Engineering Report 144

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DNO Common Network Asset Indices Methodology V3.0: Health & Criticality

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Amendments Summary

Issue	Date	Amendment	Outcome
Draft v3	01/07/2015	Formal Draft Submission to Ofgem	Ofgem Direction requesting changes received 23/10/2015
Draft v4	15/12/2015	Draft amended as instructed	Approved by Ofgem on 01/02/2016
v1.0	01/08/2016	For consultation in accordance with SLC 51 Part I	Implemented for December 2016 NAW and SDRP submissions
v1.1	30/01/2017	For consultation in accordance with SLC 51 Part I – Revision to Oil Filled Cable PoF and Steel Tower PoF & Network Performance CoF	Approved by Ofgem in May 2017 for use during RIIO-ED1 April 2015 – March 2023
v2.0 Draft	01/09/2020	For consultation on draft proposed changes for RIIO-ED2 period and beyond incorporating Long Term Risk	Post consultation report in support
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v2.0	01/01/2021	Issued to Ofgem for SSMC	
v2.1	01/04/2021	Minor typos rectified & all reference costs updated to 2020/21 base, including alignment of the time period considered in the derivation of the Long Term Risk to match payback periods considered in the RIIO-ED2 CBA	Approved by Ofgem in April 2021 Published for use during RIIO-ED2 (April 2023 – March 2028)
v2.1 (Issue 1)	June, 2024	Converted to ENA Engineering Document using the ENA standard template	Minor formatting changes and some re-organisation of text in Foreword and Scope. No technical changes to the document in the conversion
v3.0 (Issue 0)	April, 2026	Development of additional asset categories for ED3 Business Planning requirement - Consultation	

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Foreword

This document sets out a common methodology for assessing condition-based risk for electricity distribution assets. This version has been developed by a dedicated Working Group comprising representatives from all six GB Distribution Network Operator (DNO) groups and NIE Networks to meet the regulatory requirements for Network Asset Risk Metrics (NARMs). It supports the specific requirements for ED3 (1 April 2028 to 31 March 2033) but includes additional asset categories out with those requirements. The Working Group has been informed by Ofgem's ED3 Resilience Working Group on NARMs for ED3 development.

The use of the Common Network Asset Indices Methodology (CNAIM) is subject to approval by Ofgem for the regulatory period to which it applies for the asset categories covered by the regulatory licence framework. This CNAIM however contains the methodology under development for future additional approval once it is appropriate for them to be included within the licence reporting requirements.

When approved by Ofgem, this methodology will require DNOs to re-align their current processes and practices to this new standard to meet the revised regulatory reporting requirements.

This document supersedes v2.1 published in April 2021.

Once implemented, DNOs will be required to report annually against the targets set using the methodology to calculate the changes achieved. These reporting requirements are set down in the ED3 Regulatory Instructions and Guidance (RIGs).

1 Introduction

For RIIO-ED1, which ran from 1 April 2015 to 31 March 2023, Ofgem introduced regulatory reporting requirements for GB DNOs to report information relating to both Asset Health and criticality. This information is known as the Network Asset Indices, and these provide an indication of the risk of condition-based failure of network assets. These were used as a Network Output Measure, with DNOs targeted to deliver Network Asset Secondary Deliverables that reflected the risk reduction benefit delivered through activities such as asset replacement and refurbishment.

The requirement for reporting of Network Asset Indices was required within Standard Licence Condition 51 for RIIO-ED1 and Special Licence Condition 9.2 in RIIO-ED2. This licence condition also required DNOs to jointly develop a Common Network Asset Indices Methodology, such that DNOs adopted a common approach to the reporting of indices that measure Asset Health and Criticality.

The Common Network Asset Indices Methodology (v1.1) was first approved by Ofgem in May 2017, for use in RIIO-ED1. A further development was directed by Ofgem for the methodology to incorporate Long Term Risk for use during the RIIO-ED2 period which was approved in April 2021 for use from April 2023 to March 2028. This also aligned with the DNO reporting having changed from Network Output Metrics (NOMs) to the required network risk outputs relating to Network Asset Risk Metrics (NARMs). Network Asset Indices provide the required Network Asset Risk Metrics.

The required network risk outputs relate to the improvement in risk that is delivered by Asset Replacement, as well as some Refurbishment activities. Such activities are referred to as Interventions.

The required network risk outputs will again be agreed as part of the ED3 determination and are consistent across the existing 61 Asset Categories by DNOs however this version of the methodology incorporates a further 26 Asset Categories for potential inclusion in ED3 or future price control periods to be agreed and approved. Each DNO is required to report on all the required network risk outputs for all approved Asset Register Categories regardless of whether they manage such assets, by including a nil return where no assets are managed to ensure consistent reporting. Consequently, DNOs are now required to maintain the Common Network Asset Indices Methodology for all Asset Categories where they are to report the required network risk outputs as agreed for that reporting period. However, this methodology is not limited to just those reported but currently has been developed to cover 87 Asset Categories.

This revised version of the Common Network Asset Indices Methodology (herein referred to as “the Methodology”) has been further enhanced and developed by DNOs for application in ED3 to meet the anticipated changes in regulatory requirements. This revised version also incorporates changes and amendments identified by DNOs based upon the experience gained from implementing the previous two versions of the Methodology during RIIO-ED1 & RIIO-ED2.

1.1 Network Asset Indices Methodology Objectives

For RIIO-ED2, Special Licence Condition 9.2 Network Asset Risk Metric methodology, Part A states the following:

9.2.3 The licensee must have in place and act in accordance with a NARM Methodology which is comprised of: (a) a Common Network Asset Indices Methodology that complies with the requirements of paragraph 9.2.4; and

(b) a Network Asset Indices Methodology that complies with the requirements of paragraph 9.2.6.

9.2.4 The licensee must use best endeavours to work in co-operation with all other Distribution Services Providers to develop and maintain a Common Network Asset Indices Methodology that facilitates the achievement of the NARM Objectives.

9.2.5 The licensee must at all times keep the Common Network Asset Indices Methodology under review and modify it as necessary to ensure that it continues to facilitate the achievement of the NARM Objectives.

9.2.6 The licensee's Network Asset Indices Methodology must: (a) enable the licensee to:

i. assess its NARM Assets against the Network Asset Risk Metric;

ii. report in accordance with the RIGs; and

iii. assess its performance against the Baseline Network Risk Output.

(b) be consistent with the Common Network Asset Indices Methodology.

9.2.7 The licensee must at all times keep its Network Asset Indices Methodology under review and modify it as necessary to ensure it complies with the requirements of paragraph 9.2.6.

The Methodology in this document meets these objectives and those anticipated to apply for ED3.

The Methodology details the inputs, calculations and calibration parameters to be used in the calculation of Asset Health and Criticality. This means that, where the Methodology is applied, a common output shall be determined for a common set of input data. This facilitates use of the output for comparative analysis. For the avoidance of doubt, all values for parameters outlined within this document are fixed and shall be adhered to in the application of the Methodology.

The communication of information relating to the required network risk outputs, and their delivery, shall be through risk matrices (showing Asset Health and Criticality). These are required for regulatory reporting purposes. The output from the Methodology will be used for the population of these risk matrices.

1.2 Asset Health and Probability of Failure

Asset Health is a measure of the condition of an asset and the proximity to the end of its useful life. The Methodology includes a common methodology for the calculation of Asset Health for individual assets. This includes:

a) current Asset Health informed by observed and measured condition factors; and
b) future Asset Health, using assumptions regarding the likely future deterioration in Asset Health.

In order to take account of future deterioration it is necessary for the Methodology to:

a) include some age-based elements within the calculation of Asset Health; and
b) use a continuous Health Score scale for the evaluation of Asset Health.

As the health of an asset deteriorates (i.e. its condition worsens), the likelihood that it will fail due to condition increases.

The Methodology relates Asset Health to the associated probability of condition-based failure (PoF). For each asset type, the Methodology specifies the exact relationship between Health Score and PoF. Therefore, Asset Health can equally be expressed in terms of PoF.

1.3 Consequences of Failure and Asset Criticality

When an asset fails, there will be an associated impact resulting from that failure. For example, there could be a loss of supply to customers, or an injury resulting from a failure. Such impacts are referred to as Consequences of Failure (CoF).

The Methodology includes a common methodology for the evaluation of the likely CoF associated with the condition-based failure of individual assets. Monetised values are determined for all CoF in £ (at 2020/21 prices).

The criticality of an asset is a relative measure of its CoF compared with the Reference Cost of Failures for its asset type.

1.4 Regulatory Reporting of Network Asset Indices

For each asset, the Methodology shall determine:

a) the PoF (per annum);
b) a forecast of the PoF (per annum) in any given future year; and
c) the CoF (£).

associated with condition-based failures. This information is used for the regulatory reporting of the Network Asset Indices for each asset.

The Network Asset Indices comprise three components.

a) Health Index - which relates to Asset Health and PoF;
b) Criticality Index - which relates to CoF; and
c) Risk Index - this is a monetised risk measure, determined from the combination of the Health Index and Criticality Index, which represents the Long Term Risk associated with asset failure and is the present value (£) of the current and future risk associated with a typical asset within the relevant Health Index and Criticality Index Bands.

The Health Index is a framework for collecting information relating to Asset Health and PoF. The Health Index consists of five bandings. Assets are allocated a Health Index Band based on the Health Score that is determined for the individual asset, which can be directly related to its PoF.

The Criticality Index is a framework for collecting information relating to CoF. The Criticality Index consists of four bandings. Assets are allocated to a Criticality Index Band according to the relative magnitude of the CoF of the individual asset compared to a reference value for the relevant Asset Category.

Each reported asset is allocated to the Risk Matrix which consists of a Health Index Band and a Criticality Index Band. The Risk Index for an asset is based on its position in the Risk Matrix. By assigning a typical PoF and degradation assumptions to each Health Index Band, and a typical CoF to each Criticality Index Band, a monetised value of Long Term Risk (i.e. the present value of current and future risk) can be determined.

Separate Risk Matrices are produced to show:

a) existing asset risk;
b) asset risk at the end of a price control period without taking into account any impact of planned interventions; and
c) asset risk at the end of a price control period taking account of planned interventions.

1.5 Hierarchy of Asset Categories

The Methodology applies to many different types of assets (e.g. overhead line conductor, cables, switchgear etc.).

Whilst the Methodology applies the same generic principles in evaluating health and criticality for each asset type, the inputs, calculations and calibrations differ for different types of assets.

For different asset types, this recognises variations in:

a) the types of Condition-based Functional Failures;
b) the evaluation of Asset Health; and
c) the impact of failure.

Within this document the inputs, calculations and calibrations are often specified according to the type of asset. The groupings of assets used for specifying this information are referred to as Asset Categories.

There are two main types of Asset Category used within this document:

a) Asset Register Category; and
b) Health Index Asset Category.

The Asset Register Category represents the groupings of asset type that are used in reporting the asset population in Ofgem’s ED3 RIGs. The Asset Register Category is also used for the annual reporting of Network Asset Indices to Ofgem.

The Health Index Asset Category represents groupings of asset type at a higher level than the Asset Register Category, where common parameters or treatments are applied in the Methodology.

In this document, each Health Index Category is used to describe the inputs, calculations and calibrations that shall apply to assets in the Asset Register Categories shown in Table 1.

Table 1 – Categorisation of Assets

Health Index Asset Category	Asset Register Category
Battery System	Batteries at GM HV Substations Batteries at 33kV Substations Batteries at 66kV Substations Batteries at 132kV Substations
LV OHL Support	LV Poles
LV Main OHL Conductor (Pole Lines)	LV Main OHL Conductor
LV UGB	LV UGB
LV Switchgear and Other	LV Board (WM) LV Board (X-type Network) (WM) LV Circuit Breaker LV Pillar (ID) LV Pillar (OD at Substation) LV Pillar (OD not at a Substation)
HV OHL Support - Poles	6.6/11 kV Poles 20 kV Poles
HV OHL Conductor (Pole Lines)	6.6/11 kV OHL (Conventional Conductor) 6.6/11 kV OHL (BLX or similar Conductor) 20 kV OHL (Conventional Conductor) 20 kV OHL (BLX or similar Conductor)
HV Switchgear (PM)	6.6/11 kV CB (PM) 6.6/11 kV Switch (PM) 6.6/11 kV Switchgear - Other (PM) 20 kV CB (PM) 20 kV Switch (PM) 20 kV Switchgear - Other (PM)
HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary 6.6/11 kV RMU 6.6/11 kV X-type RMU 6.6/11 kV Switch (GM) 20 kV CB (GM) Secondary 20 kV RMU 20 kV Switch (GM)
HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary 20 kV CB (GM) Primary
HV Transformer (PM)	6.6/11 kV Transformer (PM) 20 kV Transformer (PM)

Health Index Asset Category	Asset Register Category
HV Transformer (GM)	6.6/11 kV Transformer (GM) 20 kV Transformer (GM)
EHV OHL Support - Poles	33 kV Pole 66 kV Pole
EHV OHL Conductor (Pole Lines)	33 kV OHL (Pole Line) Conductor 66 kV OHL (Pole Line) Conductor
EHV OHL Fittings	33 kV Fittings 66 kV Fittings
EHV OHL Conductor (Tower Lines)	33 kV OHL (Tower Line) Conductor 66 kV OHL (Tower Line) Conductor
EHV OHL Support - Towers	33 kV Tower 66 kV Tower
EHV UG Cable (Gas)	33 kV UG Cable (Gas) 66 kV UG Cable (Gas)
EHV UG Cable (Non Pressurised)	33 kV UG Cable (Non Pressurised) 66 kV UG Cable (Non Pressurised)
EHV UG Cable (Oil)	33 kV UG Cable (Oil) 66 kV UG Cable (Oil)
Sub Cables	HV Sub Cable EHV Sub Cable 132 kV Sub Cable
EHV Switchgear (PM)	33 kV Switch (PM)
EHV Switchgear (GM)	33 kV CB (Air Insulated Busbars)(ID)(GM) 33 kV CB (Air Insulated Busbars)(OD)(GM) 33 kV CB (Gas Insulated Busbars)(ID)(GM) 33 kV CB (Gas Insulated Busbars)(OD)(GM) 33 kV RMU 33 kV Switch (GM) 66 kV CB (Air Insulated Busbars)(ID)(GM) 66 kV CB (Air Insulated Busbars)(OD)(GM) 66 kV CB (Gas Insulated Busbars)(ID)(GM) 66 kV CB (Gas Insulated Busbars)(OD)(GM)
EHV Switchgear - Other	33 kV Switchgear - Other 66 kV Switchgear - Other
EHV Transformer (PM)	33 kV Transformer (PM)
EHV Transformer	33 kV Transformer (GM) 66 kV Transformer (GM)

Health Index Asset Category	Asset Register Category
132 kV OHL Support - Poles	132 kV Pole
132 kV OHL Fittings	132 kV Fittings
132 kV OHL Conductor (Pole Lines)	132 kV OHL (Pole Line) Conductor
132 kV OHL Conductor (Tower Lines)	132 kV OHL (Tower Line) Conductor
132 kV OHL Support - Tower	132 kV Tower
132 kV UG Cable (Gas)	132 kV UG Cable (Gas)
132 kV UG Cable (Non Pressurised)	132 kV UG Cable (Non Pressurised)
132 kV UG Cable (Oil)	132 kV UG Cable (Oil)
132 kV Switchgear	132 kV CB (Air Insulated Busbars)(ID)(GM) 132 kV CB (Air Insulated Busbars)(OD)(GM) 132 kV CB (Gas Insulated Busbars)(ID)(GM) 132 kV CB (Gas Insulated Busbars)(OD)(GM)
132 kV Switchgear - Other	132 kV Switchgear - Other
132 kV Transformer	132 kV Transformer (GM)

Within this document several generic terms are used to refer to higher level groupings of assets. The mapping of these generic terms to Health Index Asset Category is shown in Table 2.

Table 2 – Generic Terms for Assets

Generic term		Health Index Asset Category
Batteries		Battery System
Cable	Pressurised Cable	EHV UG Cable (Oil)
		EHV UG Cable (Gas)
		132 kV UG Cable (Oil)
		132 kV UG Cable (Gas)
	Non Pressurised Cable	EHV UG Cable (Non Pressurised)
		132 kV UG Cable (Non Pressurised)
		Sub Cables
Switchgear		LV Switchgear and Other
		LV UGB
		HV Switchgear (PM)
		HV Switchgear (GM) - Distribution
		HV Switchgear (GM) - Primary
		EHV Switchgear (PM)
		EHV Switchgear (GM)
		EHV Switchgear - Other
		132 kV Switchgear
		132 kV Switchgear - Other

<table>
<tr><th colspan="2">Generic term</th><th>Health Index Asset Category</th></tr>
<tr><td rowspan="5">Transformers</td><td rowspan="2">Transformer (PM)</td><td>HV Transformer (PM)</td></tr>
<tr><td>EHV Transformer (PM)</td></tr>
<tr><td>HV Transformer (GM)</td><td>HV Transformer (GM)</td></tr>
<tr><td rowspan="2">Primary & Grid (or EHV & 132 kV) Transformers</td><td>EHV Transformer (GM)</td></tr>
<tr><td>132 kV Transformer (GM)</td></tr>
<tr><td rowspan="10">Overhead Line</td><td rowspan="4">Poles</td><td>LV OHL Support - Pole</td></tr>
<tr><td>EHV OHL Support - Poles</td></tr>
<tr><td>HV OHL Support - Poles</td></tr>
<tr><td>132 kV OHL Support - Poles</td></tr>
<tr><td rowspan="2">Towers</td><td>EHV OHL Support - Towers</td></tr>
<tr><td>132 kV OHL Support - Towers</td></tr>
<tr><td rowspan="2">Fittings</td><td>EHV OHL Fittings</td></tr>
<tr><td>132 kV OHL Fittings</td></tr>
<tr><td rowspan="2">OHL Conductor</td><td>LV Main OHL Conductor (Pole Lines)</td></tr>
<tr><td>HV OHL Conductor (Pole Lines)</td></tr>
<tr><td rowspan="4">Overhead Line</td><td rowspan="4">OHL Conductor</td><td>EHV OHL Conductor (Pole Lines)</td></tr>
<tr><td>EHV OHL Conductor (Tower Lines)</td></tr>
<tr><td>132 kV OHL Conductor (Pole Lines)</td></tr>
<tr><td>132 kV OHL Conductor (Tower Lines)</td></tr>
</table>

In some calibration tables, asset subcomponents are identified. where not explicitly stated the calibration of the Health Index Asset Category applies to all subcomponents.

Defined Asset Register Categories not covered by the Methodology are shown in Table 3.

Table 3 – Excluded Asset Register Categories

Asset Register Category	Voltage
LV Service (OHL)	LV
LV Main (UG Consac)	LV
LV Main (UG Plastic)	LV
LV Main (UG Paper)	LV
Rising & Lateral Mains	LV
LV Service (UG)	LV
LV Service associated with RLM	LV
Cut Out (Metered)	LV
LV Transformers/Regulators	LV
6.6/11 kV UG Cable	HV
20 kV UG Cable	HV
Pilot Wire Overhead	Other

Asset Register Category	Voltage
Pilot Wire Underground	Other
Cable Tunnel (DNO owned)	Other
Cable Bridge (DNO owned)	Other
Electrical Energy Storage	Other

2 Scope

The document sets out the overall process for assessing condition-based risk and specifies the parameters, values and conditions to be used. The collective outputs of the assessment, used for regulatory reporting purposes, are known as the Network Asset Indices under the Common Network Asset Indices Methodology. The methodology requires approval from Ofgem and can be amended subject to an agreed change process.

3 Normative references

The following referenced documents, in whole or part, are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3.1 Standards publications

BS EN IEC 60422:2024, *Mineral insulating oils in electrical equipment - Supervision and maintenance guidance*

BS EN IEC 61203:2025, *Synthetic organic esters for electrical purposes - Guide for maintenance of transformer esters in equipment*

BS EN IEC 62975:2021, *Natural esters – Guidelines for maintenance and use in electrical equipment*

BS EN IEC 60599:2022, *Mineral oil-impregnated electrical equipment in service — Guide on the interpretation of dissolved and free gases analysis*

IEEE C57.155-2014, *IEEE Guide for Interpretation of Gases Generated in Natural Ester and Synthetic Ester-Immersed Transformers*

3.2 Other publications

[N1] RIIO-ED2 Business Plan Data Template - Glossary (08 October 2021) https://www.ofgem.gov.uk/sites/default/files/2021-10/RIIO-ED2BPDTs-Glossary.pdf

[N2] *The Green Book (2020),* HM Treasury, The Green Book (2020)

[N3] *Reliability Centred Maintenance*, John Moubray, 1991, Butterworth Heinemann.

[N4] Current guidance about what should and should not be considered in a duty holder's cost benefit analysis (CBA) for health and safety ALARP determinations. https://ukopa.co.uk/wp-content/uploads/2025/07/UKOPA-04-0089.pdf

[N5] *Expert System for Assessing Transformer Condition*, EA Technology Report No. 4969, Project S0446*, (M Black, J R Brailsford, D Hughes & M I Lees Sept 1999)
*This report was produced as part of a customer-funded project and is not publicly available.

[N6] Electricity Safety, Quality and Continuity Regulations 2002, as amended in 2006 (ESQCR). http://www.legislation.gov.uk/uksi/2002/2665/contents/made

[N7] Current HSE cost models. HSE: Economics of Health and safety - Appraisal values or 'unit costs'

[N8] *Reducing risks, protecting people - HSE's decision-making process* (first published in May 1999). https://www.hse.gov.uk/enforce/assets/docs/r2p2.pdf

[N9] *The National Galvanizers Association*, https://www.galvanizing.org.uk/corrosion-map/

[N10] *Update Short-Term Traded Carbon Values (2019) : Table 1 Central*, HM Treasury, Update Short-Term Traded Carbon Values (2019) : Table 1 Central

[N11] *Greenhouse gas reporting: Conversion Factors 2020 - condensed set (for most users),* HM Treasury, Greenhouse gas reporting: Conversion Factors 2020 - condensed set (for most users)

[N12] *Guidance on estimating carbon values beyond 2050: an interim approach*, HM Treasury, Guidance on estimating carbon values beyond 2050: an interim approach

4 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

Term	Definition
Ageing Rate	A parameter that describes the rate of deterioration of Asset Health with age.
Ageing Reduction Factor	A factor that slows down the Ageing Rate of older assets.
Asset Category	A generic term to describe a group of asset types where an input, calculation or calibration within the Common Network Asset Indices Methodology is common.
Asset Health	Represents the condition of an asset measured against a common set of condition factors.
Asset Register Category	Groupings of asset type that are used in reporting the asset population in Ofgem's RIIO-ED2 RIGs. Asset Register Categories are used as Asset Categories within this document, where appropriate.
Asset Replacement	An activity defined in Ofgem's RIIO-ED2 Business Plan Data Template – Glossary [Ref. N1] to remove an existing asset(s) and install a new asset.
Average Overall Consequence of Failure	The mean average of the Overall Consequence of Failure for all assets within the same Health Index Asset Category.
Catastrophic Failure	A sudden or total functional failure of an asset (or a subcomponent), from which recovery of the asset (and/ or subcomponent) is impossible.
Condition-based Functional Failure	The inability of an asset to perform its required function, because of the condition of asset. This includes: failures disruptive to the supply of electricity; catastrophic failures of equipment or subcomponents; failure of an asset to operate (or be operated) when required; and failure of an asset to perform its rated duty.
Condition Cap	A maximum limit of Health Score, which forms part of a Condition Modifier.
Condition Collar	A minimum limit of Health Score, which forms part of a Condition Modifier.
Condition Factor	A Factor, which forms part of a Condition Modifier.
Condition Input	Result of an observation or test, used to evaluate the health of an asset.
Condition Input Cap	A maximum limit of Health Score associated with a particular Condition Input.
Condition Input Collar	A minimum limit of Health Score associated with a particular Condition Input.
Condition Input Factor	A Factor associated with a particular Condition Input.
Condition Modifier	A Modifier based on a set of observed or measured Condition Inputs.
Consequence Categories	Categories relating to the different areas that may be impacted by asset failure. The categories represent areas where the Consequences of Failure can be separately evaluated.
Consequences Factor	A Factor applied to the Reference Cost of Failure in order to determine the Consequences of Failure of an asset.

Term	Definition
Consequences of Failure	The impact of Condition-based Functional Failure of an asset.
Criticality	A generic term to describe the Consequences of Failure of an asset and indicate its importance in the electricity network
Criticality Index	This is a framework for collating information on the Consequences of Failure of distribution assets and for tracking changes over time. The Criticality Index is a comparative measure of Consequence of Failure. For a particular asset, the Criticality Index is provided by: the location of the asset within the Criticality Index Bands; and the Reference Costs of Failure, for the relevant Asset Register Category
Criticality Index Banding Criteria	The criteria used to define the Criticality Index Bands, expressed as a percentage of the Reference Costs of Failure for each Asset Register Category.
Criticality Index Bands	Bandings used for the reporting of the Overall Consequence of Failure for individual assets, relative to the Reference Costs of Failure for assets in the same Asset Register Category.
Current Health Score	The Health Score calculated for an asset that represents the Asset Health at the time (i.e. in the year) of calculation.
Degraded Failure	A functional failure of an asset (or a subcomponent), from which the asset (and/ or subcomponent) can be restored, but it may not be cost effective to do so.
DGA Test Modifier	A Condition Modifier applied to HV Transformer, EHV Transformer and 132 kV Transformer assets, based on the results of dissolved gas analysis.
Duty Factor	A Factor representing the effect that duty has on the Expected Life of an asset.
Expected Life	The time (in years) in an asset's life when it would be expected to first observe significant deterioration (Health Score 5.5), taking into consideration location or duty, in addition to the asset type.
Factor	A multiplication value, varying around unity.
FFA Test Modifier	A Condition Modifier applied to HV Transformer, EHV Transformer and 132 kV Transformer assets, based on measurements of furfuraldehyde (FFA) in oil.
Future Health Score	The Health Score(s) calculated for an asset that represents the Asset Health in any year beyond the current year.
Health	A generic term to describe the Asset condition and indicate its level of degradation.
Health Index	A framework for collating information on the Asset Health of distribution assets. This framework shall enable: tracking of changes in Asset Health over time; and identification of the Probability of Failure associated with the asset condition. For a particular asset, the reported Health Index is provided by the location of the asset within the Health Index Bands.
Health Index Asset Category	Asset categorisations, used within the Network Assets Workbook, for which DNOs have agreed Secondary Deliverables. Health Index Asset Categories are used as Asset Categories within this document, where appropriate.

