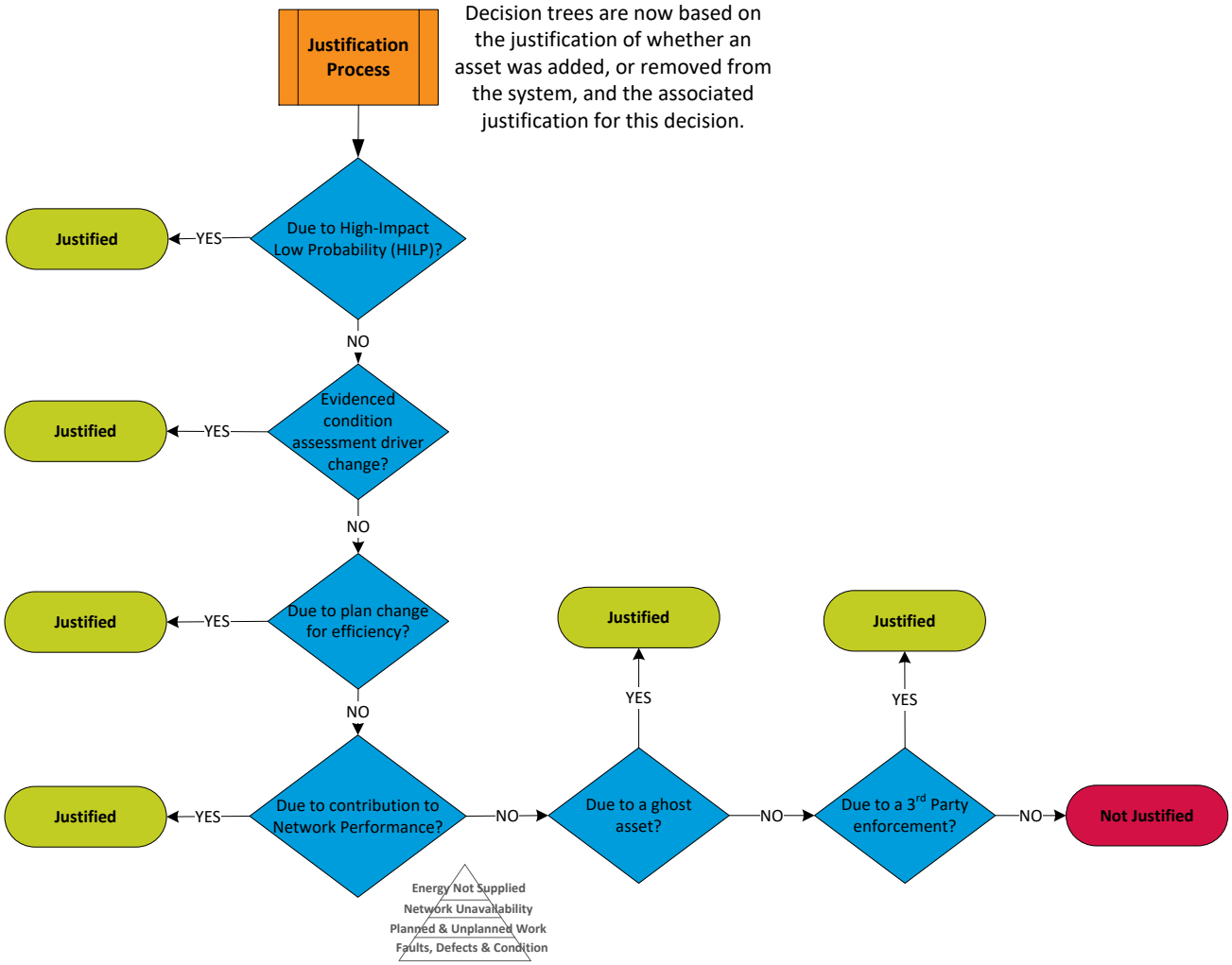
Over- or under delivery may have been achieved by both delivering, and not delivering an intervention, such that an asset may remain on the system through not doing the intervention, or may have been removed from the system through an intervention that was not originally forecast. This can be categorised following the groups below.