Term	Definition
Health Index Banding Criteria	The criteria used to define the Health Index Bands.
Health Index Bands	Bandings used for the reporting of the Health Indices for individual assets, based on the Probability of Failure indicated by each asset's health and condition.
Health Score	A numerical value representing a measure of Asset Health.
Health Score Cap	A maximum limit applied to the Health Score, associated with a particular condition point.
Health Score Collar	A minimum limit applied to the Health Score, associated with a particular condition point.
Health Score Factor	A Factor based on one or more Condition Modifiers.
Health Score Modifier	A Modifier applied to the Initial Health Score of assets.
Incipient Failure	A functional failure of an asset (or a subcomponent), which if unaddressed may lead to a degraded or catastrophic failure.
Initial Health Score	The Health Score calculated for an asset, based solely on age-based criteria.
Location Factor	A Factor representing the effect that the environment, in which the asset is installed, has on its Expected Life.
Long Term Risk	A monetised value of risk that represents the total discounted value of risk based on the predicted Probability of Failure and Consequence of Failure over the period of 30 years of an asset.
Measured Condition Input	A Condition Input associated with the measured condition of an asset
Methodology	For the purposes of this document, the Methodology means the Common Network Asset Indices Methodology.
Modifier	A value derived from factors, used to modify a base value within the Asset Health calculation.
Network Asset Risk Metric (NARM)	The measure by which Ofgem will measure the effectiveness of the asset intervention programmes as directed in its RIIO-ED2 price control determination.
Network Asset Secondary Deliverables	Secondary Deliverables relating to Asset Health, criticality and risk, as defined for the RIIO-ED1 period in Standard Condition 51 of the electricity distribution licence.
Normal Expected Life	The time (in years) in an asset's life when it would be expected to first observe significant deterioration (Health Score 5.5), based on consideration of the asset type alone.
Observed Condition Input	A Condition Input associated with the observed condition of an asset
Oil Test Modifier	A Condition Modifier applied to HV Transformer, EHV Transformer and 132 kV Transformer assets, based on oil test measurements.
Overall Consequence of Failure	The total Consequence of Failure for an asset, taking account of the Consequences of Failure in all Consequence Categories.
Probability of Failure	The likelihood of a Condition-based Functional Failure occurring (per annum).

Term	Definition
Reference Costs of Failure	A base evaluation of the Consequences of Failure in a particular Consequence Category.
Refurbishment	A one-off activity, defined in Ofgem's RIIO-ED2 Business Plan Data Template – Glossary [Ref. N1] that is undertaken on an asset that is deemed to be close to end of life or is otherwise not fit for purpose that extends the life of that asset or restores its functionality.
Reliability Collar	A minimum limit of Health Score, which forms part of a Reliability Modifier.
Reliability Factor	A Factor, which forms part of a Reliability Modifier.
Reliability Modifier	A Modifier applied (at individual DNO discretion) to the Current Health Score of assets.
Risk Index	Has the meaning given in Standard Condition 51 of the electricity distribution licence.
Risk Matrix	The 4x5 matrix formed by the Health Index and Criticality Index respectively

5 Overview of Common Network Asset Indices Methodology

This section gives a high-level overview of the Common Network Asset Indices Methodology. Detailed explanations are given in Sections 7 and 8, with accompanying worked examples in Annex F.

5.1 Key Outputs

The two key outputs from the Methodology are:

a) an evaluation of PoF (the likelihood of condition-based failure per annum) for individual assets; and
b) an evaluation of the CoF associated with condition-based failures for individual assets (i.e. the impact of a failure, expressed as a monetised value, in £).

The risk of condition-based failure, associated with an individual asset, is the product of the PoF and the CoF. Therefore, the two key outputs from the Methodology, when used together, provide information relating to condition-based risk.

PoF and CoF are calculated for all individual assets within those Health Index Asset Categories where a DNO has agreed Network Asset Secondary Deliverables. An overview of the calculation process is shown in Figure 1.

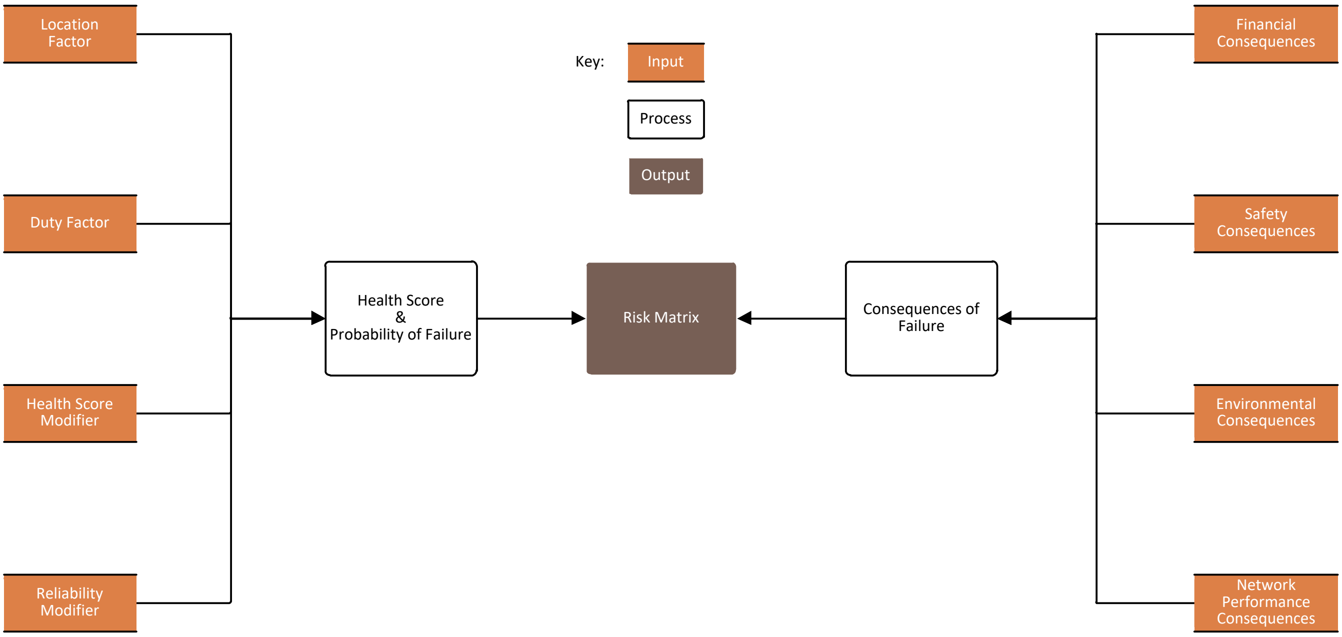

Figure 1 – Process Overview

The regulatory reporting framework for Network Asset Indices comprises three components:

a) the Health Index, summarised in five bands HI1-5;
b) the Criticality Index, summarised in four bands C1-4; and
c) the Risk Index.

For regulatory reporting purposes, individual assets are assigned to a Health Index Band based on the Health Score that has been determined for the asset under the Methodology.

The evaluation of PoF is dependent on:

a) firstly, assessing Asset Health; and
b) then deriving PoF from Asset Health.

Assets are assigned to a Criticality Index Band based on the relative magnitude of their Overall CoF, when compared to a common reference value for the Asset Register Category (the Reference Costs of Failure).

The Risk Index is a monetised risk measure that is calculated from the reported Health Index and Criticality Index information by assigning each cell in the Risk Matrix a reference risk value in £. Given the assessments above, an individual asset can be assigned a position within the Risk Matrix for that asset type.

The allocation of assets to Health Index Bands and Criticality Index Bands, and derivation of Risk Index, is described further in Section 6.

The regulatory reporting of Network Asset Indices includes the reporting of forecast future Health Index and Criticality Index for each asset, as well as the current position. This requires that the Methodology includes assessment of:

a) current PoF and CoF; and
b) forecast future PoF and CoF (including the assessment of changes arising from Interventions). This requires a common assessment of deterioration and a consistent view of which actions impact health and/or criticality.

5.2 Definition of Failure

The evaluation of PoF and CoF within the Methodology may be viewed as two separate distinct calculations. However, they are both based on consideration of the same set of condition-based failure modes (i.e. the same definition of what is a failure) to ensure the same set of potential events is being considered in the assessment of probabilities and consequences.

The Methodology considers Functional Failures in the derivation of PoF and CoF. These relate to the inability of an asset to adequately perform its intended function and therefore are not solely limited to failures that result in an interruption to supply.

Functional failures have been split into three sub-categories (Functional Failure Types), these are described as follows.

Table 4 – Description of functional failure types

Functional failure type	Description
Catastrophic	A sudden and total failure from which recovery of the asset (and or sub component) is not feasible.
Degraded	A significant failure associated with advanced degradation.
Incipient	A minor failure associated with early stage degradation.

The Functional Failures considered in the Methodology are defined for each Asset Category, in Annex A. These relate only to Functional Failures directly resulting from the condition of the asset itself. Failures of function due to third party activities are not included.

5.3 Evaluation of Current Asset Health and Probability of Failure

5.3.1 Overview

This section describes how current Asset Health is calculated and used to derive an associated PoF. Worked examples of this calculation can be found in Annex F.

5.3.2 Current Health Score

The current health of an asset is represented by a Health Score (the Current Health Score) using a continuous scale between 0.5 and 10.

A value of 0.5 on this scale represents an asset where the health is the same as would be expected for a new asset. A Health Score of 5.5 represents the point in an asset's life beyond which significant deterioration may begin to be observed. This is where the PoF of the asset is approximately double that of a new asset. A Health Score of 10 represents an asset in extremely poor condition, where the PoF is 10 times that of a new asset.

The Current Health Score for an individual asset is derived from information relating to:

a) the age of the asset;
b) the Normal Expected Life for an asset of its type;
c) factors relating to aspects of the environment in which the asset is installed that may impact on its Expected Life (Location Factors);
d) factors relating to the usage of the asset at its specific location that may impact on its Expected Life (Duty Factors);
e) factors relating to the observed condition of the asset (Observed Condition Inputs);
f) factors relating to the condition/health of the asset determined by measurements, tests or functional checks (Measured Condition Inputs); and
g) a factor relating to generic reliability issues associated with the individual make and type of an asset (Reliability Modifier).

The calculation of Current Health Score is performed in two main steps:

a) calculation of an initial age-based Health Score (the Initial Health Score) using an age-based degradation model; then
b) modification of the Initial Health Score using:
    - known condition information for the asset;
    - a Reliability Modifier, if appropriate.

These two steps are described in more detail below:

5.3.2.1 Calculation of the Initial Health Score

The Initial Health Score is calculated from the age of the asset and its Expected Life. The Expected Life for the asset is the Normal Expected Life for an asset of its type, adjusted to take account of the Location Factors and Duty Factors relating to the individual asset's location and usage.

A generic exponential relationship between age and health is used to determine the Initial Health Score. The shape of the exponential curve is dependent on the Expected Life of the asset.

The Initial Health Score is capped at a value of 5.5, so that an asset is not assigned a Current Health Score that implies that it has reached the end of its useful life purely on the basis of its age.

The Methodology defines the calculation of Initial Health Score for all Asset Categories. This includes definitions of the Location Factor and Duty Factor to be applied, and their calibration parameters. Therefore, an asset in any DNO Licence Area with the same age, type, location and duty attributes will be assigned the same Initial Health Score using the Methodology.

The steps to calculate the Initial Health Score are detailed in Sections 7.1.3 to 7.1.6.

5.3.2.2 Modification of the Initial Health Score

The Current Health Score is determined by application of a Health Score Modifier, and separate Reliability Modifier, to the Initial Health Score.

A Health Score Modifier is determined for each individual asset, using information relating to the asset's condition. This information can be broadly categorised as either:

- Observed Condition Inputs; or
- Measured Condition Inputs.

Observed Condition Inputs relate to condition information that can be gathered by the inspection of an asset. However, it is not always possible to gather observed condition data without undertaking intrusive inspection.

Alternatively, diagnostic tests, measurements or functional checks may be undertaken to ascertain the health of the asset. Measured Condition Inputs relate to condition information that is collected in this way.

The Methodology defines various Observed Condition Inputs and Measured Condition Inputs that can be used to determine the Health Score Modifier for an asset, including their calibration parameters.

These Condition Inputs and the methodology for determining the values for the Health Score Modifier are detailed in Sections 7.8 to 7.15.

The application of the Health Score Modifier to the Initial Health Score to determine the Current Health Score is described in Section 7.1.7.

It may be appropriate to apply a Reliability Modifier in the derivation of the Current Health Score (as detailed in Section 7.15). This is applied to take account of assets, where in individual DNO or industry experience, there are asset type or make issues leading to material differences in the reliability of the asset. where a DNO applies a Reliability Modifier to an asset, this shall be described within their own Network Asset Indices Methodology.

In recognition that different inspection and assessment approaches exist between DNOs, there is no requirement for data to be collected to apply all the Condition Inputs specified within the Methodology.

Where DNOs have collected the same condition information for an asset, application of the Methodology shall result in the same Health Score Modifier values being determined for the asset. As there is commonality in the derivation of the Initial Health Score, an asset in any DNO with the same age, type, location, duty and collected condition information will be assigned the same Current Health Score using the Methodology, except where a Reliability Modifier is applied.

The Reliability Modifier is applied at the final stage of the calculation of Current Health Score so that its effect on the Current Health Score can be directly observed.

The Current Health Score is capped at a value of 10.

5.3.3 Current Probability of Failure

For each Asset Category, the relationship between Health Score and PoF is defined within the Methodology. The current PoF is derived from the Current Health Score. This is described in Section 7.

As this relationship and its calibration values are defined, the PoF for assets will be identical where the Health Score and Asset Category are the same. This means that an asset in the same health is considered to have the same likelihood of condition-based failure irrespective of which DNO it is installed in.

5.4 Evaluation of Future Asset Health and Probability of Failure

5.4.1 Overview

The evaluation of future PoF assumes that as an asset ages in the future then its health will deteriorate and consequently the PoF will increase. This is performed by evaluating the forecast future Asset Health for the asset and then deriving the associated PoF.

5.4.2 Future Health Score

The Future Health Score is derived using similar age-based deterioration assumptions to those used in the calculation of the Initial Health Score. It is derived by forecasting forwards from the Current Health Score using a simple exponential relationship as detailed in Section 7.1.10.

The rate of deterioration used for forecasting the Future Health Score is informed by the amount of deterioration in Asset Health that has already been observed for the asset from its current state (i.e. Current Health Score) and age. This is detailed in Section 7.1.7.

The Future Health Score is capped at a value of 15, which is higher than the cap that is applied to the Current Health Score. This is to enable modelling of further deterioration of all assets.

5.4.3 Future Probability of Failure

The calculation of future PoF uses the same relationship between Health Score and PoF that is used in the derivation of the current PoF (see Section 5.3.3 above).

The future PoF for an asset is derived by applying this relationship to the Future Health Score.

5.4.4 Interventions

The reporting of Health Index and Criticality Index requires the effect of investment activities that are aimed at managing the risk of condition-based failures to be evaluated. This is described in Section 7.1.11.

5.5 Evaluation of Consequences of Failure

The Methodology separately evaluates the CoF for each individual asset, in four specified Consequence Categories:

a) Financial (incorporating repair & replacement costs);
b) Safety;
c) Environmental; and
d) Network Performance.

A monetised value in £ (at 2020/21 prices) is assessed for each of these Consequence Categories. The Overall Consequence of Failure for an asset can therefore be derived by the summation of the CoF in each of these categories. These represent the impact of a failure and the societal cost of that impact.

The methodology for the calculation of CoF in each of the Consequence Categories is based on the use of Reference Costs of Failure. These are defined in Section 8 of the Methodology and are common, using accepted societal costs where available.

For an individual asset, the CoF associated with the asset is driven by the localised situation of the asset. For example, the Network Performance impact will be driven by the number of customers, or amount of load, that is affected by failure of the asset. Similarly, the environmental impact may be dependent on the proximity of the asset to an environmentally sensitive area (such as a watercourse).

To reflect this, the CoF associated with each individual asset is determined by application of asset-specific modifying factors to the appropriate reference cost. These factors represent the variation to the reference costs that results from the localised situation of the individual asset.

The Methodology specifies the asset-specific factors that shall be applied in the derivation of the CoF and also the associated calibration values. As a result, application of the Methodology results in a consistent evaluation of the CoF, across DNOs, which also reflects the localised situation of individual assets.

Section 8 provides details for the methodology for determining CoF. Worked examples of this calculation can be found in Annex F.

5.6 Assimilating innovation in operation and maintenance

The Methodology has been designed such that it can seamlessly incorporate future innovation in operation and maintenance. Innovation in condition monitoring in particular has been a key driver in the development of health scores across electricity distribution over the last two decades. We envisage continual development and improvement in this field.

There are two key mechanisms that allow new developments to be assimilated:

a) Much innovation consists of improving ways of understanding existing aspects of DNO assets better. Input factors have therefore been designed so that they are broad enough in description to allow the mapping of new techniques to existing factors. For example, partial discharge is one of the measured Condition Modifiers in many Asset Categories, but how partial discharge is measured is non-prescribed. As better techniques are developed, they can be used without requiring revision of the Methodology; and

b) Occasionally innovation might produce a new technology which would allow a brand-new Condition Modifier to be used. In such an instance, the agreed change process with Ofgem would be invoked to determine the appropriate weightings for inclusion of the new factor. The Methodology combines multiple Condition Inputs using an approach that ensures that such a change is easy to implement and also that it can be incorporated into the Methodology without causing knock-on effects on the existing set of Modifiers.

Another area of innovation is in the development of new interventions. The process of scoring assets post intervention is described in Annex C to this document which is in turn governed under the RIGs Annex A and referenced in the RIIO-ED2 Business Plan Data Template – Glossary [Ref. N1]. Subject to any change in the RIGs, the agreed change process with Ofgem would apply to enable instruction as to how the change should be applied to Health Scores.

6 Risk

6.1 Overview

This section covers the methodology which will be applied by DNOs to calculate the PoF and CoF of an asset, as well as the banding for mapping these outputs to the Health Index and Criticality Index within the Risk Matrix for each Asset Register Category.

6.2 Risk Evaluation

For each asset, the Methodology determines:

a) the current PoF (per annum);
b) a forecast of the PoF (per annum) in any given future year; and
c) the Overall CoF (£).

For either the current year, or any given future year, the risk of failure associated with each individual asset can be evaluated in £ (at 2020/21 prices) from the product of the PoF (for the relevant year) and the Overall Consequence of Failure values for that asset. However, the asset-specific actual risk of failure is not used for regulatory reporting. Instead, a typical value of monetised risk, the Risk Index, is derived from the reported Health Index and Criticality Index for each asset. The Risk Index represents the Long Term Risk associated with asset failure and is the present value (£) of the current and future risk associated with a typical asset within the relevant Health Index and Criticality Index Bands[1]. This is explained further in Section 6.5.

6.3 Representation of Assets Within Risk Matrices

For the regulatory reporting of Asset Health and criticality, Risk Matrices are used. These show the population of assets within a given Asset Register Category that have the same Health Index and Criticality Index. This is illustrated in Figure 2.

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[1] In CNAIM v1.1, the Risk Index was related to the risk of failure in a given year and did not consider the value of risk associated with future years within the monetised risk measure.

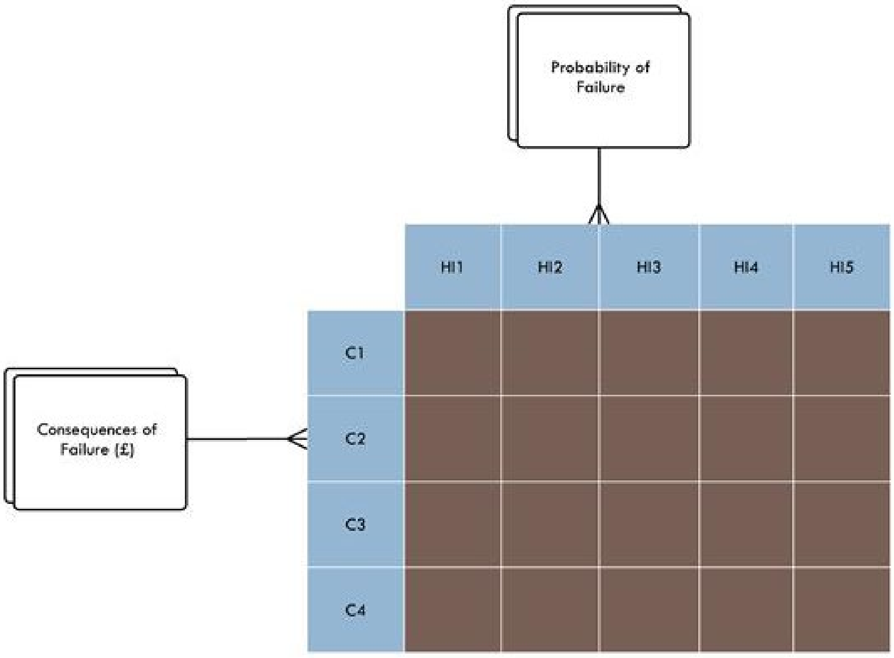

Figure 2 – Risk Reporting Matrices

The Methodology evaluates the current health of an asset using a Health Score with a continuous scale between 0.5 and 10 (this scale is extended up to 15 for the forecasting of future health). The relationship between this Health Score and PoF is defined by the Methodology and is explained in Section 7. The Health Index subsequently groups assets into one of the five bandings (HI1 to HI5) based on their Health Score as shown in Table 5.

Table 5 – Health Index banding criteria

Health Index Band	Health Index banding criteria	
	Lower limit of Health Score	Upper limit of Health Score
HI1	≥0.5	< 3.0
HI2	≥3.0	< 5.5
HI3	≥5.5	< 6.5
HI4	≥6.5	< 8.0
HI5	≥8.0	≤15.0

These Health Index Bands are subsequently translated to PoF values. Figure 3 illustrates where the Health Index Bands lie on a typical Asset Health / PoF curve.

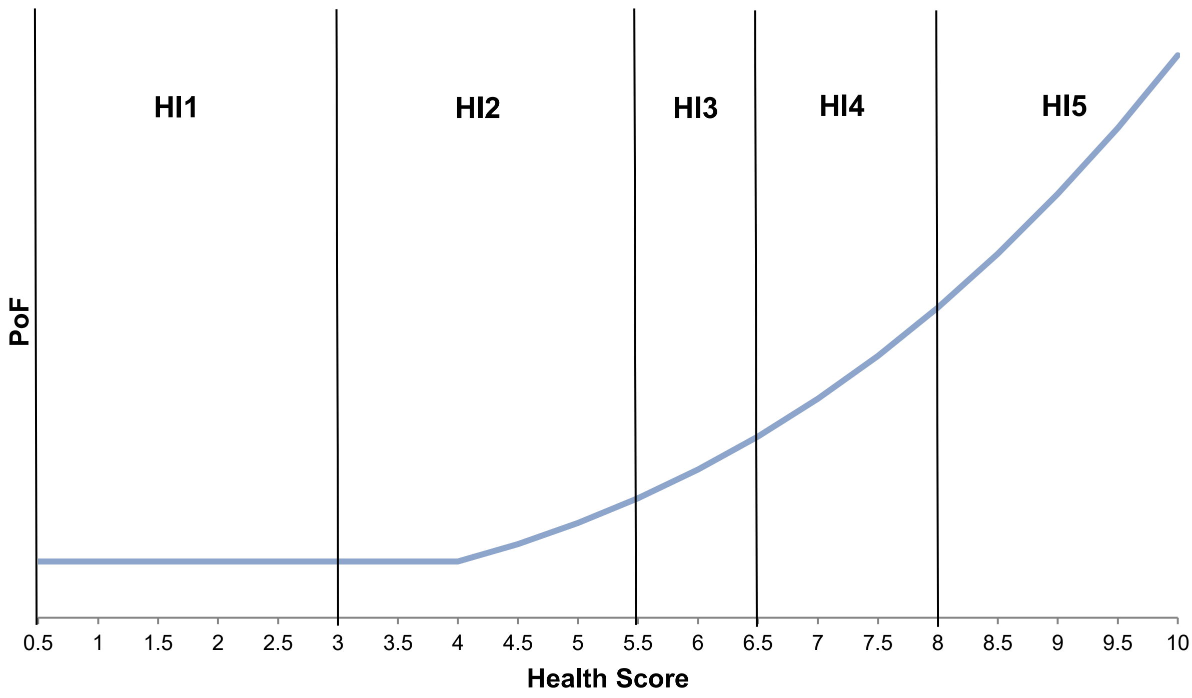

Figure 3 – HI banding

The Criticality Index groups assets into bandings based on their CoF. Each asset shall be placed in a Criticality Index Band, based on the relative magnitude of the Overall CoF of the asset, compared to the Reference Costs of Failure that are used in the determination of CoF for all assets in the Asset Register Category. The Reference Costs of Failure are defined in Section 8 of the Methodology and are common for all DNOs.

There are four Criticality Index Bands:

a) C1 - ‘Low’ criticality;
b) C2 - ‘Average’ criticality;
c) C3 - ‘High’ criticality;
d) C4 - ‘Very High’ criticality.

The ‘C2’ Criticality Index Band represents assets where the Overall CoF are approximately the same as the Reference Costs of Failure for the Asset Register Category.

For each Asset Register Category, the Criticality Index Banding Criteria are expressed as a percentage of the Reference Costs of Failure for the Asset Register Category. These are shown in Table 6.

Table 6 – Criticality Index banding criteria

Criticality Index Band	Criticality Index banding criteria	
	Lower limit of overall CoF (as % of reference Costs of Failure for the Asset Register Category)	**Upper limit of Overall CoF (as % of reference Costs of Failure for the Asset Register Category)**
C1	-	< 75%
C2	≥ 75%	< 125%
C3	≥ 125%	< 200%
C4	≥ 200%	-

Using the approach outlined above, the outputs from the Methodology can facilitate population of Risk Matrices for the regulatory reporting of the Health Index and Criticality Index for each asset.

6.4 Evaluating In-Year Risk Using Risk Matrices

By assigning:

a) a typical value of PoF (per annum) to all assets within the same Health Index Band (for a given Asset Register Category); and
b) a typical value of Consequence of Failure to all assets within the same Criticality Index Band (for a given Asset Register Category)

it is possible for the risk of failure (per annum) associated with each asset to be approximated by reference to its position within the Risk Matrix. This provides an evaluation of the 'in-year' risk of failure of an asset, enabling the asset risk at a point in time to be quantified.

The typical value of PoF is calculated from a typical Health Score for each Health Index Band using the relationship defined in Section 7.1.1 of the Methodology. Table 7 provides the input data for the derivation of typical PoF values.

Table 7 – Health Score used to derive typical PoF

Health Index Band	Health Score to be used to derive typical PoF
HI1	1.23
HI2	4.25
HI3	6.00
HI4	7.25
HI5	9.00

For the HI2 – HI4 bands, the use of the midpoint Health Score to derive the Average PoF produces a reasonable approximation of the average value that would be observed for a uniform distribution of assets within that Health Index Band. The typical Health Scores for the HI1 and HI5 bands take account of the expected typical distribution of assets within these bands.

The resulting typical PoF weightings for each Health Index Band, for each Asset Register Category, can be found in Section E.2 of Annex E.

For each Criticality Index Band, the typical value of Consequence of Failure is determined by application of the percentage factors shown in Table 8, below, to the Reference Costs of Failure (see Section 8 of the Methodology) for the relevant Asset Register Category.

Table 8 – Percentage factors used to derive typical consequences of failure

Criticality Index Band	Percentage Factor to Be Applied to The Reference Costs of Failure
C1	70%
C2	100%
C3	150%
C4	250%

The resulting typical values of Consequence of Failure for each Criticality Index Band, for each Asset Register Category, can be found in Section E.1 of Annex E.

The ‘in-year’ risk of failure of an asset (£ at 2020/21 prices) is the product of the typical PoF for its Health Index Band and the typical Consequences of Failure for its Criticality Band. The resulting value of ‘in-year’ risk of failure for each Health Index/ Criticality Index combination, for each Asset Register Category, can be found in Section E.2 of Annex E.

During RIIO-ED1, ‘in-year’ risk was used in regulatory reporting for defining targets for, and measuring performance, against Network Asset Secondary Deliverables.

For RIIO-ED2 and subsequent Price Control Periods, ED3, etc. the measure of risk used for regulatory processes shall be based on consideration of the future risk associated with an asset and consequently a Long Term measure of risk shall be used for defining targets and measuring delivery against the NARM outputs. This is described in Section 6.5 of the Methodology.

6.5 Evaluating Long Term Risk Using Risk Matrices

DNOs’ investment decisions do not just address the asset risk in the current year but also address the cumulative risk across all future years. It is therefore important to evaluate the asset risk that is forecasted for future years when considering the justification for investment decisions that are aimed at managing the condition-based risk associated with assets. This enables the impact of interventions upon the Long Term Risk of the asset to be considered against the cost of intervention. For the cumulative risk over future years to be compared with the cost of intervention, it is necessary to quantify the future risk in terms of its present value (i.e. in discounted terms). The methodology calculates this risk which is termed as the Long Term Risk.

Recognising that the risk in future years needs to be considered when evaluating the outcome of interventions, for RIIO-ED2, a Long Term measure of risk shall be used to define the targets for the NARM and measure delivery against these targets. The Long Term Risk measure shall therefore provide the Risk Index for regulatory reporting.

The Methodology can be used to determine the risk associated with an asset in the current year and forecast how the risk in each subsequent individual future year will be affected by degradation of the asset. This is achieved by considering how PoF will change in future years over a given period. The calculation of PoF, including PoF in each future year, is described in Section 6 of the Methodology. A discount factor can be applied to the risk calculated for each future year, so that the risk in each year can be considered at its present value. This can then be summated for each year across the future period under consideration to determine the present value of future (whole life) risk in the period.

By treating Consequence of Failure as a constant, the present value of future Long Term Risk can be expressed as shown in EQ. 1:

$$[\![\textit{Present value of future risk}]\!]\_(0-n) = \left[\sum^{n}(PoF_i \times (1+\mathrm{r})^{-i})\right] \times \mathrm{CoF}$$

EQ. 1

Where:

- i = number of years subsequent to current year (where current year is year 0);
- n = number of future years considered;
- PoF_i = the expected number of functional failures in year i;
- CoF = the Consequence of Failure (£ at 2020/21 prices);
- r is the discount rate.

It is appropriate when considering future risk of an asset, to consider the Consequence of Failure to be a constant, as changes to the factors that influence the Consequence of Failure, for an individual asset, are infrequent and cannot be reasonably predicted.

This equation separates the present value of future Long Term Risk into two components:

- Consequence of Failure;
- a ‘cumulative discounted PoF’ term, which represents the POF and the financial discounting elements of the equation for present value of future Long Term Risk (EQ. 2) such that:

$$\textit{Cumulative discounted } PoF_{0-n} = \left[\sum_{i=0}^{n}(PoF_i \times (1+\mathrm{r})^{-i})\right]$$

EQ. 2

By assigning:

a) a typical value of ‘cumulative discounted PoF’ to all assets within the same Health Index Band (for a given Asset Register Category); and
b) a typical value of Consequence of Failure to all assets within the same Criticality Index Band (for a given Asset Register Category),

it is possible for the Long Term Risk associated with each asset to be approximated by reference to its position within the Risk Matrix. The Risk Index for each Health Index/Criticality Index Band is the product of the typical 'cumulative discounted PoF' for the Health Index Band and typical Consequence of Failure for the Criticality Index Band.

For each Asset Register Category, a typical value of 'cumulative discounted PoF' can be assigned to each Health Index Band by considering all assets within the same Health Index Band (for the given Asset Register Category) to have:

a) the same typical value of Health Score for the current year (year 0); and
b) the same typical value of Forecast Ageing Rate.

From the typical value of current year Health Score and typical Forecast Ageing Rate, the Future Health Score for each future year can be evaluated as described in Section 7.1.10 of the Methodology and the associated value of PoF determined using the relationship defined in Section 7.1.1 of the Methodology.

The typical value of current year Health Score for each Health Index Band (for all Asset Register Categories) shall be the same value as shown in Table 7 in Section 6.4 for the determination of Typical PoF weightings.

The typical Forecast Ageing Rates for each Asset Register Category, which are used in the determination of the Future Health Scores for each future year, are shown in Section E.3 of Annex E. These are the same as the Initial Ageing Rate that would be determined, using the approach shown in Section 7.1.5 of the Methodology, if the Expected Life of the asset was considered as being the same as a typical Normal Expected Life for the Asset Register Category.

In determining the 'cumulative discounted PoF', the current year PoF and future PoF for a period of 30 years shall be considered. A discount rate of 3.5% shall be applied for each year. This discounting rate is consistent with the Social Time Preference Rate in the HM Treasury Green Book (2020) [Ref. N2] and Ofgem CBA methodology for RIIO-ED2.

For each Asset Register Category, the discounted PoF for each year, of the 30 year period, is summated to create a typical 'cumulative discounted PoF' for each Health Index Band. The resulting values of typical 'cumulative discounted PoF' are shown in Section E.3 of Annex E. These are the values used to multiply out the Risk Matrices.

For each Criticality Index Band, the typical value of Consequence of Failure is determined by application of the percentage factors to the Reference Costs of Failure, as described in Section 6.4 of the Methodology. The resulting typical values of Consequence of Failure for each Criticality Index Band, for each Asset Register Category, can be found in Section E.1 of Annex E. These are the values used to multiply out the Risk Matrices.

The Risk Index (£ at 2020/21 prices) is determined from the product of the relevant typical 'cumulative discounted PoF' and typical Consequences of Failure for each Health Index Band/ Criticality Index Band combination, for each Asset Register Category, and can be found in Section E.3 of Annex E.

The monetisation of risk is consistent across all Asset Register Categories and therefore enables risk trading within and across Asset Register Categories.

7 Probability of Failure

7.1 PoF Calculation (General)

7.1.1 Overview

The Health Index (HI) is derived from the Health Score and PoF. The PoF of an asset is a function of the asset's Health Score, with the Health Score being a function of Normal Expected Life, location, duty, reliability, observed condition and measured condition.

For the majority of assets, a single Health Score is calculated, which is then converted into a PoF. However, for HV, EHV and 132 kV Transformers and steel Towers, it is necessary to calculate a Health Score for each component and then combine these into an overall Health Score. These multi-component assets are special cases which are covered in more detail in Sections 7.2, 7.3 and 7.3. Figure 4 shows the process to be followed to calculate the PoF of an asset (or component):

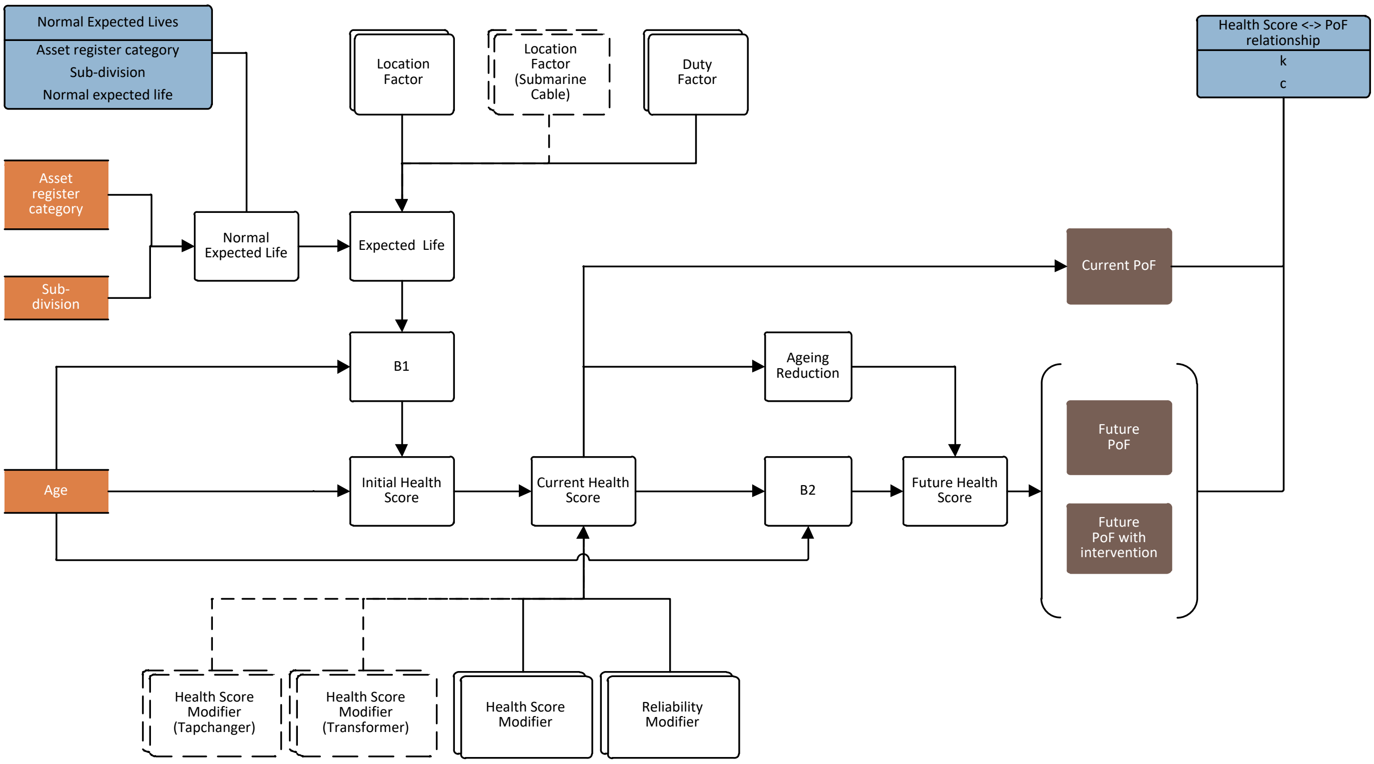

Figure 4 – Probability of Failure

The PoF per annum shall be calculated using the cubic curve shown in EQ. 3. This is based on the first three terms of the Taylor series for an exponential function. This implementation has the benefit of being able to describe a situation where the PoF rises more rapidly as asset health degrades, but at a more controlled rate than a full exponential function would describe.

$$\mathbf{PoF} = \mathbf{K} \times \left[\mathbf{1} + (\mathbf{C} \times \mathbf{H}) + \frac{(\mathbf{C} \times \mathbf{H})^2}{\mathbf{2!}} + \frac{(\mathbf{C} \times \mathbf{H})^3}{\mathbf{3!}} \right]$$

EQ. 3

Where:

- H is a variable equal to Health Score (Current or Future), unless Health Score ≤ 4 then H = 4
- K and C are constants

The constants and variables in the above equation are described in Section 7.1.2.

7.1.2 K-Value, C-Value and Constants in PoF

A generic and common PoF curve as described by EQ. 3 is used to define the relationship between asset Health Score and PoF. The curve is one commonly used in reliability theory. It shows constant PoF for low values of Health Score and an exponential increase in PoF for higher values of Health Score, representing where increasing health degradation results in an escalating likelihood of failure. The shape of a typical PoF curve can be seen in Figure 3.

For a common curve, the parameters used to construct the curve need to be common. The common parameters are the C-Value that defines the shape of the curve, the K-Value that scales the PoF to a failure rate, and the Health Score limit at which there is a transition from constant PoF to an exponential relationship. The values for the C-Values, the K-Values and the constant Health Score limit are shown in Table 23 in Annex B.

The C-Value is the same for all Asset Categories and has been selected such that the PoF for an asset in the worst state of health is ten times higher than the PoF of a new asset.

The Health Score limit represents the point at which there starts to be a direct relationship between the Health Score and an increasing PoF. The PoF associated with Health Scores below this limit relate to installation issues or random events.

The K-Value for each Asset Category has been derived by consideration of:

a) the observed number of Functional Failures per annum, considering the number of failures in each of the three failure modes that are identified in Annex A (i.e. Incipient Failures, Degraded Failures and Catastrophic Failures for each Asset Category);

b) the Health Index distribution for the asset population; and

c) volumes of assets within the population.

By calibrating K using the overall number of Functional Failures across all the failure modes, the resulting PoF represents the combined PoF for all considered failure modes.

The calibration of K has been undertaken using data representing the national population of assets and ensures that in each Asset Category the total GB expected number of Functional Failures, derived from the relative PoF contribution of every asset in the GB Health Index distribution, matches the number of GB Functional Failures.

For linear assets (Cables and Tower Conductor) the K-Value was calculated using the GB number of Functional Failures per kilometre per annum. The PoF reported for these Asset Categories is therefore the PoF per km per annum. The number of kilometres reported per Health Index Band is the sum of the length of the assets falling within that band.

The national failure rate figures used were the sum of all DNO functional failures (five-year annualised average) in accordance with the Condition-based Functional Failure definition. These are shown in Annex A.

7.1.3 Normal Expected Life

The Normal Expected Life depends on the Asset Register Category and its sub-category. It is defined as the time (in years) in an asset's life when the first significant signs of deterioration would be expected. This corresponds to a Health Score of 5.5. The value is specified in the Normal Expected Lives calibration table (Table 22, Annex B) and is expressed in years.

7.1.4 Expected Life

Expected Life is derived from Normal Expected Life, considering two degradation factors: Location Factor (which represents the effects of the surrounding environment on the asset) and Duty Factor (which represents any additional ageing due to the way in which the asset is being used). Expected Life is calculated using EQ. 4.

$$\textbf{Expected Life} = \frac{\textbf{Normal Expected Life}}{(\textbf{Duty Factor} \times \textbf{Location Factor})}$$

EQ. 4

Location and Duty Factors are described in more detail in Sections 7.5 - 7.7.

7.1.5 β_1 (Initial Ageing Rate)

The rate of change of the health of a distribution asset is modelled exponentially, as it is assumed that the processes involved as the asset deteriorates (e.g. corrosion, oil oxidation, insulation breakdown, etc.) are accelerated by the products of the deterioration process.

The Ageing Rate of the asset is determined from the natural logarithm of the asset's Health Score when new and the Health Score that corresponds to the Expected Life of the asset, using EQ. 5.

$$\boldsymbol{\beta_1} = \frac{\ln\left(\frac{\mathbf{H_{expected\ life}}}{\mathbf{H_{new}}}\right)}{\textbf{Expected Life}}$$

EQ. 5

Where:

- H_{new} is the Health Score of a new asset, equal to 0.5;
- $H_{Expected\ Life}$ is the Health Score of the asset when it reaches its Expected Life, equal to 5.5;
- Expected Life is described in Section 7.1.4.

7.1.6 Initial Health Score

The Initial Health Score is obtained by defining the generic relationship between Asset Health and age using the Expected Life of the asset.

$$\text{Initial Health Score} = H_{new} \times e^{(\beta_1 \times \text{age})}$$

EQ. 6

Where:

- H_{new} is the Health Score of a new asset, equal to 0.5;
- Initial Health Score is capped at a value of 5.5;
- β_1 is the initial Ageing Rate as described is Section 7.1.5;
- age is the current age of the asset in years.

This relationship gives an initial estimate of Asset Health but does not take into account any actual health measurement or assessment that may have been carried out. This stage provides an initial age-based indication of health up to a maximum Health Score of 5.5, which needs to be modified in the next stage to take account of available data regarding the health of the asset.

For the following Asset Register Categories, the Initial Health Score will be capped at a value of 8.0 or 7.5 for Pole Mounted Transformers, rather than the value of 5.5 as all other categories to allow the asset age to have a greater bearing on the Asset Health than the other Asset Categories when there is less availability of visual or measured assessment criteria.

Table 9 – Initial Health Score Cap for specific Asset Categories only

Asset Register Category	Initial Health Score Cap
33kV Switchgear – Other	8.0
66kV Switchgear – Other	8.0
132kV Switchgear – Other	8.0
6.6/11kV CB (PM)	8.0
6.6/11kV Switch (PM)	8.0
6.6/11kV Switchgear - Other (PM)	8.0
20kV CB (PM)	8.0
20kV Switch (PM)	8.0
20kV Switchgear - Other (PM)	8.0
33kV Switch (PM)	8.0
Batteries at GM HV Substations	8.0
Batteries at 33kV Substations	8.0
Batteries at 66kV Substations	8.0
Batteries at 132kV Substations	8.0
LV Main OHL Conductor (Pole Lines)	8.0

Asset Register Category	Initial Health Score Cap
HV OHL Conductor (Pole Lines)	8.0
EHV OHL Conductor (Pole Lines)	8.0
132kV OHL Conductor (Pole Lines)	8.0
6.6/11kV Transformer (PM)	7.5
20kV Transformer (PM)	7.5
33kV Transformer (PM)	7.5

7.1.7 Current Health Score

The Initial Health Score is modified according to available data using the Health Score Modifier and, where appropriate, a Reliability Modifier (see Section 7.15).

The Health Score Modifier consists of three components:

a) Health Score Factor, which determines how the Initial Health Score is to be modified;
b) Health Score Cap, which specifies the maximum value of Current Health Score (used in situations where a good result from a condition inspection or measurement implies that the Health Score should be no more than the specified value); and
c) Health Score Collar, which specifies the minimum value of Current Health Score (used in situations where a poor result from a condition inspection or measurement implies that the Health Score should be at least the specified value).

The Reliability Modifier may consist of two components:

a) A Reliability Factor; and
b) A Reliability Collar.

$$\textbf{Current Health Score} = \textbf{Initial Health Score} \times \textbf{Health Score Factor} \times \textbf{Reliability Factor}$$

EQ. 7

The Current Health Score is calculated initially as follows.

The Current Health Score is then compared with Health Score Cap as follows.

$$\textbf{IF Current Health Score} > \textbf{Health Score Cap}$$

$$\textbf{THEN Current Health Score} = \textbf{Health Score Cap}$$

EQ. 8

Where Current Health Score is capped at 10.

The Current Health Score is then compared with Health Score Collar as follows.

IF Current Health Score < MAX (Health Score Collar, Reliability Collar)

THEN Current Health Score = MAX (Health Score Collar, Reliability Collar)

EQ. 9

Note that the order of calculation is important; the calculation must be done in the order specified to ensure that poor condition measurements override good ones; i.e. the Current Health Score must be compared with the Health Score Cap and assigned a result before comparing this result to the Health Score Collar.

Typically, the Health Score Collar is 0.5 and Health Score Cap is 10, implying no overriding of the Health Score. However, in some instances these parameters are set to other values in the Health Score Modifier calibration tables. These overriding values are shown in Table 37 to

Table 250 and

Table 255 in Annex B.

7.1.8 β_2 (Forecast Ageing Rate)

In order to forecast a Future Health Score from the Current Health Score, the Ageing Rate needs to be re-calculated so that the effects of the Health Score Modifier and Reliability Modifier are taken into account. This is undertaken so that the forecast ageing reflects the Ageing Rate implied by the asset's actual condition. For assets where no ageing has been observed (i.e. the Current Health Score is 0.5) no re-calculation of the Ageing Rate is performed.

The Forecast Ageing Rate β_2 is derived from the Current Health Score and the current age of the asset using EQ. 10 when the Current Health Score > 0.5. where the Current Health Score = 0.5, $\beta_2 = \beta_1$.

$$\boldsymbol{\beta_2} = \frac{\ln\left(\frac{\textbf{Current Health Score}}{\mathbf{H_{new}}}\right)}{\textbf{Age}}$$

EQ. 10

Where:

- Age is the current age of the asset (i.e. the age used in the calculation of the Initial Health Score);
- β_2 is capped such that:

$$\boldsymbol{\beta_2 \leq 2 \times \beta_1}$$

EQ. 11

β_2 is capped to prevent unrealistically high rates of deterioration being applied to relatively new assets where reliability issues have been identified early on in their life.

This Forecast Ageing Rate β2 formula does include a minimum value and as such, there are circumstances where the value can be too low to adequately reflect the Health Score of an asset.

For assets that are young and in excellent condition, the calculated Health Score Factor can achieve a value of <1 which can negate the impact of any aging thus far. Due to the calculation of Forecast Ageing Rate β2, there is negligible increase of the Future Health Score from the new position (Health Score 0.5). This is especially so when considering 10 or more years hence. To ensure that a reasonable value of the Forecast Ageing Rate β2 is achieved a collar of the value of Initial Ageing Rate β1 can be used for assets up to and including 10 years old. From about 10 years old, assets tend to age in predictably with Health Score Factors indicating a better-than-expected result where appropriate.

A further phenomenon within the asset populations occurs for old assets which have surpassed their expected life. In the current year, there is a cap on the Current Health Score. In the future, as these assets age the Forecast Ageing Rate β2 becomes smaller leading to increasingly lower Health Scores and longer overall predicted lifespans. To ensure that a reasonable value of the Forecast Ageing Rate β2 is achieved a collar of the value of 0.5 * Initial Ageing Rate β1 can be applied.

The combined approach for the Forecast Ageing Rate β2 is to set a collar with a minimum value of β1 x 0.5 for assets > 10 and β1 for assets <= 10.

7.1.9 Ageing Reduction Factor

The use of the exponential curve results in an escalating acceleration effect once assets reach a high Health Score. For assets that are approaching end of life, this can result in a run-away effect in the forecast future PoF, which would not reflect the deterioration that would be observed in real life.

The cause of the runaway effect is due to the imperfect match of the selected curve once the asset reaches high values of health and hence resultant PoF. To minimise the potential for overstatement of the forecast future PoF, an Ageing Reduction Factor is introduced to modify the asset's rate of deterioration. This slows down the Ageing Rate of the asset by flattening the exponential curve especially (although not exclusively) where the Health Score is greater than 5.5.

In young assets of unproven reliability, there may be a higher PoF when compared to assets of a higher age. Therefore, as an asset has reached the higher age with no identified issues, the probability is that it will continue to provide good service and hence its life expectancy is longer than the younger asset. Therefore, the old asset's PoF can be reduced in relative terms from the value calculated.

The ageing reduction technique as described above is used to reduce the forecast increase in PoF with time for assets where the Current Health Score represents any significant level of degradation. The Ageing Reduction Factor acts by reducing the original ageing factor. This practice is in keeping with the common use by engineers of P-F interval reliability concepts [Ref. N3] which set:

a) P as the point where a potential failure can be detected; and

b) F as where the functional failure occurs.

In such concepts, a curve is drawn between the two points, P and F, to produce a forecast of time to failure and the reduction effect is capped so that the accelerated ageing that occurs as the asset approaches failure is correctly reflected.

In the Methodology, the Ageing Reduction Factor applied will vary, depending on the Current Health Score for the asset:

a) for assets where the Current Health Score is greater than 5.5, the Ageing Reduction Factor is set to its maximum permissible value; and
b) for assets where the Current Health Score is less than 2, the Ageing Reduction Factor is set to unity.

In order to prevent low Health Score assets deteriorating more quickly than high Health Score assets when forecasting, there must be no significant step change in the factor value. The Ageing Reduction Factor therefore varies linearly between unity and its maximum permissible value, for Health Scores between 2 and 5.5.

The maximum permissible value of the Ageing Reduction Factor is set to 1.5.

The Ageing Reduction Factor calibration table can be seen in Table 265 in Annex B and is illustrated in Figure 5.

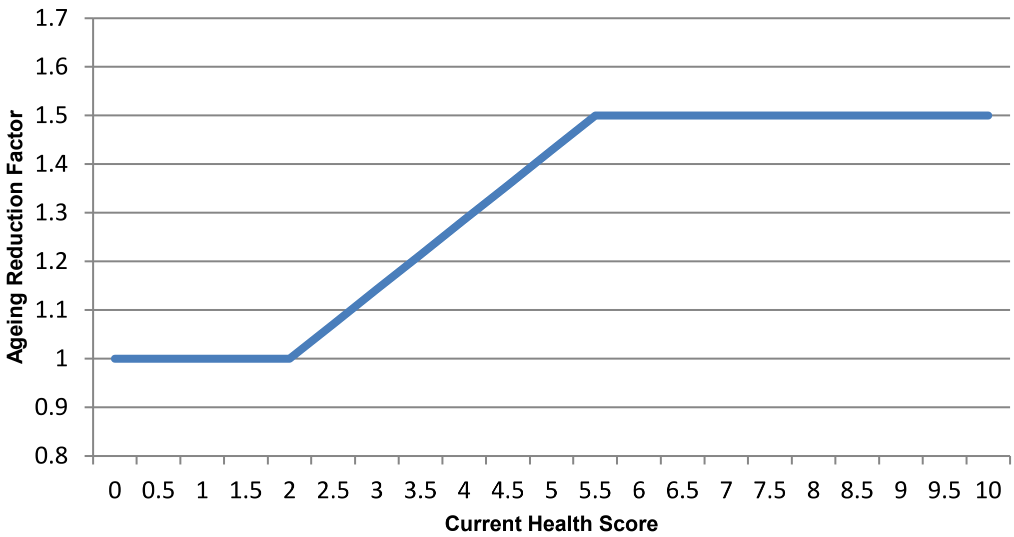

Figure 5 – Ageing Reduction Factor

The effects of the changes to the ageing assumptions that arise from re-calculation of the Ageing Rate for forecasting future health (as described in Section 7.1.8) and the application of an Ageing Reduction Factor are shown in Figure 6. This shows three deterioration curves based on:

i) the initial Ageing Rate, β_1;
ii) the "trued-up" Ageing Rate which would have been necessary for the asset to be in its current condition; and
iii) the application of an Ageing Reduction Factor.