Asset removed from the system due to:	**Asset remains on the system due to:**
Worse than forecast condition	Better than forecast condition
Interaction with the load-related plan	Interaction with the load-related plan
Consequence changes (Increase)	Consequence changes (Decrease)
Reprioritisation due to worse than forecast condition of other assets	Reprioritisation due to better than forecast condition of other assets
Data quality revisions	Data quality revisions

Table Representation

In order to review this information, it is relevant to tabulate the categories to show where the interventions are grouped. Using the aggregated asset categories, and aggregated voltages, the targets can be compared with the annual forecast level, or actual level at the end of the RIIO-T1 or T2 period. This can either be represented using the current targets, or monetised targets at an aggregated asset and voltage level.

Once the assets are categorised, each of the specific interventions can pass through the justification process, in order to provide a first-pass classification, as to whether the specific intervention is justified or unjustified. The decision tree below is a representation of the process that would be followed in undertaking this first pass. Balanced and quantifiable evidence will need to be sought at each stage of the process.

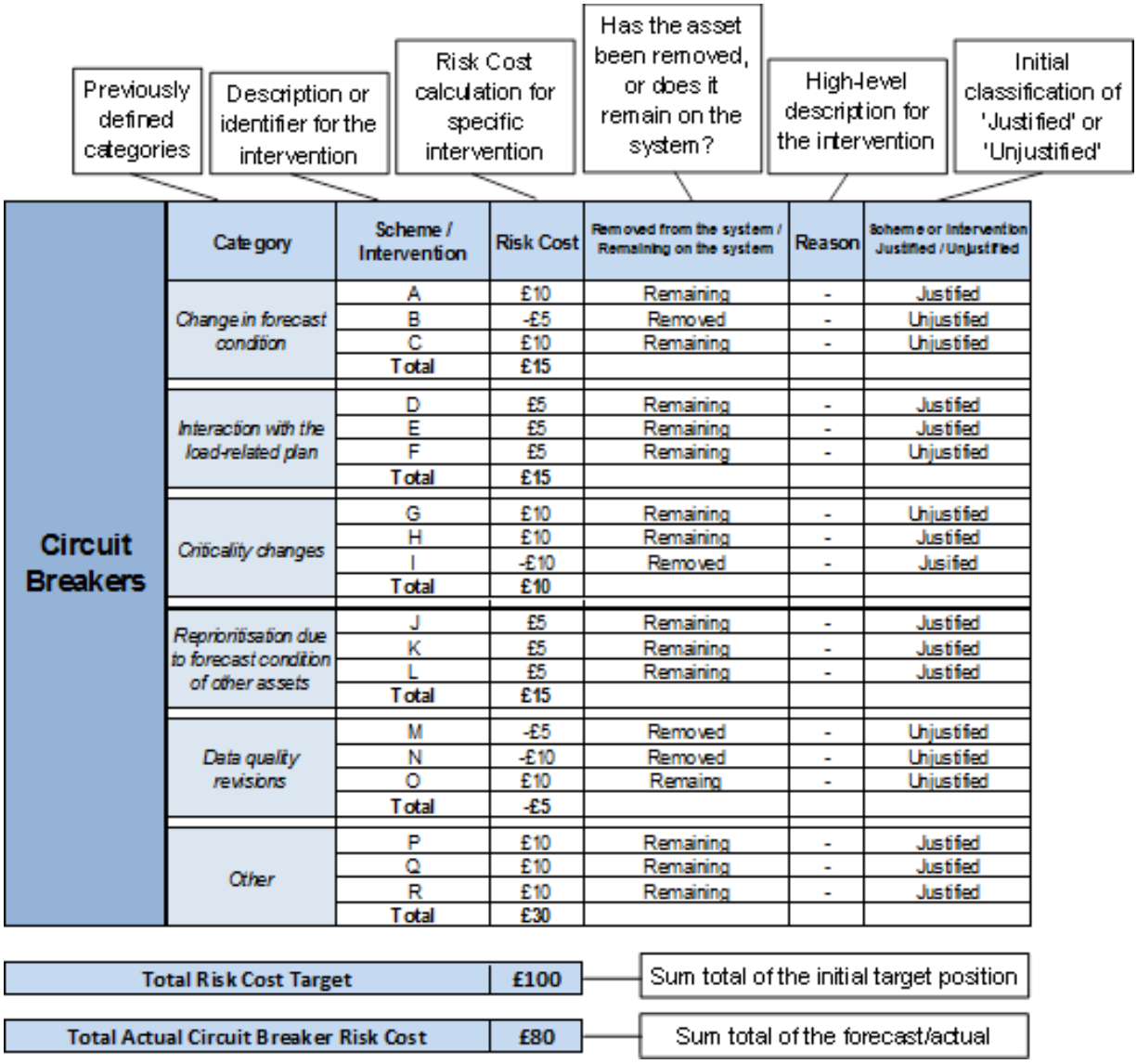


Once these decision trees have been reviewed, an outcome of whether the over- or under-delivery against the target was justified can then be made. It is then clearer, due to the initial aggregation at an asset category and voltage level, as to where the specific over- or under-delivery originated.