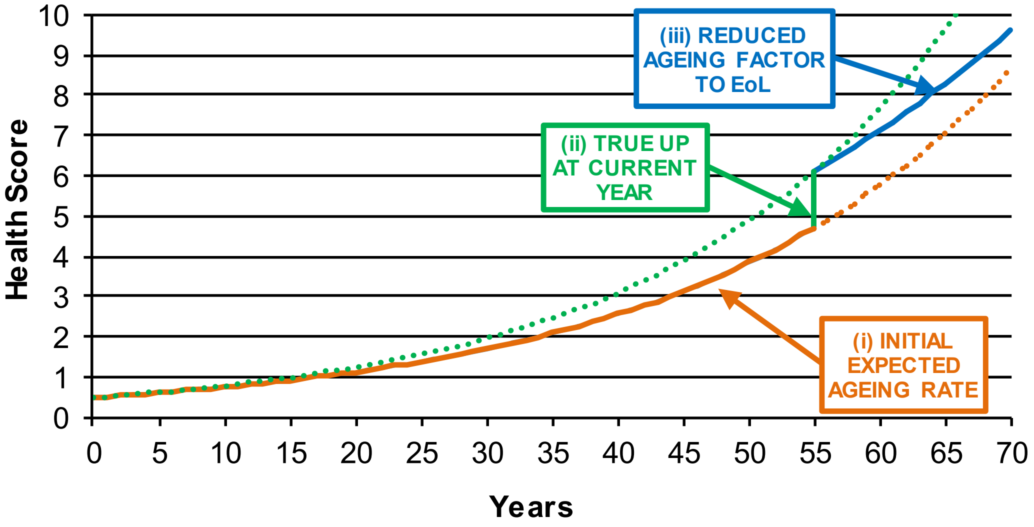

Figure 6 – Effect of Ageing Reduction Factor on Asset Deterioration

7.1.10 Future Health Score – Deterioration

The Future Health Score is calculated using the same exponential based methodology as the Initial Health Score. This in detail in Equation 12 below:

$$Future\ Health\ Score_t = Current\ Health\ Score_{t-1} * e^{\left(\left(q_t * \frac{\beta_2}{r}\right) * 1\right)}$$

EQ. 12

Where:

- t is the number of future years;
- Current Health Score is as described in Section 7.1.7;
- β2 is the Forecast Ageing Rate as described in Section 7.1.8;
- r is the Ageing Reduction Factor as described in Section 7.1.9;
- $q_t = q_{(t-1)} * c_{(y+t)}$, q_0=1, Health Score$_0$ = Current Health Score and y is the current year: as described in Annex B.11 Ageing Rate Adjustment Sets. This acts as a multiplier to the ageing rate that is a function of time, to reflect changing deterioration rates due to incremental climate change effects over time. i.e. the ageing rate changes for each future year considered.
- Future Health Score is capped at 15.

7.1.11 Interventions

Interventions are activities that are undertaken to manage the risk of condition-based failure. In the RIIO-ED price control periods, DNOs have Network Asset Secondary Deliverables that relate to the improvement in risk that is delivered by Asset Replacement, as well as some Refurbishment activities. Such activities are primarily aimed at managing risk by reducing the PoF.

The effect of these activities is calculated by modifying the input data used in the Methodology. This approach shall be used for the calculation of either the Current Health Score or Future Health Score.

For Asset Replacement interventions, this is simply a recalculation of Asset Health and Criticality (and hence risk) taking account of the changes in the asset population that have resulted from the Intervention (i.e. removal of assets and the addition of new assets).

For Refurbishment interventions, the Asset Health and Criticality are recalculated using revised input data for the asset that is subject to the Refurbishment activity. This revised input data should take account of the change in input data that has resulted from the Refurbishment activity e.g. changes to the Health Score Modifier to reflect the observed or measured condition following completion of the Refurbishment.

Only certain Refurbishment activities contribute to the delivery of the Network Asset Secondary Deliverables. These are defined in Ofgem's RIIO-ED Regulatory Instructions and Guidance – Annex A.

Annex C identifies these Refurbishment activities and also the input data that should be re-evaluated in order to account for the improvement in risk delivered by such activity.

7.2 PoF Calculation (HV, EHV and 132 kV Transformers – Ground Mounted only)

The PoF for Ground Mounted HV Transformers, EHV Transformers (33 kV & 66 kV Transformers) and 132 kV Transformers is derived by separate consideration of the health of two distinct subcomponents:

a) the main transformer; and
b) the tapchanger (EHV and 132 kV Transformers only).

This recognises the degree of independence between the health of these components.

The Health Score for the overall transformer asset is derived from the combination of the Health Scores for both of these components.

Health Scores for the main transformer and tapchanger components are separately determined, using broadly the same approach as outlined in Section 7.1. This is summarised below:

a) A separate Initial Health Score is calculated for the main transformer subcomponent and the tapchanger subcomponent, using EQ. 6, as described in Section 7.1.6. For each component different Normal Expected Lives and age information shall be used. However, the same Location Factor is applied to both the main transformer and the tapchanger but they each have a different duty factor. The Normal Expected Life of the tapchanger subcomponent and main transformer subcomponent are shown in Table 22 in Annex B.

   To calculate the Initial Health Scores using EQ. 6:

   - for the main transformer, the Normal Expected Life for a transformer is used and the age is taken as being the age of the main transformer component;

- for the tapchanger, the Normal Expected Life for a tapchanger is used and the age is taken as being the age of the tapchanger component.

Where the age of the tapchanger and the age of the main transformer component are not separately known, it is assumed that both components have the age that is recorded for the overall transformer asset.

b) Separate Health Score Modifiers are calculated for both the main transformer and the tapchanger components. The calculation of these Health Score Modifiers is discussed in Section 7.8.

For both the main transformer and tapchanger components, the Health Score Modifier is derived using an Observed Condition Modifier, a Measured Condition Modifier and an Oil Test Modifier. The determination of these Modifiers is described in Sections 7.9, 7.10, 7.11.

For the main transformer subcomponent, a DGA Test Modifier and FFA Test Modifier are also used in addition to the Observed Condition Modifier, Measured Condition Modifier and Oil Test Modifier. These additional Modifiers are described in Sections 7.12 and 7.13.

c) Separate Current Health Scores are calculated for both components using the Health Score Modifier and the Initial Health Score calculated for the relevant component, e.g. the Health Score Modifier for the tapchanger component is applied to the Initial Health Score for the tapchanger component to calculate the Current Health Score for the tapchanger component.

d) A Forecast Ageing Rate, β_2, is separately calculated for each component, using the approach described in Section 7.1.8. For each component, the age used in the calculation of β_2 is the same age that was used in the calculation of the Initial Health Score.

e) The Future Health Score is calculated for each component using EQ. 12, as described in Section 7.1.10. For each component the Current Health Score and value of β_2, relating to that component, is used in the determination of the Future Health Score.

The Current Health Score of the overall transformer asset is taken as the maximum of the Current Health Score of the main transformer component and the Current Health Score of the tapchanger component.

Similarly, the Future Health Score of the overall transformer asset is taken as the maximum of the Future Health Score of the main transformer component and the Future Health Score of the tapchanger component.

The PoF for the overall transformer asset is determined by application of EQ. 3 (Section 7.1.1) to the overall Health Score (i.e. the maximum Health Score of the subcomponents).

7.3 PoF Calculation (Steel Towers)

Steel Towers are made up of individual steel members bolted together to form a lattice arrangement above ground. Tower foundations are the interlinking component between the support and the ground (soil and/or rock).

The life of a steel Tower is primarily dependent on the rate of deterioration of this steelwork both above and below ground.

New steelwork is protected from corrosion by zinc galvanising. Under normal circumstances galvanising would be expected to provide protection against the onset of corrosion, for the steelwork above ground, for a period of up to 30 years.

A paint system would normally be applied to the steelwork above ground, in order to provide a secondary form of protection against corrosion. The paintwork, itself, will deteriorate over time (typically providing protection for up to 20 years) and will require reapplication in order to maintain its protective function. The first application of a paint system to a Tower normally takes place after 30 years once the zinc galvanising has expired.

For Towers, once corrosion has set in the intervention requirement changes considerably from low cost piecemeal steel member replacement and the application of a protective paint system, to much more expensive full Tower replacement. Therefore, with regards to the above ground steelwork, the typical strategy adopted by DNOs is to paint/refurbish before significant corrosion sets in. The typical effect of such a strategy on the Health Score of a Tower, through its life, is illustrated in Figure 7.

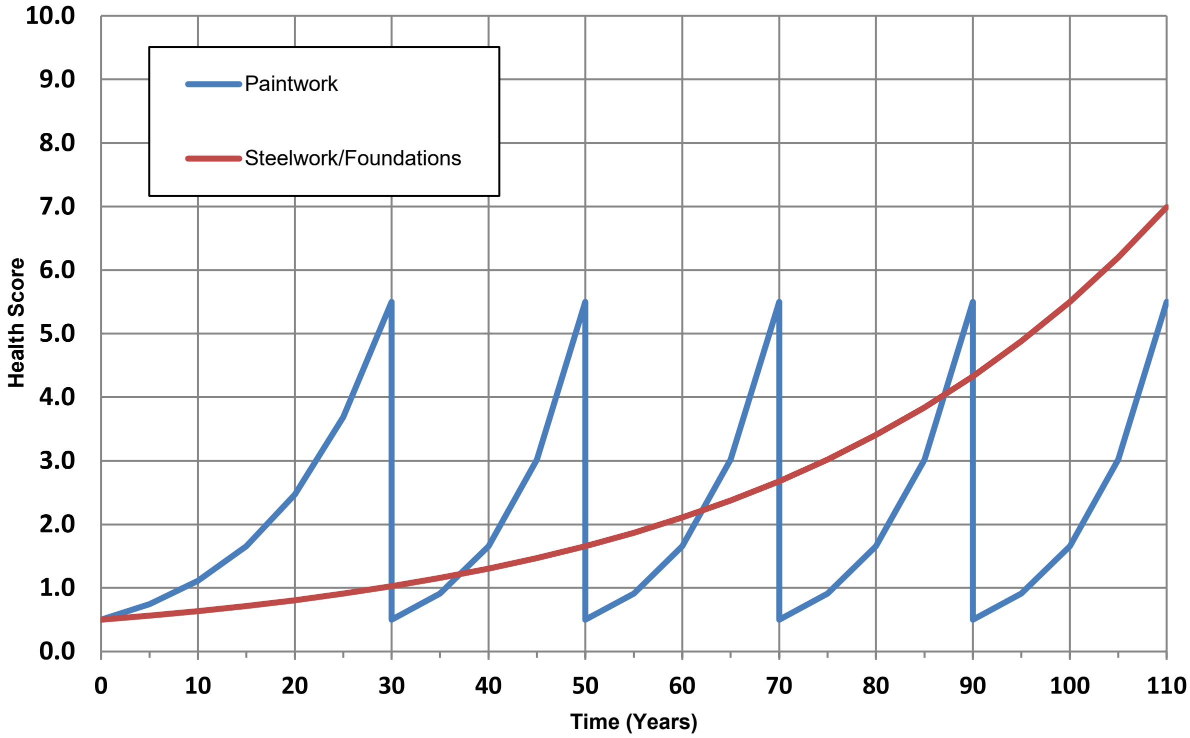

Figure 7 – Steel Tower Health Score

Therefore, within this framework the overall life cycle (Health Score) for a steel Tower is defined as a function of three discrete elements of the Tower:

a) the paintwork;
b) the steelwork; and
c) the foundations.

Health Scores for each of these three components are separately determined, using broadly the same approach as outlined in Section 7.1. This is summarised below:

a) A separate Initial Health Score is calculated for each of the three components, using EQ. 6, as described in Section 7.1.6. For each component different Normal Expected Lives and age information shall be used. However, the same Location and Duty Factors are applied to all three components. The Normal Expected Life of the paint system (rather than the Tower), foundations and steelwork are shown in Table 22 in Annex B. To calculate the Initial Health Scores using EQ. 6:

    - for the Tower steelwork: The Normal Expected Life of steelwork shall be used[2];
    - for the paintwork:
        - if the Tower is unpainted: The Normal Expected Life of the galvanising is used, and the age is taken as being the age of the Tower steelwork;
        - if the Tower is painted: The Normal Expected Life of paint is used, and the age is taken as time that has elapsed since the Tower was last painted;
    - for the Tower foundation: The Normal Expected Life of the Tower foundation is used, and the age is taken as being the age of the foundation.

    Where the age of the Tower steelwork and the age of the Tower foundation are not separately known, it is assumed that both the steelwork and foundation have the age that is recorded for the overall Tower.

b) Separate Health Score Modifiers are calculated for each of the three components.

c) Separate Current Health Scores are calculated for each of the three components using the Health Score Modifier and the Initial Health Score calculated for the relevant component, e.g. the Health Score Modifier for the paintwork component is applied to the Initial Health Score for the paintwork component to calculate the Current Health Score for the paintwork component. The Current Health Score for the paintwork component is capped at 6.4 to reflect the limited effect of paintwork, alone, on the overall health of a tower.

d) A forecast Ageing Rate, β_2 is separately calculated for each of the three components, using the approach described in Section 7.1.8. For each component, the age used in the calculation of β_2 is the same age that was used in the calculation of the Initial Health Score.

e) A Future Health Score is calculated for each of the three components using EQ. 12, as described in Section 7.1.10. For each component the Current Health Score and value of β_2, relating to that component, shall be used in the determination of the Future Health Score. The Future Health Score for the paintwork component is capped at 6.4 to reflect the limited effect of paintwork, alone, on the overall health of a tower.

2 The primary age of the Tower steelwork will be that of the Tower itself, accepting that some of the steelwork may have been replaced piecemeal in later years.

The Current Health Score of the Tower is taken as the maximum of the Current Health Score of the steelwork, the Current Health Score of the paintwork and the Current Health Score of the foundations. As Paintwork condition on its own does not instigate replacement of a steel tower, a cap of 6.4 is applied to the Current Health Score of the paintwork component (as described in (c) above). This has been done to match the impact and importance of the paintwork condition on the overall score of a Tower to reality.

Similarly, the Future Health Score of the Tower is taken as the maximum of the Future Health Score of the steelwork, the Future Health Score of the paintwork and the Future Health Score of the foundations. Again, the effect of the paintwork component upon the Future Health Score of the Tower is limited by application of a cap on the value of the Future Health Score of the paintwork (as described in (e) above).

The PoF for the overall Tower is determined by application of EQ. 3 (Section 7.1.1) to the overall Health Score (i.e. the maximum Health Score across the three subcomponents).

7.4 PoF Calculation (Battery Systems)

The PoF for Battery Systems is derived by separate consideration of the health of two distinct subcomponents:

a) the charger; and

b) the battery.

This recognises the degree of independence between the health of these subcomponents.

The Health Score for the overall Battery System asset is derived from the combination of the Health Scores for both of these subcomponents.

Health Scores for the charger and battery subcomponents are separately determined, using broadly the same approach as outlined in Section 7.1. This is summarised below:

A separate Initial Health Score is calculated for the charger subcomponent and the battery subcomponent, using EQ. 6, as described in Section 7.1.6 but capped at a value of 8. For each subcomponent, different Normal Expected Lives and age information shall be used. However, the same Location Factor is applied to both. The Normal Expected Life of the charger subcomponent and battery subcomponent are shown in Table 22 in Annex C.

To calculate the Initial Health Scores using EQ. 6:

a) for the charger, the Normal Expected Life for a charger is used and the age is taken as being the age of the charger subcomponent;

b) for the battery, the Normal Expected Life for a battery is used and the age is taken as being the age of the battery subcomponent.

Separate Health Score Modifiers are calculated for both the charger and the battery subcomponents.

For both the charger and battery subcomponents, the Health Score Modifier is derived using an Observed Condition Modifier and a Measured Condition Modifier separately.

Separate Current Health Scores are calculated for both subcomponents using the Health Score Modifier and the Initial Health Score calculated for the relevant subcomponent, e.g. the Health Score Modifier for the battery subcomponent is applied to the Initial Health Score for the battery subcomponent to calculate the Current Health Score for the battery subcomponent.

A forecast Ageing Rate, β2, is separately calculated for each subcomponent, using the approach described in Section 7.1.8. For each subcomponent, the age used in the calculation of β2 is the same age that was used in the calculation of the Initial Health Score.

The Future Health Score is calculated for each subcomponent using EQ. 12, as described in Section 7.1.10. For each subcomponent, the Current Health Score and value of β2, relating to that subcomponent, is used in the determination of the Future Health Score.

The Current Health Score of the overall Batteries asset is taken as the maximum of the Current Health Score of the main charger subcomponent and the Current Health Score of the battery subcomponent.

Similarly, the Future Health Score of the overall Batteries asset is taken as the maximum of the Future Health Score of the charger subcomponent and the Future Health Score of the battery subcomponent.

The PoF for the overall Batteries asset is determined by application of EQ. 3 (Section 7.1.1) to the overall Health Score (i.e. the maximum Health Score of both the subcomponents).

7.5 Location Factor (General)

7.5.1 Overview

The Expected Life of an asset is affected by the environment in which the asset is installed. For example, assets exposed to higher levels of moisture or pollution may be expected to degrade quicker than assets of the same type exposed to lower levels of moisture or pollution. The levels of exposure will depend on the location of the asset and also whether or not it is installed within an enclosure that affords protection from the weather.

This effect is recognised by the use of an asset-specific Location Factor, as shown in Figure 8, in the determination of the Expected Life for individual assets. For all Asset Categories, except LV UGB and Cable, this Factor is influenced by:

a) distance from coast;
b) altitude;
c) corrosion category; and
d) environment (indoor / outdoor).

Where it is not known whether an asset is located indoor or outdoor, a default assumption based on the Asset Register Category shall be applied as per Table 28 in Annex B.

Different factors are considered in the derivation of an asset-specific Location Factor for sub cable assets. These are explained in Section 7.6.

For LV UGB assets and all non-sub cable assets (i.e. cables installed on land), a Location Factor of 1 is assigned to all assets.

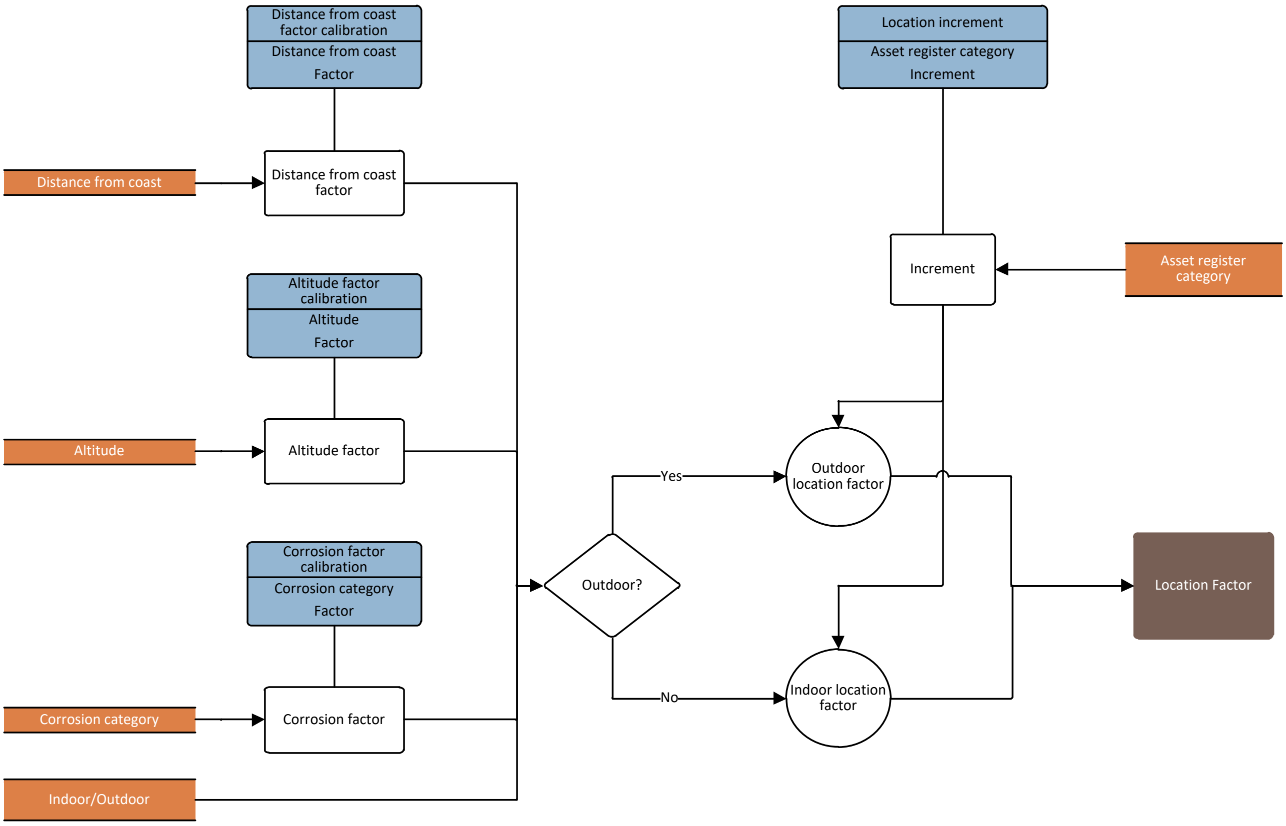

Figure 8 – Location Factor

7.5.2 Distance from Coast Factor

The Distance from Coast Factor is determined based on the distance of the asset (or its substation location) from the coast, measured in km. The Distance from Coast Factor is applied as shown in Table 24 in Annex B.

7.5.3 Altitude Factor

An Altitude Factor is determined based on the altitude of the asset (or its substation location, measured in metres). The derivation of Altitude Factor is based on a look up table using bandings of altitude. The Altitude Factor is applied as shown in Table 25 in Annex B.

7.5.4 Corrosion Factor

A Corrosion Factor is determined based on the Corrosion Category Index (1-5) for the location of the asset.[Ref. N9] The Corrosion Factor is applied as shown in Table 26 in Annex B.

7.5.5 Determining the Location Factor for assets in an outdoor environment

Where an asset is installed in an outdoor environment, the Location Factor is determined as follows.

a) If the maximum of the Distance from Coast Factor, Altitude Factor and Corrosion Factor is greater than 1:

$$\textbf{Location Factor} = \textbf{MAX}(\textbf{Distance From Coast Factor}, \textbf{Altitude Factor}, \textbf{Corrosion Factor}) + \left(((\textbf{COUNT of factors greater than 1}) - \textbf{1}) \times \textbf{INC}\right)$$

EQ. 13

Where INC is the increment constant for the asset type (shown in Table 27).

b) If the maximum of the Distance from Coast Factor, Altitude Factor and Corrosion Factor is not greater than 1:

$$\textbf{Location Factor} = \textbf{MIN}(\textbf{Distance From Coast Factor}, \textbf{Altitude Factor}, \textbf{Corrosion Factor})$$

EQ. 14

7.5.6 Determining the Location Factor for assets in an indoor environment

Where an asset is installed in an indoor environment, the Location Factor is determined as follows.

a) If the maximum of the Distance from Coast Factor, Altitude Factor and Corrosion Factor is greater than 1:

$$\textbf{Initial Location Factor} = \textbf{MAX}(\textbf{Distance From Coast Factor}, \textbf{Altitude Factor}, \textbf{Corrosion Factor}) + \left(((\textbf{COUNT of factors greater than 1}) - \textbf{1}) \times \textbf{INC}\right)$$

EQ. 15

where INC is the increment constant for the asset type (shown in Table 27)

b) If the maximum of the Distance from Coast Factor, Altitude Factor and Corrosion Factor is not greater than 1:

$$\textbf{Initial Location Factor} = \textbf{MIN}(\textbf{Distance From Coast Factor}, \textbf{Altitude Factor}, \textbf{Corrosion Factor})$$

EQ. 16

c) Steps (a) and (b) are the same as for an asset in an outdoor environment. This additional step recognises the shielding effect of the indoor environment on the asset in question. The Location Factor is calculated from the Initial Location Factor using EQ. 17.

$$\textbf{Location Factor} = 0.25 \times (\textbf{Initial Location Factor} - \textbf{Minimum Initial Location Factor}) + \textbf{Minimum Initial Location Factor}$$

EQ. 17

Where Minimum Initial Location Factor is the value of Initial Location Factor that would be determined if all location factors (i.e. Distance From Coast Factor, Altitude Factor and Corrosion Factor) were at their minimum possible value for the asset type, from the calibration Table 24 to Table 26.

7.6 Location Factor (Sub Cables)

7.6.1 Overview

The Location Factor for Sub Cable, as shown in Figure 9, is made up of four factor inputs:

a) Sub Cable Route Topography Factor;
b) Situation Factor;
c) Wind/Wave Factor; and
d) Combined Wave & Current Energy Factor.

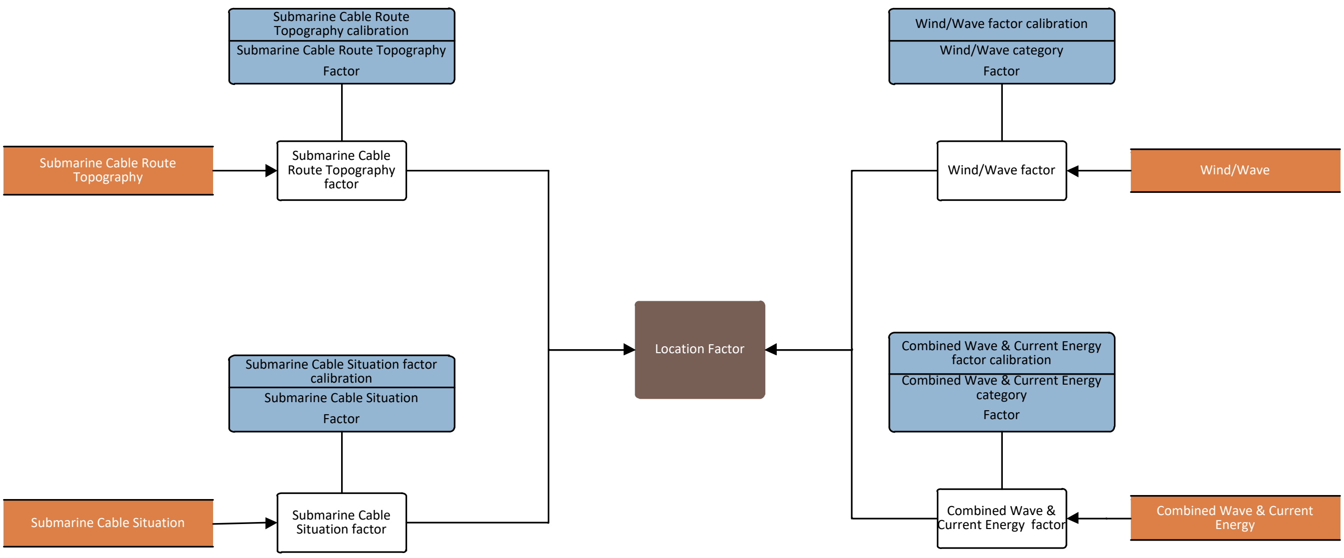

Figure 9 – Location Factor - Sub Cables

7.6.2 Sub Cable Route Topography Factor

The route topography factor considers the nature of the cable route in which the submarine cable has been laid. This considers the seabed makeup, landscape and the potential for cable to be suspended above the seabed.

The value for this factor is applied as shown in Table 29 in Annex B.

7.6.3 Sub Cable Situation Factor

The Sub Cable Situation factor takes into account its installed situation: laid on bed, covered and buried.

The value for this factor is applied as shown in Table 30 in Annex B.

7.6.4 Wind/Wave Factor

The wind and wave environment that sub cables are subjected to has been identified as directly affecting the severity of mechanical movement (action) on the shore ends. This is captured by the wind/wave factor.

The value for this factor is applied as shown in Table 31 in Annex B.

7.6.5 Combined Wave & Current Energy Factor

The rate at which fretting (abrasion of the cable armour) takes place is heavily dependent on the amount of energy exerted on both the cable and the seabed due to waves, tidal currents, or their combined effects. The combined wave and current energy factor take this into account.

The value for this factor is applied as shown in Table 32 in Annex B.

7.6.6 Determining the Location Factor for Sub Cables

If the maximum of the Sub Cable Route Topography Factor, Situation Factor, Wind/Wave Factor, Combined Wave & Current Energy Factor is greater than 1:

$$\begin{aligned}&\textbf{Location Factor}\\&= \textbf{MAX}(\textbf{Submarine Cable Route Topography Factor}, \textbf{Situation Factor}, \textbf{Wind}\\&\textbf{/Wave Factor}, \textbf{Combined Wave} \,\&\, \textbf{Current Energy Factor})\\&+ \left(\left((\textbf{COUNT of factors greater than 1}) - \mathbf{1}\right) \times \textbf{INC}\right)\end{aligned}$$

EQ. 18

Where INC is the increment constant for the asset type (Table 27, Annex B) .

If the maximum of the Sub Cable Route Topography Factor, Situation Factor, Wind/Wave Factor, Combined Wave & Current Energy Factor is not greater than 1:

$$\begin{aligned}&\textbf{Location Factor}\\&\qquad = \textbf{MIN}(\textbf{Submarine Cable Route Topography Factor}, \textbf{Situation Factor}, \textbf{Wind}\\&\qquad \textbf{/Wave Factor}, \textbf{Combined Wave} \,\&\, \textbf{Current Energy Factor})\end{aligned}$$

EQ. 19

7.7 Duty Factor

The Expected Life of an asset varies depending on the duty to which it is subjected.

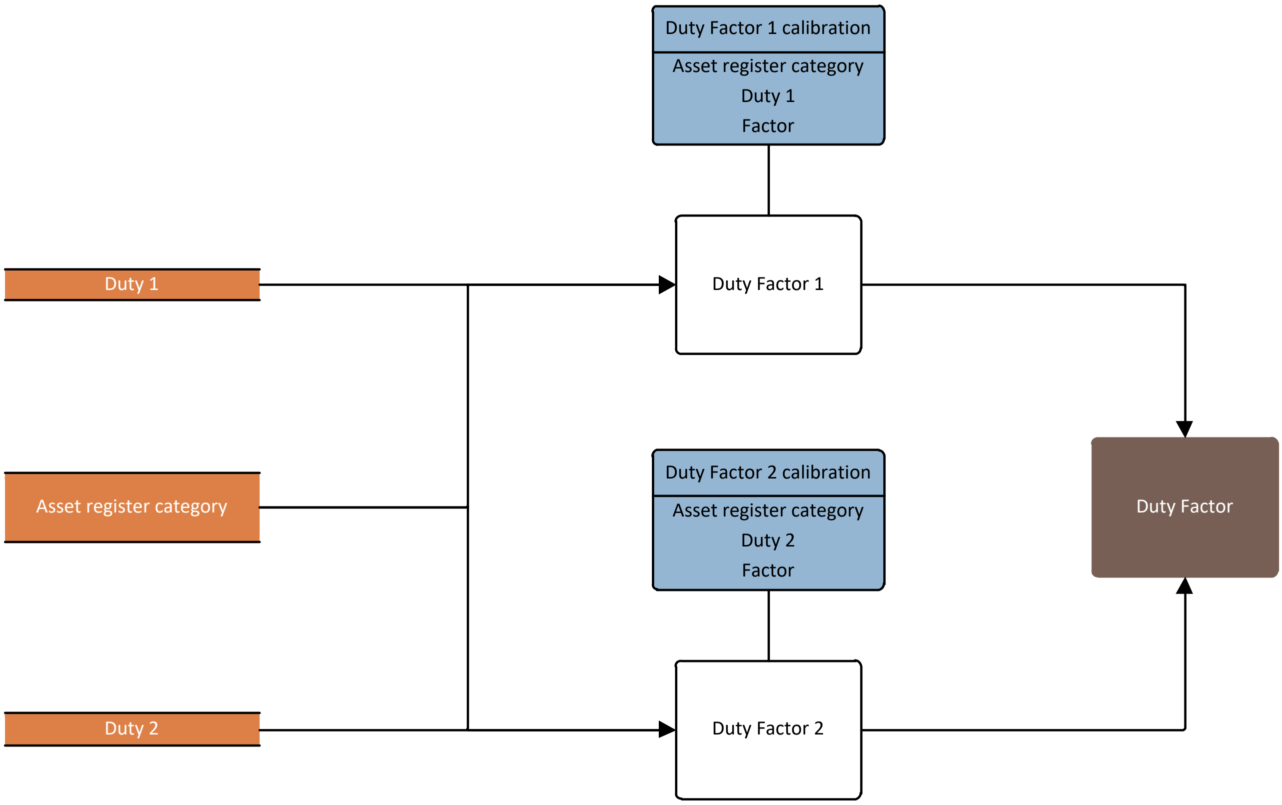

Figure 10 – Duty Factor

For electrical assets, the duty factor is a function of loading, number of operations, design voltage and operating voltage. Table 10 – Duty Factor shows how these factors are to be applied to the different Asset Categories:

Table 10 – Duty Factor Methodology

Asset Category	Duty Factor 1 (DF1)	Duty Factor 2 (DF2)
Cables	% Utilisation	Operating Voltage ÷ Design Voltage
Poles	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Batteries	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
LV UGB	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Switchgear - LV	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Switchgear - HV Distribution	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Switchgear - HV Primary	Number of Operations	N/A
Switchgear - EHV & 132 kV	Number of Operations	N/A
HV & EHV Switchgear (PM)	Number of Operations	N/A
EHV & 132kV Switchgear Other	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Steel Tower	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Conductor Tower Lines	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A

Asset Category	Duty Factor 1 (DF1)	Duty Factor 2 (DF2)
OHL Conductor Pole Lines	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Fittings	No asset-specific Duty Factor 1 (i.e. DF1 = 1)	N/A
Transformer (PM)	% Utilisation	N/A
HV Transformer (GM)	% Utilisation	N/A
Transformers - EHV & 132 kV	Transformer: % Utilisation	N/A
	Tapchanger: Average Number of Daily Tapping Operations	N/A

$$\mathbf{Duty\ Factor} = \mathbf{DF1}$$

EQ. 20

Where there is only a single Duty Factor, then:

Where two Factors are combined to create the Duty Factor, then:

$$\mathbf{Duty\ Factor} = \mathbf{0.5 \times DF1 + 0.5 \times DF2}$$

EQ. 21

The Duty Factor lookup tables which are applied to the respective Asset Categories are shown in Table 33 to

Table 36.

7.8 Health Score Modifier

7.8.1 Overview

Asset-specific Health Score Modifiers are calculated for each individual asset. The Health Score Modifier is determined from observed condition and measurement results. The Health Score Modifier is used to inform the Current Health Score, such that it reflects the observed health of the asset.

For all Health Index Asset Categories, except for EHV Towers, 132 kV Towers, HV Transformers, EHV Transformers and 132 kV Transformers, a single Health Score Modifier is calculated for each asset. The calculation of Health Score for assets in the EHV Towers, 132 kV Towers, HV Transformers, EHV Transformers and 132 kV Transformers Asset Categories requires separate evaluation of the Health Score for several subcomponents. Consequently, for these Asset Categories, separate Health Score Modifiers are evaluated for each subcomponent. In such cases, the appropriate Health Score Modifier is applied to determine the Current Health Score for each subcomponent of the asset.

The Health Score Modifier consists of three elements:

a) a Health Score Factor, which is a multiplication factor, derived from Condition Modifiers, that is applied to the Initial Health Score;
b) a Health Score Cap, which is a maximum limit that is applied to the product of the Initial Health Score and the Health Score Factor; and
c) a Health Score Collar, which is a minimum limit that is applied to the product of the Initial Health Score and the Health Score Factor.

Where a cap or a collar is applied an explanation for the application is provided in the associated table values in the appropriate appendices.

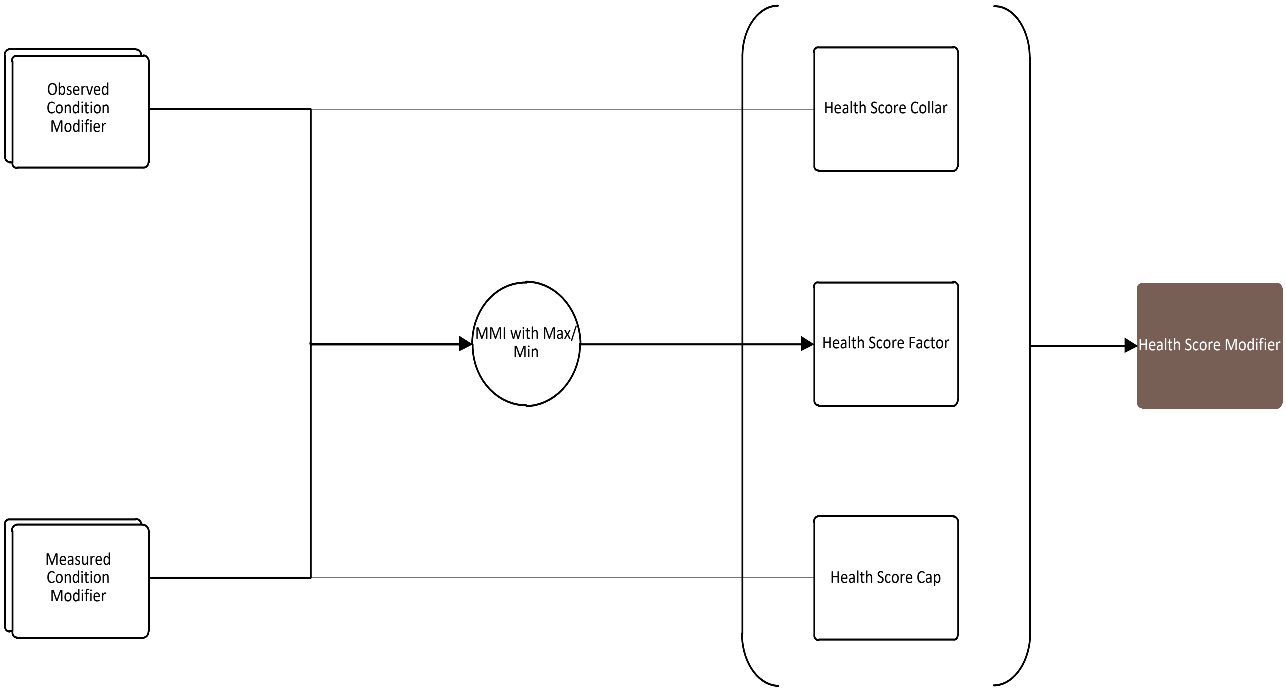

Figure 11 – Health Score Modifier

For assets, other than those in the HV, EHV and 132 kV Transformer Health Index Asset Categories, the Health Score Modifier is determined by combining:

a) an Observed Condition Modifier, based on Observed Condition Inputs (such as condition assessment observations); and
b) a Measured Condition Modifier, based on Measured Condition Inputs.

The derivation of the Observed Condition Modifier and Measured Condition Modifier are described in Sections 7.10 and 7.11. Like the Health Score Modifier, each of these Condition Modifiers is comprised of three elements, i.e.:

a) a Condition Factor, which is a value associated with an observation or measurement, used to derive the Health Score Factor;
b) a Condition Cap, which is a maximum limit that is used to derive the Health Score Cap; and
c) a Condition Collar, which is a minimum limit that is used to derive the Health Score Collar.

The derivation of the Health Score Modifier for the HV, EHV and 132 kV Transformer Asset Categories is described separately in Section 7.9***.***

In determining the Health Score Modifier, only the Condition Modifiers (and associated Condition Inputs) specified within the Methodology are applied. In recognition of different inspection and assessment approaches between DNOs:

a) There is no requirement for data to be collected to apply all the Condition Inputs specified within the Methodology. Where DNOs do not have data available to determine a specific Condition Input, the default values for that Condition Input (as specified in the calibration table for that Condition Input) are applied.

b) The calibration tables for each Condition Input (Annex C.5and C.6) are defined in terms of the outcomes or conclusions drawn from the relevant condition assessments or tests and are common to all DNOs. Where required, DNOs shall map data from their own systems against the relevant criteria shown on the calibration tables. This enables common Condition Inputs to be determined for all DNOs without specifying the exact format of data that is collected in each individual DNOs inspection and assessment regimes.

c) It will be permissible for DNOs to combine multiple measurements or observations from their own data set (or adjust for elapsed time since the condition data was collected) in their mapping to an individual Condition Input.

DNOs shall be required to record all mappings of their data to the Methodology's Condition Inputs within their own Network Asset Indices Methodology.

7.8.2 Combining Factors Using a Maximum and Multiple Increment (MMI) Technique

The Condition Factors, which form part of the Condition Modifiers, are combined together to derive the Health Score Factor using a technique that is referred to as "maximum and multiple increment". The calculation of the Health Score Factor is described in Section 7.8.3.

Each specific Condition Factor is derived from multiple Condition Input Factors, which come from associated lookup tables that map the observed or measured condition to a Condition Input Factor.

The combination of Condition Inputs to create the Observed Condition Modifier and the Measured Condition Modifier is described in Sections 7.10 and 7.11. This also uses an MMI approach.

By using the MMI approach throughout, this ensures that the Health Score Factor is primarily driven by the strongest observed or measured Condition Input Factor, supplemented to a lesser and controlled degree by any additional Condition Input Factors (depending on their strength).

This approach enables a single methodology to be applied to all asset groups, with the variation between asset groups captured through calibration factors.

Whilst multiple Factors may be considered in the derivation of a single combined Factor using the MMI technique, there will be instances where not all of the multiple Factors affect the resulting Factor. This is because:

a) where all of the multiple Factors are less than, or equal to 1, the resulting combined single Factor is determined from only the lowest and second lowest of the multiple Factors; and

b) where any of the multiple Factors are greater than 1, the resulting combined single Factor will be determined from consideration of the highest of the multiple Factors and a given number of the next highest Factors. The total number of Factors considered in each case will be no greater than the Max. No. of Combined Factors, which is a calibration parameter that is specified for each instance that the MMI technique is applied. The Max. No. of Combined Factors describes the total number of Factors that may be considered in the derivation of the combined single Factor, which is a count of Factors that includes the maximum Factor and any additional Factors that may be used to supplement it.

The combination of multiple Factors into a single Factor using the MMI technique is described below:

If any of the Factors is greater than 1

- Var_1 = Maximum of Factors
- Var_2 = Excluding Var_1,
    - For remaining Factors where (Factor - 1) > 0
    - Sum (Factor - 1) for the highest n-1 of these; where *n = Max. No. of Combined Factors*
- Var_3 = Var_2 / Factor Divider 1
- Combined Factor = Var_1 + Var_3

- Else

- Var_1 = Minimum of Factors
- Var_2 = Second Lowest of Factors
- Var_3 = (Var_2 - 1) / Factor Divider 2
- Combined Factor = Var_1 + Var_3

where:

- Max. No. of Combined Factors specifies how many Factors are able to simultaneously affect the Combined Factor.
- Factor Divider 1 and Factor Divider 2 are constants that specify the degree to which additional “good” or “bad” Factors are able further drive the Combined Factor.

A case statement description of this algorithm is demonstrated below.

Case 1: one or more Factors > 1

- Factors = 1.2, 1.0, 1.1, 1.02, 0.9, Max. No of Combined Factors = 4, Factor Divider 1 and Factor Divider 2 = 2

- Var 1 = maximum of Factors = Max(1.2, 1.0, 1.1, 1.02, 0.9) = 1.2
- Var 2 = sum remaining Factors where Factor - 1 > 0 = (1.1-1) + (1.02 - 1) = 0.12
- Var 3 = Var 2 / Factor Divider 1 = 0.12 / 2 = 0.06
- Combined Factor = Var 1 + Var 3 = 1.2 + 0.06 = 1.26

Case 2: all Factors ≤ 1

- Factors = 1, 1, 0.8, 1, 0.9, Max. No of Combined Factors = 4, Factor Divider 1 and Factor Divider 2 = 2
- Var 1 = minimum of Factors = Min(1, 1, 0.8, 0.9) = 0.8
- Var 2 = Second minimum of Factors = 2^{nd} Min(1, 1, 0.8, 0.9) = 0.9
- Var 3 = (Var 2 - 1) / Factor Divider 2 = (0.9 - 1) / 2 = -0.05
- Combined Factor = Var 3 + Var 1 = 0.8 + -0.05 = 0.75

7.8.3 Health Score Factor Calculation

The Health Score Factor is a multiplier that is applied to the Initial Health Score.

The Observed and Measured Condition Factors are combined to derive the Health Score Factor using the MMI technique described in Section 7.8.2.

For assets, other than those in the HV, EHV Transformer and 132 kV Transformer Health Index Asset Categories, Factor Divider 1 and Factor Divider 2 have a value of 1.5 and the Max. No. of Combined Factors is 2. This means that the description of the combination method can be simplified to:

a) The Health Score Factor for an individual asset is determined by evaluating:
    - the maximum of the Observed Condition Factor and the Measured Condition Factor for the asset; and
    - the minimum of the Observed Condition Factor and the Measured Condition Factor for the asset.
b) The calculation used to determine the Health Score Factor is dependent on the magnitudes of the maximum and minimum Condition Factors. The Health Score Factor is calculated as shown in Table 11.

Table 11 – Health Score Factor

a = Maximum of (Observed Condition Factor, Measured Condition Factor)	b = Minimum of (Observed Condition Factor, Measured Condition Factor)	Health Score Factor
>1	>1	= a + ((b-1)/1.5)
>1	≤1	= a
≤1	≤1	= b + ((a-1)/1.5)

The derivation of the Health Score Factor for the HV, EHV Transformer and 132 kV Transformer Asset Categories is described separately in Section 7.9.

7.8.4 Health Score Cap

For assets, other than those in the HV, EHV and 132 kV Transformer Health Index Asset Categories, the Health Score Cap is the minimum of:

a) The Observed Condition Cap associated with the Observed Condition Modifier; or
b) The Measured Condition Cap associated with the Measured Condition Modifier.

The derivation of the Condition Caps associated with the Observed and Measured Condition Modifiers is described in Sections 7.10.3 and 7.11.3 respectively.

The derivation of the Health Score Cap for the HV, EHV and 132 kV Transformer Asset Categories is described in Section 7.8.4.

7.8.5 Health Score Collar

For assets, other than those in the HV, EHV and 132 kV Transformer Health Index Asset Categories, the Health Score Collar is the maximum of:

a) The Observed Condition Collar associated with the Observed Condition Modifier; or
b) The Measured Condition Collar associated with the Measured Condition Modifier.

The derivation of the Condition Collars associated with the Observed and Measured Condition Modifiers is described in Sections 7.10.4 and 7.11.4 respectively.

The derivation of the Health Score Collar for the HV, EHV and 132 kV Transformer Asset Categories is described in Section 7.8.5.

In all cases, the Health Score Collar shall be limited to a value of no greater than 10.

7.9 Health Score Modifier for HV, EHV and 132 kV Transformers – Ground Mounted only

7.9.1 Main Transformer

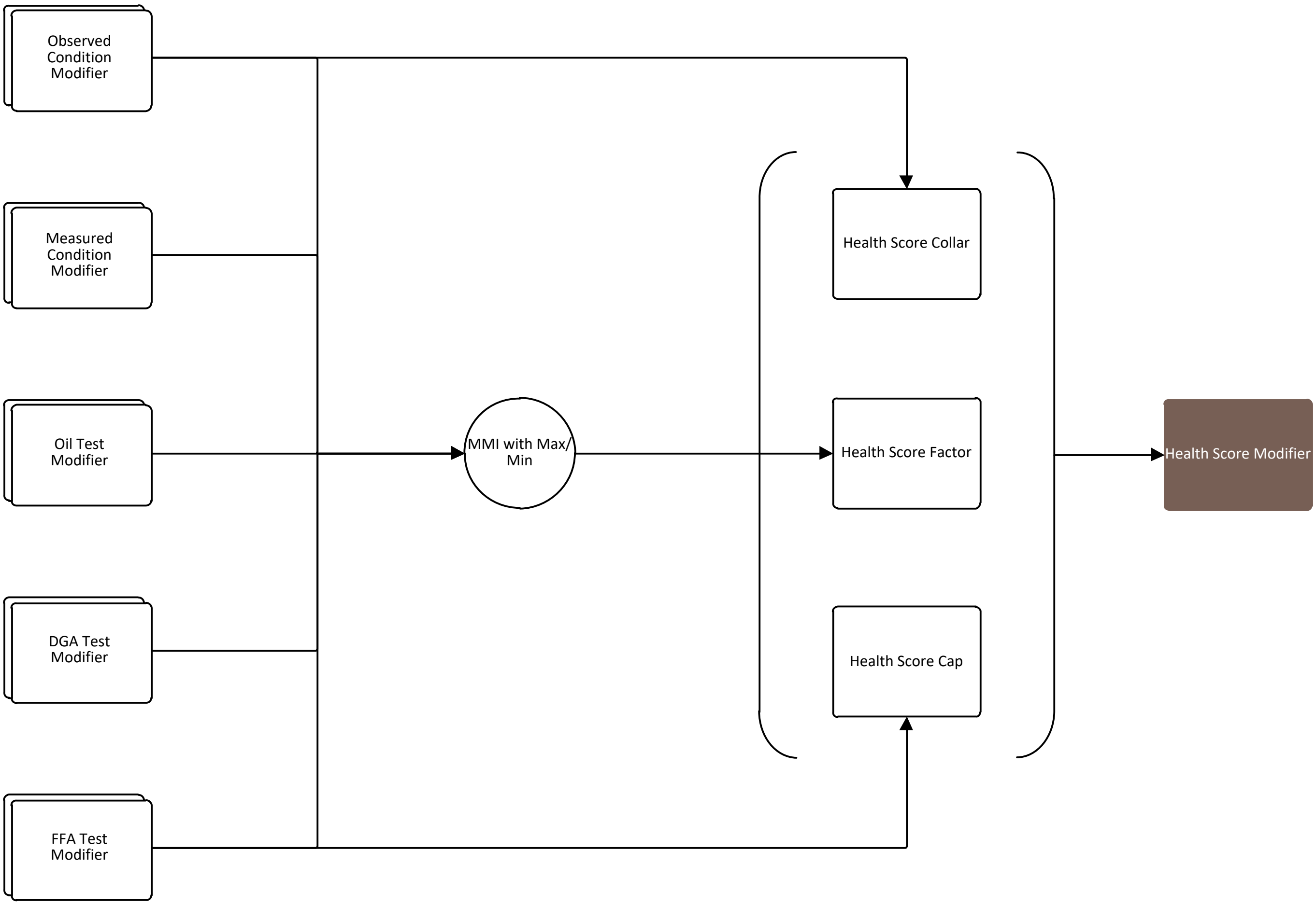

Figure 12 – Health Score Modifier - Main Transformer

The Health Score Modifier for HV, EHV and 132 kV Transformers is derived in exactly the same way as for a generic Health Score Modifier, apart from the following differences:

a) There are three additional Condition Modifiers to the model: the Oil Test Modifier, the DGA Test Modifier and the FFA Test Modifier;
b) The parameters used to combine the Factors associated with these Condition Modifiers in order to derive the Health Score Factor are as shown in
c) Table 12.

Table 12 – Health Score Factor For Transformers

Parameters for Combination Using MMI Technique		
Factor Divider 1	**Factor Divider 2**	**Max. No. of Condition Factors**
1.5	1.5	4

These additional inputs enable the Health Score of the Main Transformer component to be determined with greater accuracy.

7.9.2 Tapchanger for EHV and 132 kV Transformers only

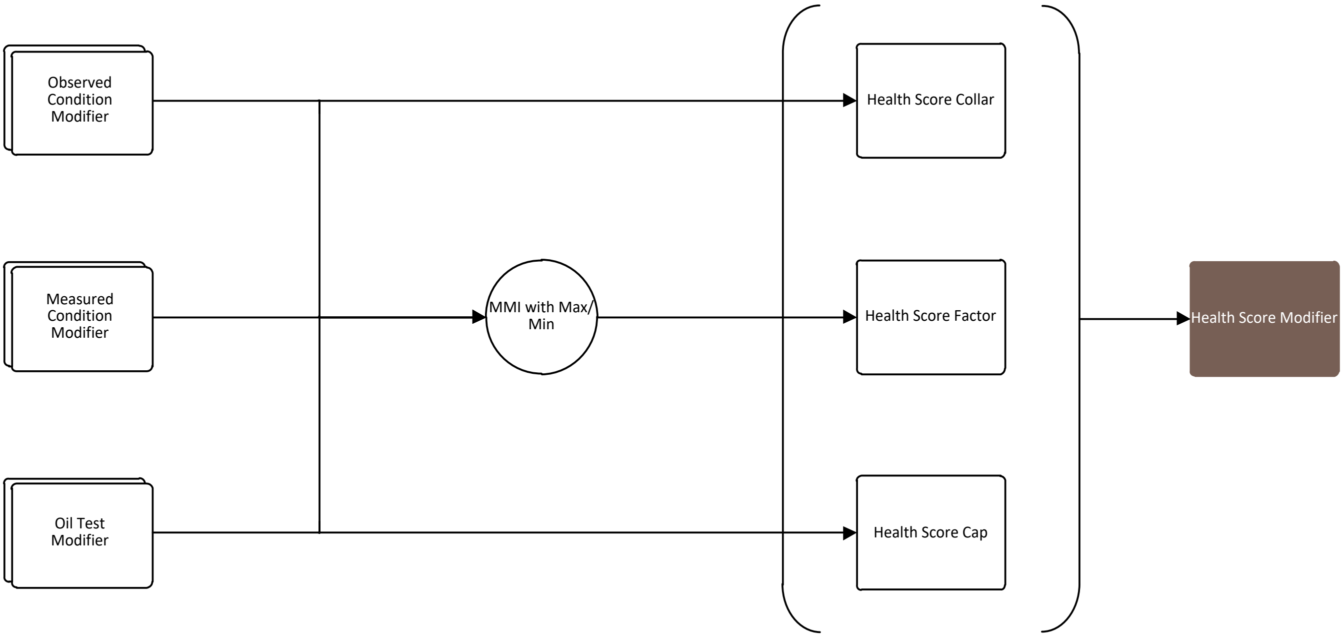

Figure 13 – Health Score Modifier - Tapchanger

The Health Score Modifier for a Transformer Tapchanger (where the Health Score needs to be separately determined) is derived in the same way as for a generic Health Score Modifier, apart from the following differences:

a) There is an additional Condition Modifier to the model: the Oil Test Modifier;

b) The parameters used to combine the Factors associated with these Condition Modifiers in order to derive the Health Score Factor are as shown in Table 13.