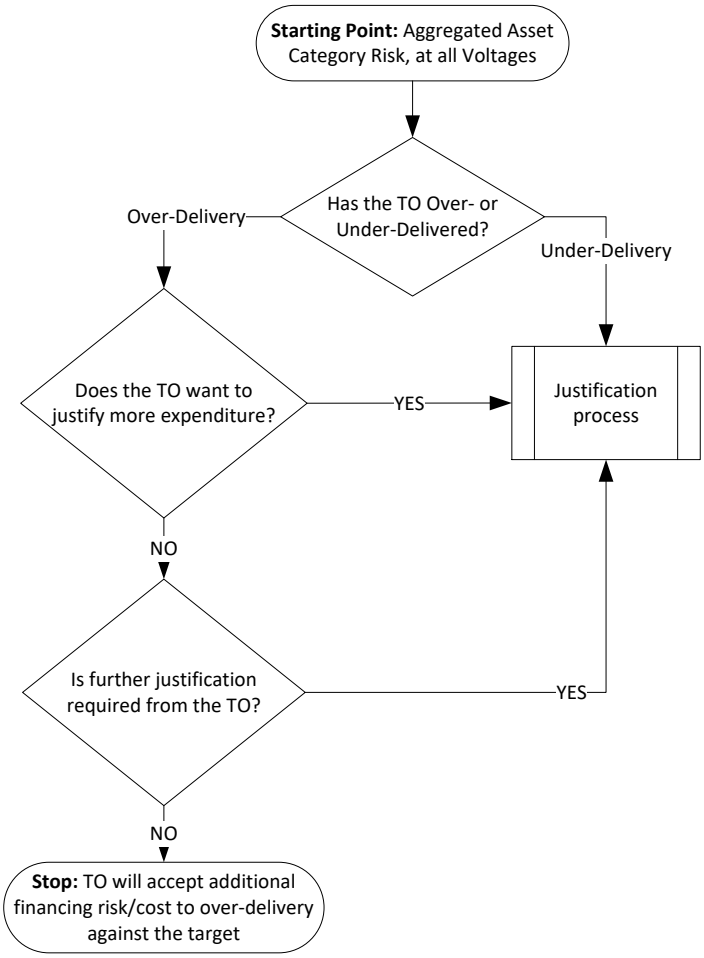
Providing the output has been appropriately categorised consistently with the information in the table above, the NRO target can be assessed against the actual network risk to determine whether this position is over- or under-delivered against the NRO target. This can be performed using the original risk targets, or a monetised Risk Cost, which can be calculated once the targets are monetised:

$$£Risk\ Cost = £Risk_{Before\ Intervention} - £Risk_{After\ Intervention}$$

This provides the monetised Risk Cost associated with performing the intervention, and the specific intervention itself can describe whether the asset has been removed from the system, or whether it remains on the system. Supporting this with a high-level description for why the intervention was performed or not, which could be due to intrinsic or extrinsic factors, supports the process for justifying each of the specific interventions. This has been shown below where Circuit Breakers have been used as an example.



At this level, should a TO have delivered, or over-delivered against an aggregated asset category at all voltages, then it should be assessed whether the TO is seeking to justify the additional expenditure in line with this. In this example, the TO has over-delivered against the target, and the following decision tree outlines the initial treatment of this step.



If the targets have been achieved, or more work has been carried out and the TO has over delivered, and the TO is willing to accept the additional financing costs of this, then the requirement to review the itemised targets is reduced.

If the targets have not been achieved, such that the TO is in a position of under-delivery against the original NRO targets, then there is a need to review the justification for the specific cases of under-delivery. This is then simplified, due to the aggregation of an asset and voltage level assessment, as it may be the case that not all asset categories are under-delivered.

Following this process, justification over- and under-delivery becomes possible, and categorises the intervention in line with special licence condition 2M. The financial treatment of these categories can then be determined, based upon the specific interventions for that particular asset category.