Table 13 – Health Score Factor For Tapchangers

Parameters for Combination Using MMI Technique		
Factor Divider 1	**Factor Divider 2**	**Max. No. of Condition Factors**
1.5	1.5	2

This additional input enables the Health Score of the Tapchanger to be determined with greater accuracy.

7.10 Observed Condition Modifier

7.10.1 Overview

The Observed Condition Modifier is used in the determination of the Health Score Modifier.

An asset-specific Observed Condition Modifier is determined for each individual asset. For all Health Index Asset Categories, except for Battery System, EHV Towers, 132 kV Towers, HV Transformers, EHV Transformers and 132 kV Transformers, a single Observed Condition Modifier is calculated for each asset.

The calculation of Health Score for assets in the EHV Towers, 132 kV Towers, HV Transformers, EHV Transformers and 132 kV Transformers Health Index Asset Categories requires separate evaluation of the Health Score for subcomponents of these assets. Consequently, for these Asset Categories, separate Observed Condition Modifiers are evaluated for each subcomponent associated with each asset.

This Condition Modifier is based on observed condition.

The Observed Condition Modifier consists of three components:

a) an Observed Condition Factor, which used in the derivation of the Health Score Factor;

b) an Observed Condition Cap, which is a maximum limit of Health Score that is used in the derivation of the Health Score Cap; and

c) an Observed Condition Collar, which is a minimum limit of Health Score that is used in the derivation of the Health Score Collar.

Multiple Observed Condition Inputs are used to derive the Observed Condition Modifier. Each Observed Condition Input consists of three elements:

a) a Condition Input Factor;
b) a Condition Input Cap; and
c) a Condition Input Collar.

The Condition Input Factors are used to derive the Observed Condition Factor using the MMI technique described in Section 7.8.2. Each Condition Input Cap is used in the derivation of the Observed Condition Cap and each Condition Input Collar is used in the derivation of the Observed Condition Collar.

The calibration tables relating to each of the Observed Condition Inputs are shown in Annex C.5. The values assigned to each Condition Input, for an asset, are determined by looking up the relevant Condition Input values that correspond to the DNO’s data for that asset.

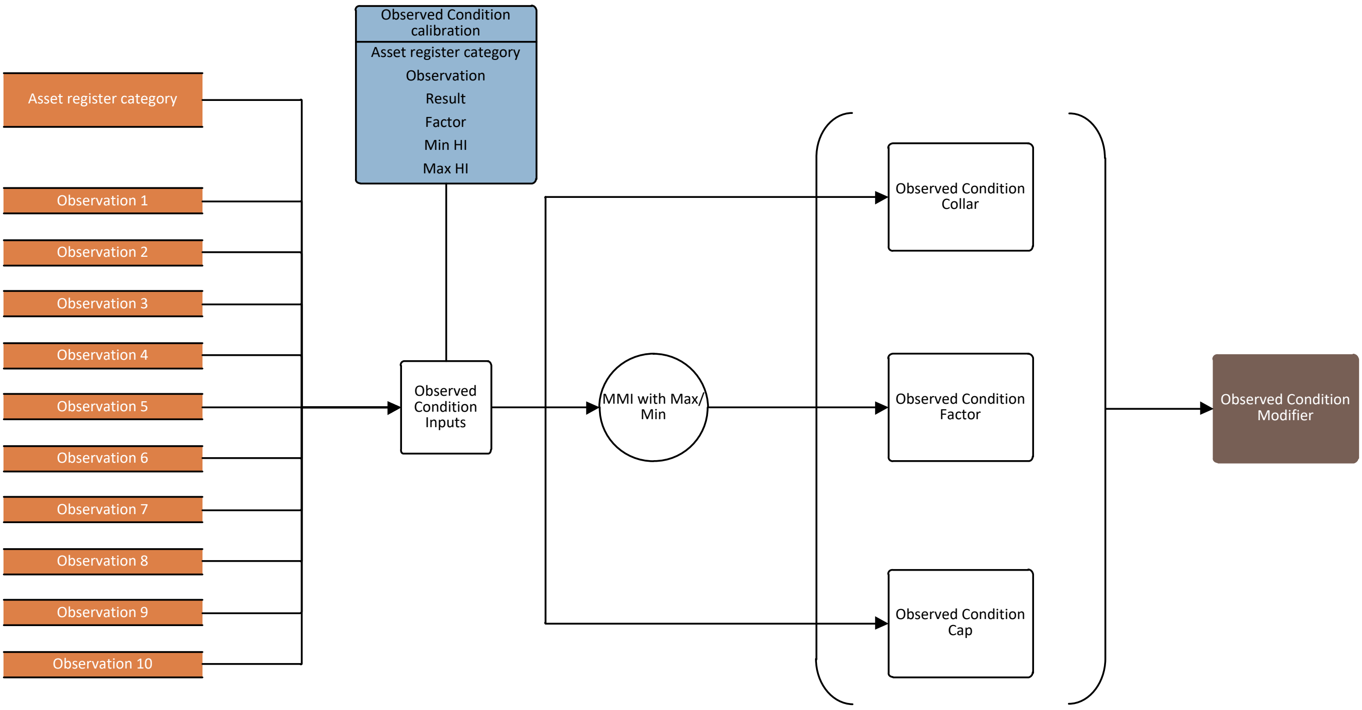

Figure 14 – Observed Condition Modifier

Table 14 shows the Observed Condition Inputs that are included in the determination of the Observed Condition Modifier for each Health Index Asset Category.

Table 14 – Observed Condition Inputs

Health Index Asset Category	Subcomponent	Observed Condition Input
Battery Systems	Batteries	1.Visual condition 2. Environment temperature
	Chargers	1.Visual condition
LV UGB	N/A	1. Steel Cover and Pit condition 2. Water/Moisture 3. Bell Condition 4. Insulation Condition 5. Signs of heating 6. Phase Barriers
LV Circuit Breaker	N/A	1. Switchgear external condition
LV Board (WM)	N/A	1. Switchgear external condition 2. Compound Leaks 3. Switchgear internal condition and operation 4. Insulation 5. Signs of Heating 6. Phase Barriers

Health Index Asset Category	Subcomponent	Observed Condition Input
LV Pillar	N/A	1. Switchgear external condition 2. Compound Leaks 3. Switchgear internal condition and operation 4. Insulation 5. Signs of Heating 6. Phase Barriers
HV Switchgear (PM)	N/A	1. Switchgear external condition 2. Oil leaks / gas pressure (insulation leaks)
HV Switchgear (GM) - Primary	N/A	1. Switchgear external condition 2. Cable boxes condition 3. Oil leaks/ Gas pressure 4. Thermographic Assessment 5. Switchgear internal condition and operation 6. Indoor Environment
HV Switchgear (GM) - Distribution	N/A	1. Switchgear external condition 2. Cable boxes condition 3. Oil leaks/ Gas pressure 4. Thermographic Assessment 5. Switchgear internal condition and operation 6. Indoor Environment
EHV Switchgear (GM)	N/A	1. Switchgear external condition 2. Cable boxes condition 3. Oil leaks/ Gas pressure 4. Thermographic Assessment 5. Switchgear internal condition and operation 6. Indoor Environment 7. Support Structures
EHV Switchgear (PM)	N/A	1. Switchgear external condition 2. Oil leaks / gas pressure (insulation leaks)
EHV Switchgear – Other	N/A	1. Switchgear external condition 2. Thermographic assessment 3. Support structures
132 kV Switchgear (GM)	N/A	1. Switchgear external condition 2. Cable boxes condition 3. Oil leaks/ Gas pressure 4. Thermographic Assessment 5. Switchgear internal condition and operation 6. Indoor Environment 7. Support Structures 8. Air systems

Health Index Asset Category	Subcomponent	Observed Condition Input
132 kV Switchgear – Other	N/A	1. Switchgear external condition 2. Thermographic assessment 3. Support structures
HV & EHV Transformer (PM)	N/A	1. Transformer external condition 2. Bushing condition
HV Transformer (GM)	N/A	1. Transformer external condition 2. Cable boxes condition
EHV Transformer (GM)	Main Transformer	1. Main tank condition 2. Coolers/Radiator condition 3. Bushings condition 4. Kiosk condition 5. Cable boxes condition
	Tapchanger	1. Tapchanger external condition 2. Internal Condition 3. Drive Mechanism Condition 4. Condition of Selector & Diverter Contacts 5. Condition of Selector & Diverter Braids
132 kV Transformer (GM)	Main Transformer	1. Main tank condition 2. Coolers/Radiator condition 3. Bushings condition 4. Kiosk condition 5. Cable boxes condition
	Tapchanger	1. Tapchanger external condition 2. Internal Condition 3. Drive Mechanism Condition 4. Condition of Selector & Diverter Contacts 5. Condition of Selector & Diverter Braids
EHV Cable (Non Pressurised)	N/A	None
EHV Cable (Oil)	N/A	1. Presence of Crystalline Lead
EHV Cable (Gas)	N/A	1. Presence of Crystalline Lead
132 kV Cable (Non Pressurised)	N/A	None
132 kV Cable (Oil)	N/A	1. Presence of Crystalline Lead
132 kV Cable (Gas)	N/A	1. Presence of Crystalline Lead
Sub Cable	N/A	1. External Condition 2. Shore End* – Cable Erosion 3. Shore End* – Cable Protection 4. Cable Suspensions
LV Poles	N/A	1. Visual Pole Condition 2. Pole Fittings Condition 3. Pole Top Rot 4. Pole Leaning 5. Bird / Animal Damage

Health Index Asset Category	Subcomponent	Observed Condition Input
LV Main OHL Conductor (Pole Lines)	N/A	1. Visual Condition 2. Midspan joints
HV Poles	N/A	1. Visual Pole Condition 2. Pole Fittings Condition 3. Pole Top Rot 4. Pole Leaning 5. Bird / Animal Damage
HV OHL Conductor (Pole Lines)	N/A	1. Visual Condition 2. Midspan joints
EHV Poles	N/A	1. Visual Pole Condition 2. Pole Fittings Condition 3. Pole Top Rot 4. Pole Leaning 5. Bird / Animal Damage
EHV OHL Conductor (Pole Lines)	N/A	1. Visual Condition 2. Midspan joints
132 kV Poles	N/A	1. Visual Pole Condition 2. Pole Fittings Condition 3. Pole Top Rot 4. Pole Leaning 5. Bird / Animal Damage
132 kV OHL Conductor (Pole Lines)	N/A	1. Visual Condition 2. Midspan joints
EHV Towers	Tower Steelwork	1. Tower Legs 2. Bracings 3. Crossarms 4. Peak
	Tower Paintwork	1. Paintwork Condition
	Foundations	1. Foundation Condition
132 kV Towers	Tower Steelwork	1. Tower Legs 2. Bracings 3. Crossarms 4. Peak
	Tower Paintwork	1. Paintwork Condition
	Foundations	1. Foundation Condition
EHV Fittings	N/A	1. Tower fittings 2. Conductor fittings 3. Insulators - Electrical 4. Insulators - Mechanical

Health Index Asset Category	Subcomponent	Observed Condition Input
132 kV Fittings	N/A	1.Tower fittings 2.Conductor fittings 3.Insulators - Electrical 4. Insulators - Mechanical
EHV Tower Line Conductor	N/A	1. Visual Condition 2. Midspan joints
132 kV Tower Line Conductor	N/A	1. Visual Condition 2. Midspan joints

*Shore End refers to cable section which is above water level as defined by the Mean Low Water Springs, which is the average height of low tides during spring tides. It's a long-term average of two successive low tides that occur during the period of greatest tidal range.

7.10.2 Observed Condition Factor

The Observed Condition Factor is used in the derivation of the Health Score Factor.

For each asset, multiple Observed Condition Input Factors are combined to create the Observed Condition Factor. These Observed Condition Input Factors are combined using the MMI technique that is described in Section 7.8.2.

Table 15 shows the parameters that are used when combining the Observed Condition Input Factors using the MMI technique.

Table 15 – Observed Condition Modifier - MMI Calculation Parameters

Asset Category	Subcomponent	Parameters for Combination Using MMI Technique		
		Factor Divider 1	Factor Divider 2	Max. No. of Combined Factors
Battery Systems	Batteries	1.5	1.5	2
	Chargers	1.5	1.5	1
LV UGB	N/A	1.5	1.5	3
LV Circuit Breaker	N/A	1.5	1.5	1
LV Board (WM)	N/A	1.5	1.5	3
LV Pillar	N/A	1.5	1.5	3
HV Switchgear (PM)	N/A	1.5	1.5	2
HV Switchgear (GM) - Distribution	N/A	1.5	1.5	3
HV Switchgear (GM) - Primary	N/A	1.5	1.5	3
EHV Switchgear (PM)	N/A	1.5	1.5	2
EHV Switchgear (GM)	N/A	1.5	1.5	3
EHV Switchgear (Other)	N/A	1.5	1.5	3

Asset Category	Subcomponent	Parameters for Combination Using MMI Technique		
		Factor Divider 1	Factor Divider 2	Max. No. of Combined Factors
132 kV Switchgear (GM)	N/A	1.5	1.5	3
132 kV Switchgear (Other)	N/A	1.5	1.5	3
HV & EHV Transformer (PM)	N/A	1.5	1.5	2
HV Transformer (GM)	N/A	1.5	1.5	2
EHV Transformer (GM)	Main Transformer	1.5	1.5	3
	Tapchanger	1.5	1.5	3
132 kV Transformer (GM)	Main Transformer	1.5	1.5	3
	Tapchanger	1.5	1.5	3
EHV Cable (Non Pressurised)	N/A	-	-	-
EHV Cable (Oil)	N/A	1.5	1.5	1
EHV Cable (Gas)	N/A	1.5	1.5	1
132 kV Cable (Non Pressurised)	N/A	-	-	-
132 kV Cable (Oil)	N/A	1.5	1.5	1
132 kV Cable (Gas)	N/A	1.5	1.5	1
Sub Cable	N/A	1.5	1.5	4
LV Poles	N/A	1.5	1.5	2
LV Main OHL Conductor (Pole Lines)	N/A	1.5	1.5	2
HV Poles	N/A	1.5	1.5	2
HV OHL Conductor (Pole Lines)	N/A	1.5	1.5	2
EHV Poles	N/A	1.5	1.5	2
EHV OHL Conductor (Pole Lines)	N/A	1.5	1.5	2
132 kV Poles	N/A	1.5	1.5	2
132 kV OHL Conductor (Pole Lines)	N/A	1.5	1.5	2
EHV Towers	Tower Steelwork	1.5	1.5	3
	Tower Paintwork	1.5	1.5	1
	Foundations	1.5	1.5	1
132 kV Towers	Tower Steelwork	1.5	1.5	3
	Tower Paintwork	1.5	1.5	1
	Foundations	1.5	1.5	1
EHV Fittings	N/A	1.5	1.5	3
EHV Tower Line Conductor	N/A	1.5	1.5	1
132 kV Fittings	N/A	1.5	1.5	3
132 kV Tower Line Conductor	N/A	1.5	1.5	1

7.10.3 Observed Condition Cap

The Observed Condition Cap for an asset is the minimum value of Condition Input Cap associated with each of the Observed Condition Inputs relating to that asset (as shown in the calibration tables for Observed Condition Inputs in Annex B).

7.10.4 Observed Condition Collar

The Observed Condition Collar for an asset is the maximum value of Condition Input Collar associated with each of the Observed Condition Inputs relating to that asset (as shown in the calibration tables for Observed Condition Inputs in Annex B).

7.10.5 Observed Condition Modifier for EHV Cable (Non Pressurised) and 132 kV Cable (Non Pressurised)Assets

As shown in Table 15, EHV Cable (Non Pressurised) and 132 kV Cable (Non Pressurised) are the only asset categories where no Observed Condition Inputs are applicable. For these asset categories:

a) the Observed Condition Factor is set to 1;
b) the Observed Condition Cap is 10; and
c) the Observed Condition Collar is 0.5.

7.11 Measured Condition Modifier

7.11.1 Overview

The Measured Condition Modifier is used in the determination of the Health Score Modifier.

An asset-specific Measured Condition Modifier is determined for each individual asset.

For all Health Index Asset Categories, with the exception of EHV Towers, 132 kV Towers, EHV Transformers and 132 kV Transformers, a single Measured Condition Modifier is calculated for each asset.

The calculation of Health Score for assets in the Battery System, EHV Towers, 132 kV Towers, EHV Transformers and 132 kV Transformers Health Index Asset Categories requires separate evaluation of the Health Score for subcomponents of these assets. Consequently, for these Asset Categories, separate Measured Condition Modifiers are evaluated for each subcomponent associated with each asset.

This Condition Modifier is based on measured condition.

The Measured Condition Modifier consists of three components:

a) a Measured Condition Factor, which is used in the derivation of the Health Score Factor;

b) a Measured Condition Cap, which is a maximum limit of Health Score that is used in the derivation of the Health Score Cap; and

c) a Measured Condition Collar, which is a minimum limit of Health Score that is used in the derivation of the Health Score Collar.

Multiple Measured Condition Inputs are used to derive the Measured Condition Modifier. Each Measured Condition Input consists of three elements:

a) a Condition Input Factor;
b) a Condition Input Cap; and
c) a Condition Input Collar.

The Condition Input Factors are used to derive the Measured Condition Factor using the MMI technique described in Section 7.8.2. Each Condition Input Cap is used in the derivation of the Measured Condition Cap and each Condition Input Collar is used in the derivation of the Measured Condition Collar.

The calibration tables relating to each of the Measured Condition Inputs are shown in Annex C.6. The values assigned to each Condition Input for a particular asset are determined by looking up the relevant Condition Input values that correspond to the DNO's data for that asset.

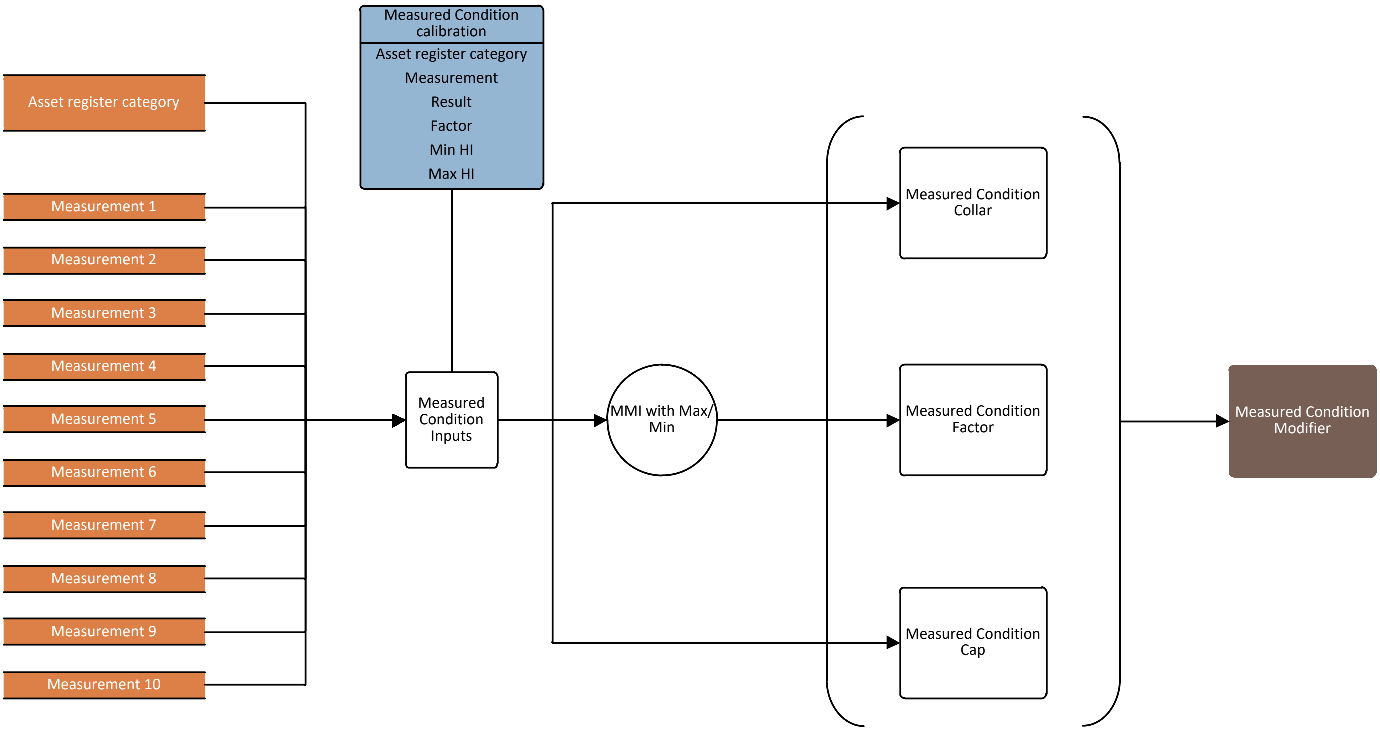

Figure 15 – Measured Condition Modifier

Table 16 shows the Measured Condition Inputs that are included in the determination of the Measured Condition Modifier for each Asset Category.

Table 16 – Measured Condition Inputs

Asset category	Subcomponent	Measured Condition Input
Battery System	Batteries	1.Load/Conductance test 2. Impedance test 3. Specific gravity test
	Chargers	1.Low/No Output
LV UGB	N/A	1. Operational Adequacy
LV Circuit Breaker	N/A	1. Operational Adequacy
LV Board (WM)	N/A	1. Operational Adequacy
LV Pillar	N/A	1. Operational Adequacy
HV Switchgear (PM)	N/A	1. Operational Adequacy
HV Switchgear (GM) - Distribution	N/A	1. Partial Discharge 2. Ductor Test 3. Oil Tests 4. Temperature Readings 5. Trip Test
HV Switchgear (GM) - Primary	N/A	1. Partial Discharge 2. Ductor Test 3. IR Test 4. Oil Tests 5. Temperature Readings 6. Trip Test
EHV Switchgear (PM)	N/A	1. Operational Adequacy
EHV Switchgear (GM)	N/A	1. Partial Discharge 2. Ductor Test 3. IR Test 4. Oil Tests/ Gas Tests 5. Temperature Readings 6. Trip Test
EHV Switchgear (Other)	N/A	1. Operational Adequacy
132 kV Switchgear (GM)	N/A	1. Partial Discharge 2. Ductor Test 3. IR Test 4. Oil Tests/ Gas Tests 5. Temperature Readings 6. Trip Test
132 KV Switchgear (Other)	N/A	1. Operational Adequacy
HV & EHV Transformers (PM)	N/A	None
HV Transformer (GM)	N/A	1. Partial Discharge 2. Temperature Readings
EHV Transformer (GM)	Main Transformer	1. Partial Discharge 2. Temperature Readings
	Tapchanger	1. Tapchanger Partial Discharge
132 kV Transformer (GM)	Main Transformer	1. Partial Discharge 2. Temperature Readings
	Tapchanger	1. Tapchanger Partial Discharge

Asset category	Subcomponent	Measured Condition Input
EHV Cable (Non Pressurised)	N/A	1. Sheath Test 2. Partial Discharge 3. Fault history
EHV Cable (Oil)	N/A	1. Leakage
EHV Cable (Gas)	N/A	1. Leakage
132 kV Cable (Non Pressurised)	N/A	1. Sheath Test 2. Partial Discharge 3. Fault history
132 kV Cable (Oil)	N/A	1. Leakage
132 kV Cable (Gas)	N/A	1. Leakage
Sub Cable	N/A	1. Sheath Test 2. Partial Discharge 3. Fault history
LV Poles	N/A	1. Pole decay / deterioration
LV Main OHL Conductor (Pole Lines)	N/A	None
HV Poles	N/A	1. Pole decay / deterioration
HV OHL Conductor (Pole Lines)	N/A	1.Conductor sampling
EHV Poles	N/A	1. Pole decay / deterioration
EHV OHL Conductor (Pole Lines)	N/A	1.Conductor sampling
132 kV Poles	N/A	1. Pole decay / deterioration
132 kV OHL Conductor (Pole Lines)	N/A	1.Conductor sampling
EHV Towers	Tower Steelwork	None
	Tower Paintwork	None
	Foundations	None
132 kV Towers	Tower Steelwork	None
	Tower Paintwork	None
	Foundations	None
EHV Fittings	N/A	1. Thermal Imaging 2. Ductor Tests
132 kV Fittings	N/A	1. Thermal Imaging 2. Ductor Tests
EHV Tower Line Conductor	N/A	1. Conductor Sampling 2. Corrosion Monitoring Survey
132 kV Tower Line Conductor	N/A	1. Conductor Sampling 2. Corrosion Monitoring Survey

7.11.2 Measured Condition Factor

The Measured Condition Factor is used in the derivation of the Health Score Factor.

For each asset, multiple Measured Condition Input Factors are combined to create the Measured Condition Factor. These Measured Condition Input Factors are combined using the MMI technique that is described in Section 7.8.2.

Table 17 shows the parameters that are used when combining the Measured Condition Factors using the MMI technique.

Table 17 – Measured Condition Modifier - MMI calculation parameters

Asset Category	Subcomponent	Parameters for combination using MMI technique		
		Factor divider 1	Factor divider 2	Max. No. Of combined factors
Battery System	Batteries	1.5	1.5	1
	Chargers	1.5	1.5	1
LV UGB	N/A	1.5	1.5	1
LV Circuit Breaker	N/A	1.5	1.5	1
LV Board (WM)	N/A	1.5	1.5	1
LV Pillar	N/A	1.5	1.5	1
HV Switchgear (PM)	N/A	1.5	1.5	1
HV Switchgear (GM) - Distribution	N/A	1.5	1.5	3
HV Switchgear (GM) - Primary	N/A	1.5	1.5	3
EHV Switchgear (PM)	N/A	1.5	1.5	1
EHV Switchgear (GM)	N/A	1.5	1.5	3
EHV Switchgear (Other)	N/A	1.5	1.5	1
132 kV Switchgear (GM)	N/A	1.5	1.5	3
132 kV Switchgear (Other)	N/A	1.5	1.5	1
HV Transformer (PM)	N/A	N/A	N/A	N/A
HV Transformer (GM)	N/A	1.5	1.5	2
EHV Transformer (PM)	N/A	N/A	N/A	N/A
EHV Transformer (GM)	Main Transformer	1.5	1.5	2
	Tapchanger	1.5	1.5	1
132 kV Transformer (GM)	Main Transformer	1.5	1.5	2
	Tapchanger	1.5	1.5	1
EHV Cable (Non Pressurised)	N/A	1.5	1.5	2
EHV Cable (Oil)	N/A	1.5	1.5	1

Asset Category	Subcomponent	Parameters for combination using MMI technique		
		Factor divider 1	Factor divider 2	Max. No. Of combined factors
EHV Cable (Gas)	N/A	1.5	1.5	1
132 kV Cable (Non Pressurised)	N/A	1.5	1.5	2
132 kV Cable (Oil)	N/A	1.5	1.5	1
132 kV Cable (Gas)	N/A	1.5	1.5	1
Sub Cable	N/A	1.5	1.5	3
LV Poles	N/A	1.5	1.5	1
LV Main OHL Conductor (Pole Lines)	N/A	N/A	N/A	N/A
HV Poles	N/A	1.5	1.5	1
HV OHL Conductor (Pole Lines)	N/A	1.5	1.5	1
EHV Poles	N/A	1.5	1.5	1
EHV OHL Conductor (Pole Lines)	N/A	1.5	1.5	1
132 kV Poles	N/A	1.5	1.5	1
132kV OHL Conductor (Pole Lines)	N/A	1.5	1.5	1
EHV Towers	Tower Steelwork	-	-	-
	Tower Paintwork	-	-	-
	Foundations	-	-	-
132 kV Towers	Tower Steelwork	-	-	-
	Tower Paintwork	-	-	-
	Foundations	-	-	-
EHV Fittings	N/A	1.5	1.5	1
132 kV Fittings	N/A	1.5	1.5	1
EHV Tower Line Conductor	N/A	1.5	1.5	1
132 kV Tower Line Conductor	N/A	1.5	1.5	1

7.11.3 Measured Condition Cap

The Measured Condition Cap for an asset is the minimum value of Condition Input Cap associated with each of the Measured Condition Inputs relating to that asset (as shown in the calibration tables for Measured Condition Inputs in Annex B).

7.11.4 Measured Condition Collar

The Measured Condition Collar for an asset is the maximum value of Condition Input Collar associated with each of the Measured Condition Inputs relating to that asset (as shown in the calibration tables for Measured Condition Inputs in Annex B).

7.11.5 Measured Condition Modifier for Steel Towers (Structure Only)

There are no Measured Condition Inputs for Steel Towers (Steelwork, Paint or Foundation components). For these assets:

a) the Measured Condition Factor is set to 1;
b) the Measured Condition Cap is 10; and
c) the Measured Condition Collar is 0.5.

7.12 Oil Test Modifier

The Oil Test Modifier is derived from the oil condition information (moisture content, acidity and breakdown strength) [Section 3.1 **Standards publications**]. It provides additional information to determine the Health Score when oil condition test data is available. This test data can be used to identify defects or degradation within the asset and is therefore used to increase the Health Score when necessary.

The Oil Test Modifier consists of three components:

a) an Oil Test Factor, which used in the derivation of the Health Score Factor;
b) an Oil Test Cap, which is a maximum limit of Health Score that used in the derivation of the Health Score Cap; and
c) an Oil Test Collar, which is a minimum limit of Health Score that is used in the derivation of the Health Score Collar.

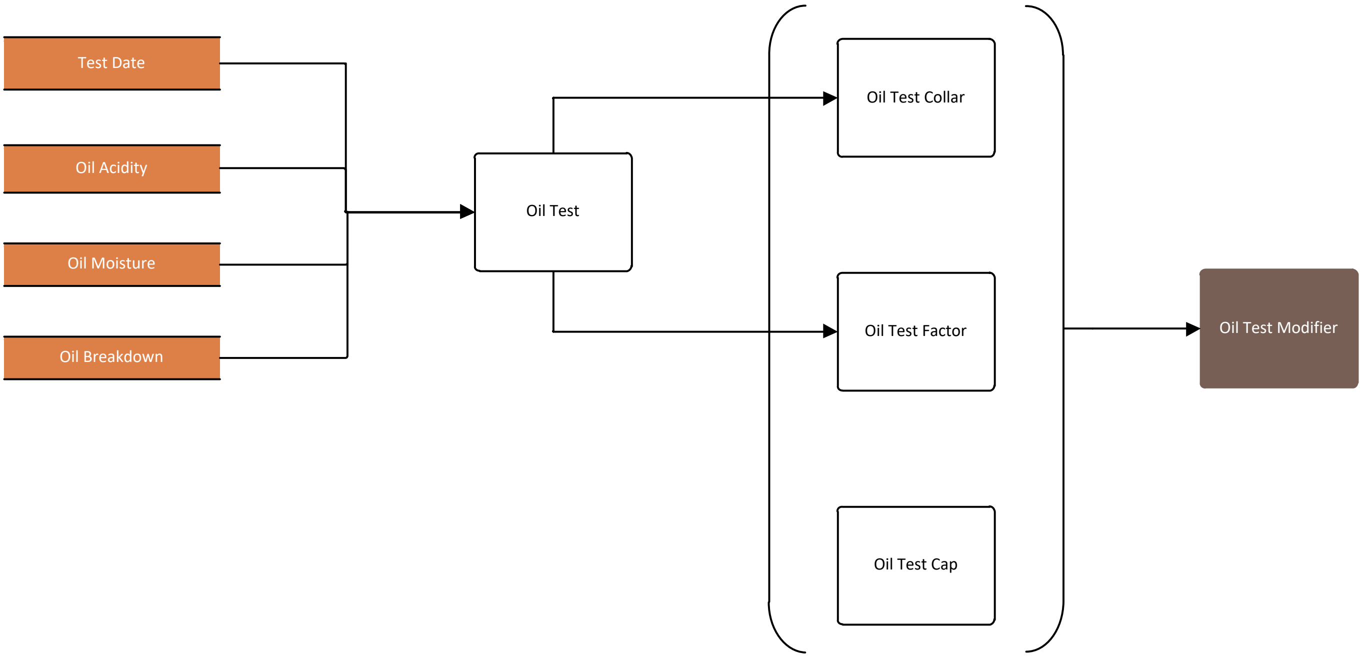

Figure 16 – Oil Test Modifier

The process for converting the results into a score and subsequently into an Oil Test Factor, an Oil Test Cap and an Oil Test Collar is as follows.

a) The moisture, acidity and breakdown strength results are standardised by converting them into scores using the Condition State calibration tables; respectively Table 251, Table 252 and Table 253 in Annex B. Note that these tables consider oil types, i.e. mineral oil, synthetic ester and natural ester. In the absence of oil type used in the transformer, the default oil type to be selected is mineral oil.

$$\textbf{Oil Condition Score} = 80 \times \textbf{Moisture Score} + 125 \times \textbf{Acidity Score} + 80 \times \textbf{Breakdown Strength Score}$$

EQ. 22

b) The scores for the three condition points (moisture, breakdown strength and acidity) are then multiplied by the values relative to the importance of the measured condition point and summed to create an Oil Condition Score as shown in EQ. 22.

c) The Oil Condition Factor and Oil Test Collar value are then derived using the lookup values shown in Table 254 and Table 255 in Annex B.

d) The Oil Test Cap is always set to 10: because oil can be renewed, oil tests are unable to determine the absence of degradation in an asset - only its presence. Therefore, the Oil Test Cap cannot be set to less than 10, regardless of the Oil Test result.

7.13 DGA Test Modifier

The DGA Test Modifier is derived from the dissolved gas content in the oil [Section 3.1 **Standards publications**]. It provides additional information to determine the Health Score when DGA test data is available. This test data can be used to detect abnormal electrical or thermal activity within the asset and is therefore used to increase the Health Score when necessary.

The DGA Test Modifier consists of three components:

a) a DGA Test Factor, which is used in the derivation of the Health Score Factor;
b) a DGA Test Cap, which is a maximum limit of Health Score that is used in the derivation of the Health Score Cap; and
c) a DGA Test Collar, which is a minimum limit of Health Score that is used in the derivation of the Health Score Collar.

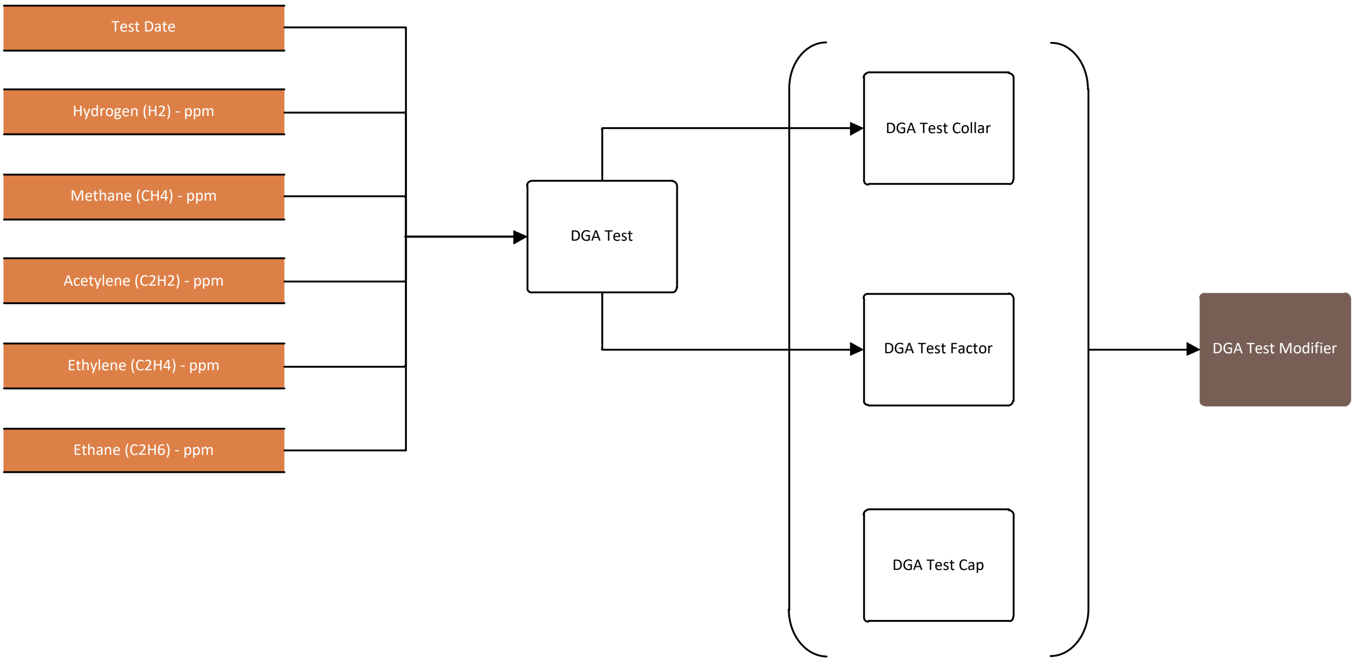

Figure 17 – DGA Test Modifier

The diagnostic process described here was developed by EA Technology in conjunction with a number of GB Distribution Network Operators within Module 4 of the Strategic Technology Programme [Ref. N5]. Of nine gases measured during DGA (namely oxygen, nitrogen, carbon monoxide, carbon dioxide, hydrogen, methane, ethylene, ethane and acetylene) only the latter five were recognised as providing an indication of transformer condition.

Therefore, only the levels of the following gases are used to derive the DGA Test Modifier:

a) Hydrogen;
b) Methane;
c) Ethylene;
d) Ethane; and
e) Acetylene.

The gas levels used to produce this modifier are calibrated based on the 90% typical gas concentration values in the international standards [Section 3.1 **Standards publications**].

The results for each of the five gases are standardised by converting them into scores using condition state calibration tables; these are shown in Table 256 - Table 260 in Annex B.

The condition state scores for the five gases (hydrogen, methane, ethane, ethylene and acetylene) are then multiplied by values relative to the importance of the quantity of each gas measured and summed to create a DGA Score as shown in EQ. 23.

$$\textbf{DGA Score} = 50 \times \textbf{Hydrogen Score} + 30 \times \textbf{Methane Score}$$
$$+ 30 \times \textbf{Ethylene Score} + 30 \times \textbf{Ethane Score} + 120 \times \textbf{Acetylene Score}$$

EQ. 23

In order to create a DGA Test Collar that can be considered in the Health Score Factor calculation, in the range of 0.5 to 10, the DGA Score is divided by a DGA divider value as shown in EQ. 24.

$$\textbf{DGA Test Collar} = \textbf{DGA Score} \div \textbf{DGA Divider}$$

EQ. 24

The DGA Divider is set to 260 regardless of oil type. This corresponds to a DGA Test Collar of 4. If this is the Health Score, it represents the tipping point where PoF starts to change (note that PoF is constant for a Health Score ≤ 4 as shown in Figure 3: HI Banding). The total DGA Score at this point is 1040, derived from having a condition state score of 4 for all five gases, multiplied by their respective importance values (i.e. 50 for hydrogen, 30 for methane, 30 for ethane, 30 for ethylene and 120 for acetylene). In the absence of DGA records a default DGA Test Collar of 0.5 is used.

The DGA Test Factor is then created by considering the trend with historical results (annualised) for the same asset. The annualised percentage change is derived as shown in EQ. 25. For assets where DGA tests are not routinely undertaken or in the absence of two valid time stamped DGA tests, the DGA Test Factor is always set to 1. This prevents comparison with previous results.

$$\% \textbf{ Change} = \frac{\textbf{DGA Score}_{\textbf{latest}} - \textbf{DGA Score}_{\textbf{previous}}}{\textbf{DGA Score}_{\textbf{previous}}} \times \textbf{100} \times \frac{\textbf{365}}{|\textbf{\textit{Days between Latest and Prev DGA Test}}+\textbf{1}|}$$

EQ. 25

This is used to categorise the trend into one of five categories or bands (negative, neutral, small, significant or large), as depicted in calibration Table 261 in Annex B.

The category or band is then used to assign the DGA Test Factor, using the calibration Table 262 in Annex B.

The DGA Test Cap is always set to 10: because oil can be renewed, DGA tests are unable to determine the absence of degradation in an asset - only its presence. Therefore, the DGA Test Cap cannot be set to less than 10, regardless of the DGA test result.

7.14 FFA Test Modifier

The FFA Test Modifier is derived from the level of furfuraldehyde (FFA) in oil. It provides additional information to determine the Health Score when FFA test data is available. This test data can be used to detect degradation of cellulose paper, and hence residual mechanical strength of insulation within the asset. It is used to increase the Health Score when necessary.

The FFA Test Modifier consists of three components:

a) an FFA Test Factor, which is used in the derivation of the Health Score Factor;

b) an FFA Test Cap, which is a maximum limit of Health Score that is used in the derivation of the Health Score Cap; and
c) an FFA Test Collar, which is a minimum limit of Health Score that is used in the derivation of the Health Score Collar.

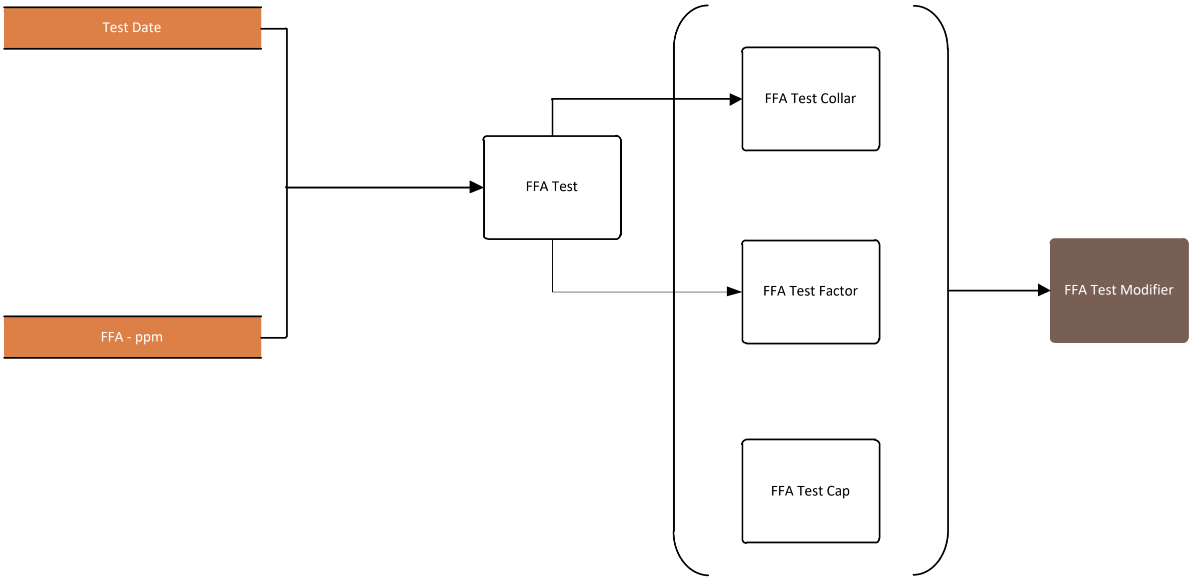

Figure 18 – FFA Test Modifier

The FFA Test Collar is derived from the furfuraldehyde (FFA) value.

Furfuraldehyde is one of a family of compounds (furans) produced when cellulose (paper) degrades. As the paper ages, the cellulose chains progressively break, reducing the mechanical strength. The average length of the cellulose chains is defined by the degree of polymerisation (DP) which is a measure of the number of Carbon-Carbon bonds or the length of chains making up the paper fibres. In a new transformer, the DP value is approximately 1000. "When this is reduced to approximately 350, the paper is aged; and when it is further reduced to approximately 250, it has very little remaining strength and is at risk of failure during operation. "

There is an approximate relationship between the value of furfuraldehyde in the oil and the DP of the paper, which has been established experimentally. Using Chendong's equation that relates DP to FFA as a reference, the FFA Test Collar is calibrated to give a value of 8 for a FFA value of 2, which corresponds to a DP of approximately 350; This empirical relationship has been mathematically described as shown in EQ. 26.

$$\textbf{FFA Test Collar} = 10 \times e^{(-2.9957 \times e^{-1.2986 \times S})}$$

EQ. 26

Where S is the FFA value in ppm.

The FFA Test Factor is determined from the FFA value using the calibration FFA test modifier in Annex B. The default value for the FFA Test Factor is 1. The FFA Test Cap is always set to 10.

The FFA Test Factor is then created by considering the trend with historical results (annualised) for the same asset. The annualised percentage change is derived as shown in EQ. 27. For assets where FFA tests are not routinely undertaken or in the absence of two valid time stamped FFA tests, the FFA Test Factor is always set to 1. This prevents comparison with previous results.

$$\% \; \boldsymbol{Change} = \frac{FFA\ Score_{Latest} - FFA\ Score_{Prev}}{FFA\ Score_{Prev}} \times 100 \times \frac{365}{|Days\ between\ Latest\ and\ Prev\ FFA\ Test + 1|}$$

EQ. 27

This is used to categorise the trend into one of five categories or bands (negative, neutral, small, significant or large), as depicted in calibration Table 263 in Annex B.

The category or band is then used to assign the FFA Test Factor, using the calibration Table 264 in Annex B.

7.15 Reliability Modifier

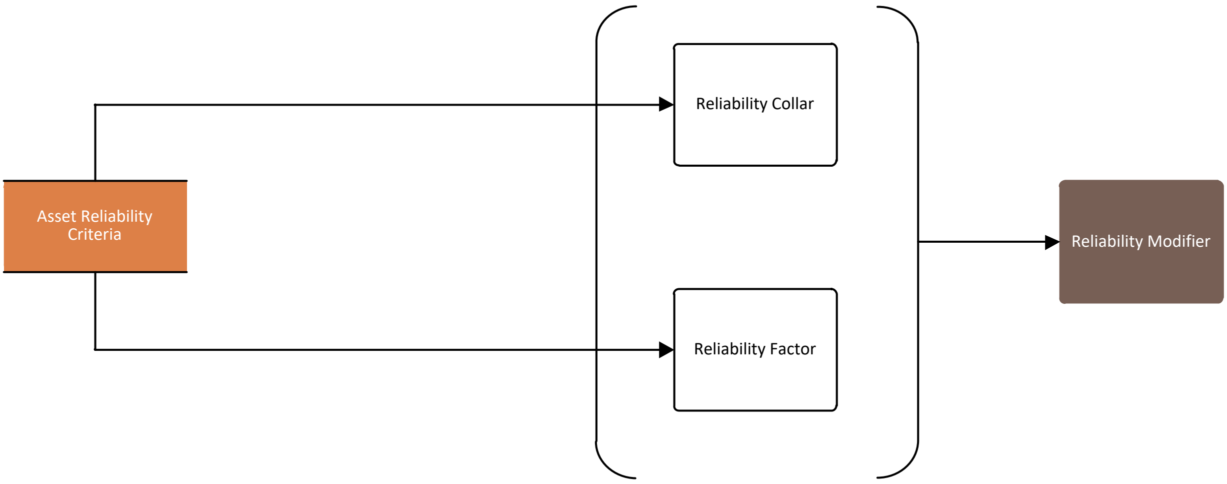

Figure 19 – Reliability Modifier

An additional Reliability Modifier may be applied (at individual DNO discretion) to the Current Health Score of those assets that the individual DNO believes have a materially different PoF than would be expected for a typical asset within the same Asset Category with the same Health Score, because of generic issues that affect health/reliability associated with:

a) the make and type of the asset; and
b) the construction of the asset (e.g. material used, or treatment applied).

Typically, these issues would have been identified from manufacturer notifications, failure investigations, forensic analysis or because of inspections from assets of the same make or type. This recognises that there are wider sources of knowledge about the condition and performance of individual assets.

Where a DNO applies a Reliability Modifier to an asset, this shall be documented within their own Network Asset Indices Methodology.

The Reliability Modifier may comprise of two separate components:

a) a multiplication factor applied in the calculation of the Current Health Score (the Reliability Factor); and

b) a Health Score Collar applied as a minimum limit to the Current Health Score (the Reliability Collar).

The Reliability Factor shall be applied as a multiplier to the Current Health Score that is derived from the initial age-based Health Score and the Health Score Modifier.

The Reliability Collar shall be applied as a minimum limit to the Health Score that is derived from the initial age-based Health Score, the Health Score Modifier and the Reliability Factor (where applied).

The Reliability Factor shall have a value between 0.6 and 1.5 with a default value of 1. The default value for the Reliability Collar shall be 0.5. Each DNO has discretion over whether the Reliability Modifier applied to individual asset types comprises:

a) only a Reliability Factor;
b) only a Reliability Collar; or
c) both.

When applying Reliability Modifiers, individual DNOs may use any appropriate data they have relating to the asset or assets. This will include their own defect databases as well as information gathered as part of the national notification process for:

a) National Equipment Defect Reports (NEDeRs);
b) Dangerous Incident Notifications (DINs); or
c) Suspension of Operational Practice notices (SOPs).

8 Consequences of Failure

8.1 Overview

The second key dimension of the Methodology is a consideration of the consequences of asset failure. This is used in combination with an assessment of the probability of asset failure to derive a single value for network risk.

The Methodology breaks the effects of failure down into four Consequence Categories:

a) Financial;
b) Safety;
c) Environmental; and
d) Network Performance.

Each of these is quantified in terms which allow for the monetisation within each Consequence Category. The four values are then simply added to produce an overall CoF value. All quoted values are in £ (at 2020/21 prices).

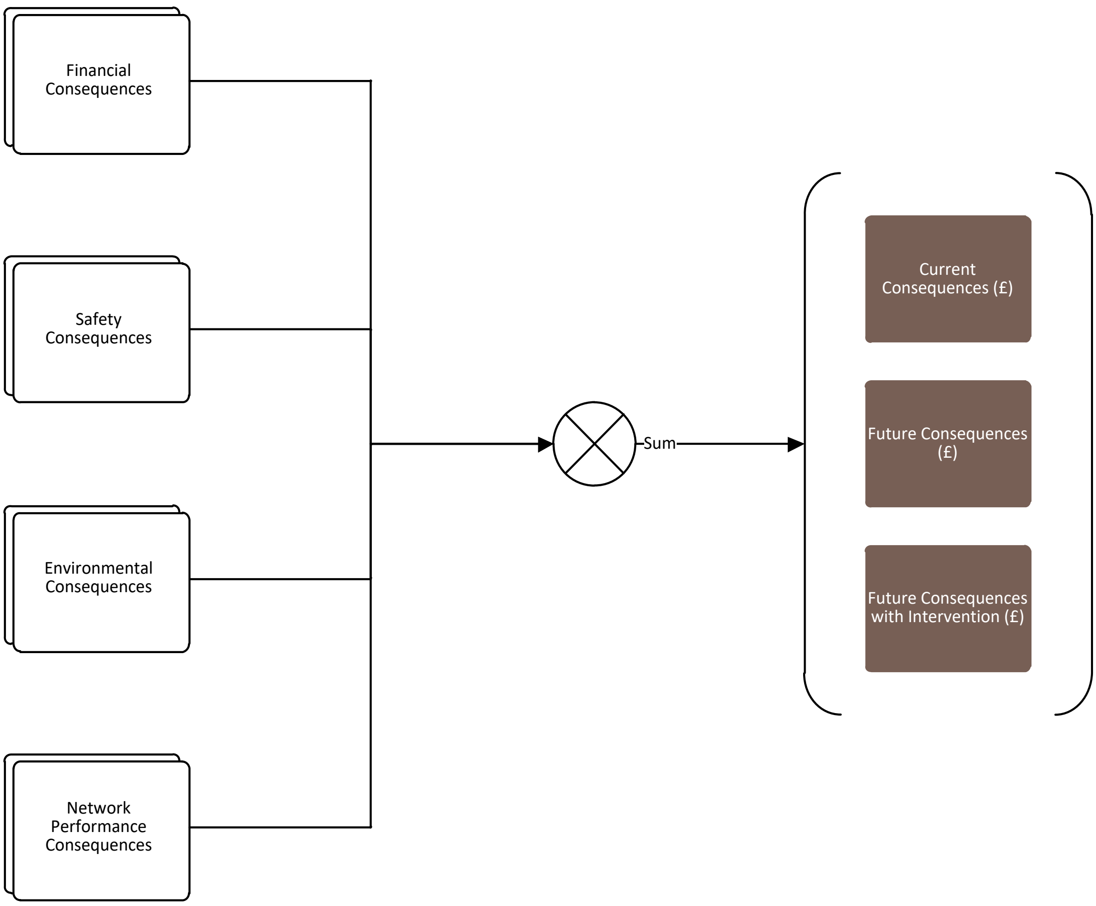

Figure 20 – Consequences of Failure

These are the only Consequence Categories considered within the Methodology.

CoF is generally assumed to remain static over time, unless affected by investment or third-party actions, hence current consequence and forecast future consequence values will generally be the same.

The calculation of CoF is based on the same failure modes as PoF, i.e. Incipient Failure, Degraded Failure and Catastrophic Failure.

The Methodology is based on the production of a Reference Cost of Failure for each asset type which represents the 'typical' effects of a failure based on DNO experience. Asset-specific costs are based on the application of specific modifying factors to these reference costs to reflect the costs associated with a condition-based failure of the asset in question. The reference costs and factors used within the Methodology are common for all DNOs. This process is shown in Figure 21.

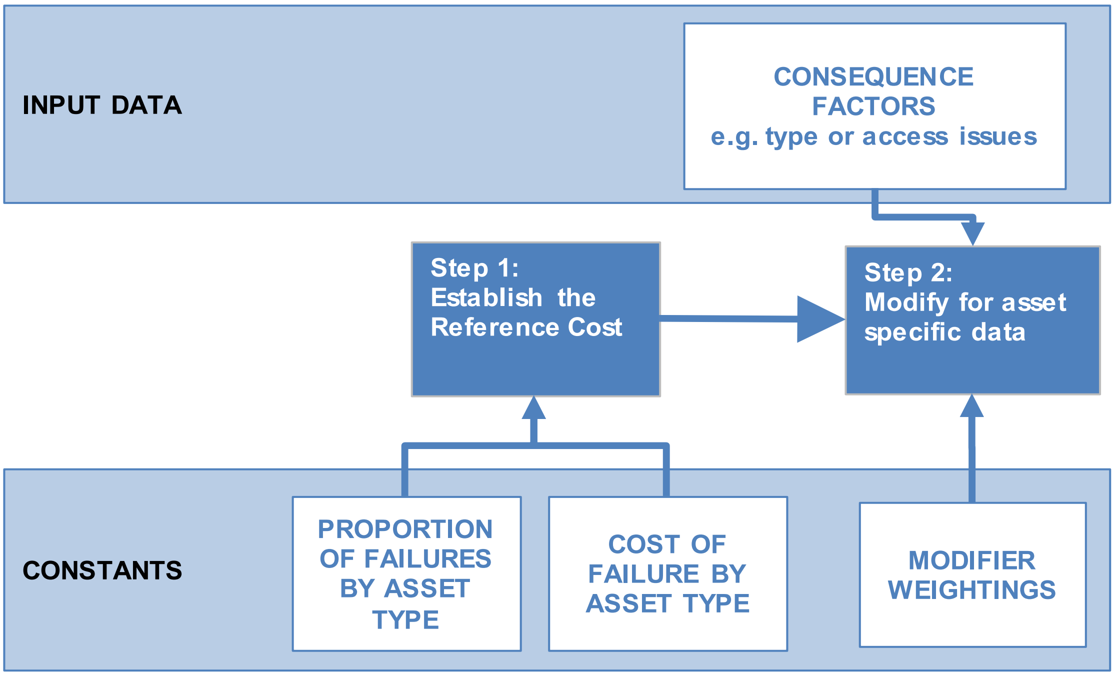

Figure 21 – CoF Methodology

The interdependence of assets in terms of Network Performance is considered at EHV and 132 kV (typically N-1 assets) by including a factor for coincident failure in deriving the Reference Network Performance Cost of Failure. This is done by considering the Probability of a Coincident Outage (see Table 286). Other assets are assumed to be independent of one another, reflecting the radial nature of distribution networks. However, the impact of the failure of one asset on the propensity of another asset to fail is implicitly included in the observable failure rate and hence the PoF parameters (e.g. K-Value in Table 23).

8.2 Reference Costs of Failure

The following sections set out the process to produce the Reference Costs of Failure and modifying factors for each of the four Consequence Categories within the Methodology. These costs are shown in Table 18.

Table 18 – Reference Costs of Failure

Asset Register Category	Financial1)	Safety1)	Environ-mental1)	Network Perform-ance1)	Total1)
Batteries at GM HV Substations	£896	£5	£24	£16	£941
Batteries at 33 kV Substations	£3 765	£5	£38	£0	£3 808
Batteries at 66 kV Substations	£3 765	£5	£38	£0	£3 808
Batteries at 132 kV Substations	£3 896	£5	£38	£2	£3 941
LV Poles	£1 337	£601	£90	£542	£2 570
LV Main (OHL) Conductor	£3 132	£26 561	£24	£3 037	£32 754
6.6/11 kV Poles	£1 913	£200	£90	£1 930	£4 133
6.6/11 kV OHL (Conventional Conductor)	£4 386	£34 153	£24	£17 680	£56 243
6.6/11 kV OHL (BLX or similar Conductor)	£6 902	£34 153	£24	£17 680	£58 760
20 kV Poles	£2 295	£200	£90	£2 895	£5 480
20 kV OHL (Conventional Conductor)	£5 678	£34 153	£24	£26 520	£66 375
20 kV OHL (BLX or similar Conductor)	£8 763	£34 153	£24	£26 520	£69 460
33 kV Pole	£2 466	£200	£90	£92	£2 847
33 kV OHL (Pole Line) Conductor	£8 437	£56 784	£24	£706	£65 951
66 kV Pole	£3 718	£200	£90	£183	£4 191
66 kV OHL (Pole Line) Conductor	£9,855	£56 784	£24	£1 830	£68 493
132 kV Pole	£4 589	£200	£90	£608	£5 487
132 kV OHL (Pole Line) Conductor	£14 948	£102 047	£24	£5 164	£122 158
33 kV Tower	£6 749	£377	£186	£580	£7 893
66 kV Tower	£12 647	£377	£186	£1 663	£14 873
132 kV Tower	£14 623	£377	£186	£4 157	£19 343
33 kV Fittings	£227	£1 508	£96	£267	£2 098

Asset Register Category	Financial[1)]	Safety[1)]	Environ-mental[1)]	Network Perform-ance[1)]	Total[1)]
66 kV Fittings	£292	£1 508	£96	£533	£2 429
132 kV Fittings	£485	£1 508	£96	£1 333	£3 423
33 kV OHL (Tower Line) Conductor	£17 793	£1 508	£96	£1 333	£20 731
66 kV OHL Conductor	£23 600	£1 508	£96	£2 667	£27 871
132 kV OHL (Tower Line) Conductor	£20 408	£1 508	£96	£6 667	£28 680
HV Sub Cable	£181 996	£2	£3 600	£190 344	£375 942
33 kV UG Cable (Non Pressurised)	£31 644	£2	£726	£3 530	£35 901
33 kV UG Cable (Oil)	£129	£2	£5 885	£4	£6 019
33 kV UG Cable (Gas)	£317	£2	£54	£35	£407
66 kV UG Cable (Non Pressurised)	£64 021	£2	£726	£7 059	£71 808
66 kV UG Cable (Oil)	£140	£2	£5 885	£7	£6 033
66 kV UG Cable (Gas)	£519	£2	£54	£71	£645
132 kV UG Cable (Non Pressurised)	£109 244	£2	£1 086	£17 648	£127 980
132 kV UG Cable (Oil)	£154	£2	£7 410	£18	£7 583
132 kV UG Cable (Gas)	£802	£2	£81	£176	£1 060
EHV Sub Cable	£285 322	£2	£3 600	£3 530	£292 453
132 kV Sub Cable	£480 542	£2	£3 600	£17 648	£501 792
LV Circuit Breaker	£4 070	£9 109	£22	£11 085	£24 285
LV Pillar (ID)	£5 669	£9 109	£22	£8 243	£23 042
LV Pillar (OD at Substation)	£6 170	£9 109	£22	£8 243	£23 543
LV Pillar (OD not at Substation)	£3 429	£9 622	£22	£8 243	£21 316
LV UGB	£3 429	£9 622	£85	£2 748	£15 884
LV Board (WM)	£7 833	£9 109	£22	£8 243	£25 206
LV Board (X-type Network) (WM)	£9 244	£9 109	£22	£8 243	£26 617
6.6/11 kV CB (PM)	£8 358	£5	£1 192	£4 825	£14 379
6.6/11 kV CB (GM) Secondary	£9 510	£4 823	£1 486	£13 524	£29 343
6.6/11 kV CB (GM) Primary	£14 483	£23 502	£1 547	£47 334	£86 865

Asset Register Category	Financial[1)]	Safety[1)]	Environ-mental[1)]	Network Perform-ance[1)]	Total[1)]
6.6/11 kV Switch (GM)	£9 317	£4 823	£1 486	£13 524	£29 149
6.6/11 kV RMU	£9 839	£4 823	£1 486	£13 524	£29 672
6.6/11 kV X-type RMU	£13 314	£4 823	£1 486	£13 524	£33 147
6.6/11kV Switchgear - Other (PM)	£8 358	£1 030	£1 192	£4 825	£15 405
20 kV CB (PM)	£9 753	£1 038	£1 192	£7 238	£19 221
20 kV CB (GM) Primary	£18 144	£23 502	£1 547	£47 334	£90 527
20 kV CB (GM) Secondary	£9 702	£4 823	£1 486	£20 286	£36 297
20 kV Switch (GM)	£9 575	£4 823	£1 486	£20 286	£36 170
20 kV RMU	£10 024	£4 823	£1 486	£20 286	£36 618
20 kV Switchgear - Other (PM)	£4 785	£1 038	£1 192	£7 238	£14 253
33 kV Switch (PM)	£4 012	£1 233	£2 346	£1 798	£9 389
33 kV CB (Air Insulated Busbars)(ID)(GM)	£27 707	£23 502	£4 356	£29 120	£84 685
33 kV CB (Air Insulated Busbars)(OD)(GM)	£17 870	£23 502	£4 356	£14 740	£60 467
33 kV CB (Gas Insulated Busbars)(ID)(GM)	£41 968	£23 502	£4 356	£29 120	£98 946
33 kV CB (Gas Insulated Busbars)(OD)(GM)	£21 984	£23 502	£4 356	£14 740	£64 581
33 kV Switch (GM)	£10 257	£23 502	£4 356	£14 740	£52 854
33 kV RMU	£25 347	£23 502	£4 356	£14 740	£67 944
33 kV Switchgear - Other	£4 788	£3	£8	£3 811	£8 610
66 kV CB (Air Insulated Busbars)(ID)(GM)	£55 230	£23 502	£4 356	£29 120	£112 207
66 kV CB (Air Insulated Busbars)(OD)(GM)	£46 252	£23 502	£4 356	£14 740	£88 849
66 kV CB (Gas Insulated Busbars)(ID)(GM)	£99 608	£23 502	£4 356	£29 120	£156 586
66 kV CB (Gas Insulated Busbars)(OD)(GM)	£52 176	£23 502	£4 356	£14 740	£94 773
66 kV Switchgear - Other	£5 218	£3	£8	£3 811	£9 041
132 kV CB (Air Insulated Busbars)(ID)(GM)	£154 812	£36 171	£21 756	£134 693	£347 432

Asset Register Category	Financial[1)]	Safety[1)]	Environ-mental[1)]	Network Perform-ance[1)]	Total[1)]
132 kV CB (Air Insulated Busbars)(OD)(GM)	£38 181	£36 171	£21 756	£34 033	£130 140
132 kV CB (Gas Insulated Busbars)(ID)(GM)	£322 430	£36 171	£21 756	£134 693	£515 050
132 kV CB (Gas Insulated Busbars)(OD)(GM)	£168 892	£36 171	£21 756	£34 033	£260 852
132 kV Switchgear - Other	£10 587	£3	£29	£8 532	£19 151
6.6/11 kV Transformer (PM)	£3 107	£1 038	£2 063	£430	£6 639
6.6/11 kV Transformer (GM)	£13 413	£4 823	£3 809	£5 072	£27 117
20 kV Transformer (PM)	£4 004	£1 038	£2 063	£565	£7 670
20 kV Transformer (GM)	£15 272	£4 823	£3 809	£5 072	£28 976
33 kV Transformer (PM)	£2 649	£1 038	£2 169	£565	£6 421
33 kV Transformer (GM)	£87 698	£23 502	£17 048	£28 940	£157 188
66 kV Transformer (GM)	£134 796	£23 502	£17 048	£28 940	£204 285
132 kV Transformer (GM)	£263 015	£36 171	£35 095	£230 441	£564 721

[1)] values rounded to nearest £ for presentation in this table

8.3 Financial Consequences

8.3.1 Overview

The Financial CoF is the cost of repair or replacement to return an asset to its pre-fault state. In the context of the Methodology, it is derived using an Asset Category Reference Financial Cost of Failure, which is then modified based on asset-specific data.

The overall process for deriving the Financial CoF is shown in Figure 22.

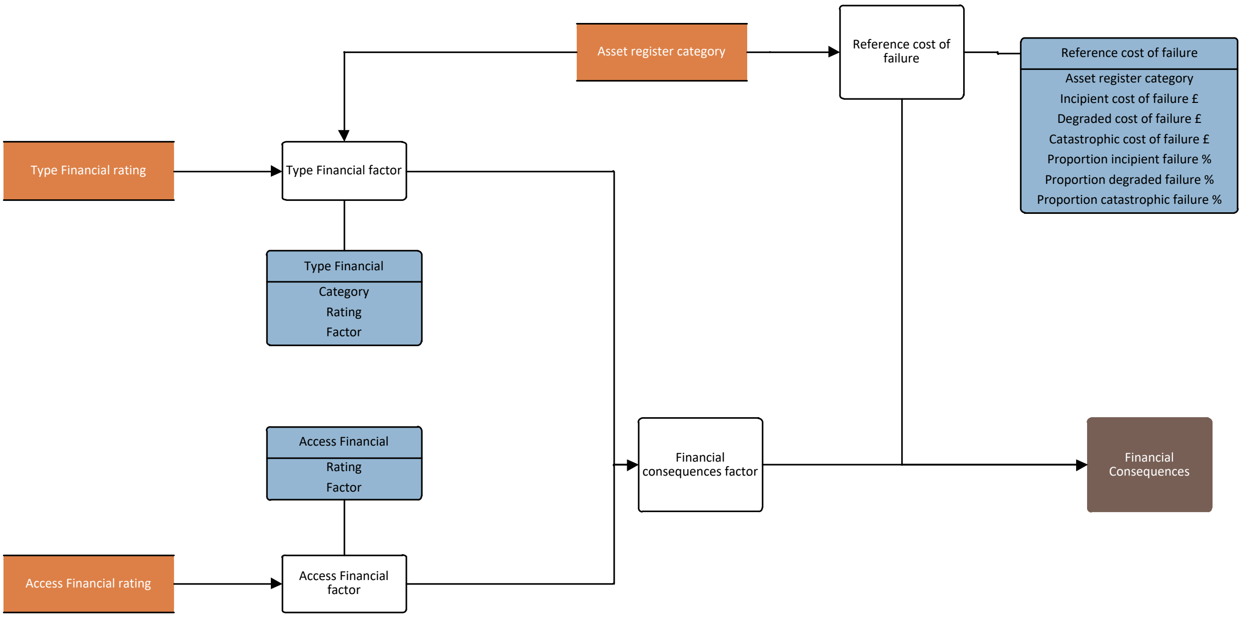

Figure 22 – Financial CoF

8.3.2 Reference Financial Cost of Failure

The Reference Financial Cost of Failure is based on an assessment of the typical replacement and repair costs incurred by a failure of the asset in each of its three failure modes; incipient, degraded and catastrophic. This assessment considers the cost of a repair in each case, and the relative proportions of failures that are associated with each failure mode, to derive a weighted average financial cost.

$$\textbf{Reference Financial Cost of Failure} = $$

$$(\textbf{Proportion of Failures that are Incipient Failure} \times \textbf{Likely Cost of Incipient Failure})$$

$$+ (\textbf{Proportion of Failures that are Degraded Failures} \times \textbf{Likely Cost of Degraded Failure})$$

$$+ (\textbf{Proportion of Failures that are Catastrophic Failures} \times \textbf{Likely Cost of Catastrophic Failure})$$

EQ. 27

The financial consequences framework has been built with reference to historic reported costs for repairs and replacement such that the values used represent the actual typical costs incurred by a DNO in returning a faulted asset to pre-fault serviceability.

Further detail, including the relative proportions of failures by failure type (incipient, degraded and catastrophic), used in the derivation of the Reference Financial Cost of Failure can be found in Table 268 in Annex D. The Reference Financial Cost of Failure shown in this table, for the relevant Asset Category, shall be used to calculate the Financial CoF, for each asset.

8.3.3 Financial Consequences Factor

The Financial CoF can then be derived for individual assets by applying a Type Financial Factor and/or an Access Financial Factor to the Reference Financial Cost of Failure. This results in a Financial CoF that reflects the consequence characteristics of an individual asset of that type which may materially affect the cost of returning the asset to its pre-fault state, in comparison to what would be considered typical for the Asset Category.

$$\begin{aligned}&\textbf{Financial Consequences of Failure}\\&\qquad = \textbf{Reference Financial Cost of Failure} \times \textbf{Financial Consequences Factor}\end{aligned}$$

EQ. 28

where:

$$\textbf{Financial Consequences Factor} = \textbf{Type Financial Factor} \times \textbf{Access Financial Factor}$$

EQ. 29

8.3.3.1 Type financial factor

This Factor allows for an adjustment to be made based on considerations specific to an asset or group of assets at a sub-level of the Asset Register Category. This will typically be applied to reflect industry experience with operating specific subcategories of asset where repair and replacement costs vary from the reference cost. Lookup tables containing the criteria and values for the Type Financial Factor can be found in Table 269 in Annex D.

8.3.3.2 Access financial factor

This Factor allows for an adjustment to be made based on a consideration of access to the faulted asset, insofar as issues of access will have a direct and material influence on the scale of Financial Consequences, e.g. access to constrained sites/confined spaces. Lookup tables containing the criteria and values for the Access Financial Factor can be found in Table 270 and Table 271 in Annex D.

8.4 Safety Consequences

8.4.1 Overview

The Safety Consequences have been derived with reference to appropriate safety regulations and guidance. The guidance for the components comprising safety consequences comes from the Electricity Safety, Quality and Continuity Regulations (ESQCR) 2002 [Ref. N6] and associated guidance from the Health and Safety Executive (HSE) [Ref. N7]. (See Section 3)

The overall process for deriving the Safety CoF is shown in Figure 23.

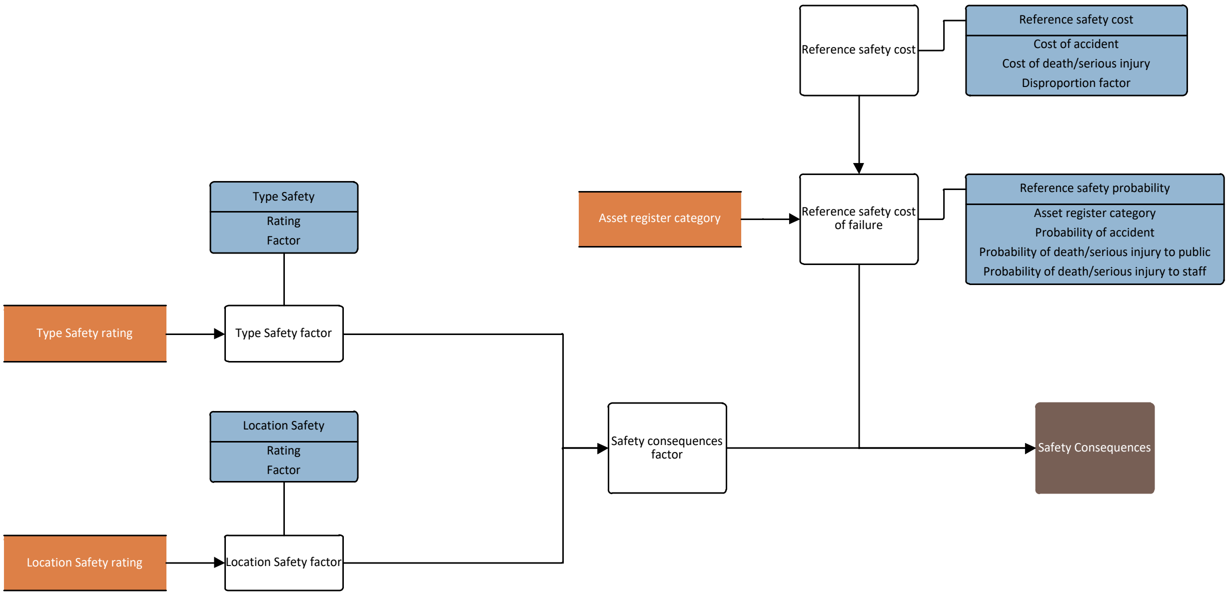

Figure 23 – Safety Consequences of Failure

8.4.2 Reference Safety Cost of Failure

The Reference Safety Cost of Failure is derived initially by applying the probability that a failure could result in an accident, serious injury or fatality to the cost of a Lost Time Accident (LTA) or Death or Serious Injury (DSI) as appropriate.

$$\textbf{Reference Safety Cost of Failure} = \Big((\textbf{Probability of LTA} \times \textbf{Cost of LTA}) + \Big((\textbf{Probability of DSI to the Public} + \textbf{Probability of DSI to the Staff}\Big) \times (\textbf{Cost of DSI})\Big) \times \textbf{Disproportion Factor}$$

EQ. 280

where:

- Cost of LTA is the Reference Cost of a Lost Time Accident as shown in Table 272 in Annex D;
- Cost of DSI is the Reference Cost of a Death or Serious Injury as shown in Table 272 in Annex D;
- Disproportion Factor is explained later in this section.

Each Asset Category has an associated reference safety probability based on applying the appropriate value (of preventing a LTA or DSI) to the corresponding probability that each of these events occurs, categorised as follows.

a) LTA;
b) DSI to member of staff; and
c) DSI to member of the public.

These values have been derived from an assessment of both disruptive and non-disruptive failure probabilities for these events based on bottom up assessments of faults. These have been evaluated for each Asset Category and are:

a) probability that event could be hazardous;
b) probability that person who is present suffers the effect; and
c) probability that affected person is present when fault occurs.

The Reference Safety Cost of Failure uses costs for ‘death or serious injury’ and ‘accident’ that are based on the HSE’s GB cross-industry wide appraisal values for fatal injuries and for non-fatal injuries [Ref. N7]. These represent a quantification of the societal value of preventing a fatality or lost time accident. The same valuation of costs for ‘death or serious injury’ and ‘accident’ has been used in the derivation of the Reference Safety Cost of Failure for all Asset Categories.

In addition, a Disproportion Factor recognising the high-risk nature of the electricity distribution industry is applied. Such factors are described by the HSE guidance when identifying reasonably practicable costs of mitigation [Ref. N4]. This value is not mandated by the Health and Safety Executive (HSE), but they state that they believe that “the greater the risk, the more should be spent in reducing it, and the greater the bias should be on the side of safety”. They also suggest that the extent of the bias must be argued in the light of all the circumstances and that the factor is unlikely to be higher than 10. In the Methodology, the factor is set to 6.25 (see Table 273), which serves to cap the current value of preventing a fatality at around £11m.

This work aligns to risk analysis carried out within the HSE’s “Tolerability of Risk” (ToR) framework [Ref. N8].

Further detail including the probabilities of Lost Time Accidents and Death or Serious Injury and the values for Reference Safety Cost can be found in Annex D. The cost of an LTA and the cost of a DSI are common for all asset types.

8.4.3 Safety Consequences Factor

The Methodology includes the ability to vary the Safety CoF for an individual asset around the Reference Safety Cost of Failure for its type, based on a consideration of two additional factors; the Type Safety Factor and the Location Safety Factor. These are designed to capture the specific circumstances of individual assets insofar as they are likely to have a material impact on the safety consequences of any failure of the asset and are applied as a combined Safety Consequences Factor to the Reference Safety Cost of Failure. This is shown in EQ. 31.

$$\textbf{Safety Consequences of Failure} = \textbf{Reference Safety Cost of Failure} \times \textbf{Safety Consequences Factor} \times \textbf{Safety Risk Reduction Factor}$$

EQ. 31

Where:

- The Safety Consequences Factor is derived using a lookup value from the location/type matrix shown in Table 275 & Table 276, applying the criteria shown in Section D.2 of Annex D and an additional Safety Risk Reduction Factor is applied as shown in Table 277.

The requirement to undertake assessments of this type is stated in the ESQCR and the guidance below is adapted from the guidance associated with the regulations.

8.4.3.1 Type safety factor

This addresses the principal characteristics of the equipment and its siting.

This can include reflection of the "Nature and situation of equipment" category within the ESQCR risk assessment. Generally, equipment comprising exposed conductors will be higher risk in view of the consequences of persons coming into contact with that equipment. Plant which is fully insulated, or metal enclosed will generally be lower risk. Equipment or plant which is likely to be attractive to vandals or thieves (e.g. terminal Towers) will generally be higher risk than plant which is less attractive to such persons (e.g. single wood poles).

Another characteristic considered for switchgear is the interruption medium and arc flash protection as oil filled switchgear failures can be explosive.

8.4.3.2 Location safety factor

This is taken from the "Nature and situation of surrounding land" test in the ESQCR risk assessment. Here duty holders are required to take a view of the risk of danger from interference with the equipment - whether wilful or accidental - in consideration of the environment in which the equipment is placed.

There are two aspects to this test: firstly, the geography of the land and its features (for example forests, rivers, flat fields, motorway, city streets) and secondly the use of the land (for example agricultural machinery, recreational areas, schools, housing estate).

For example, electrical equipment in housing estates or in close proximity to unsupervised recreational playing fields will generally be at higher risk of danger from interference than equipment situated on sparsely populated land or contained within occupied premises.

8.5 Environmental Consequences

8.5.1 Overview

The Environmental Consequences have been derived with reference to appropriate environmental regulations and stakeholders.

The overall process for deriving the Environmental CoF is shown in Figure 24.

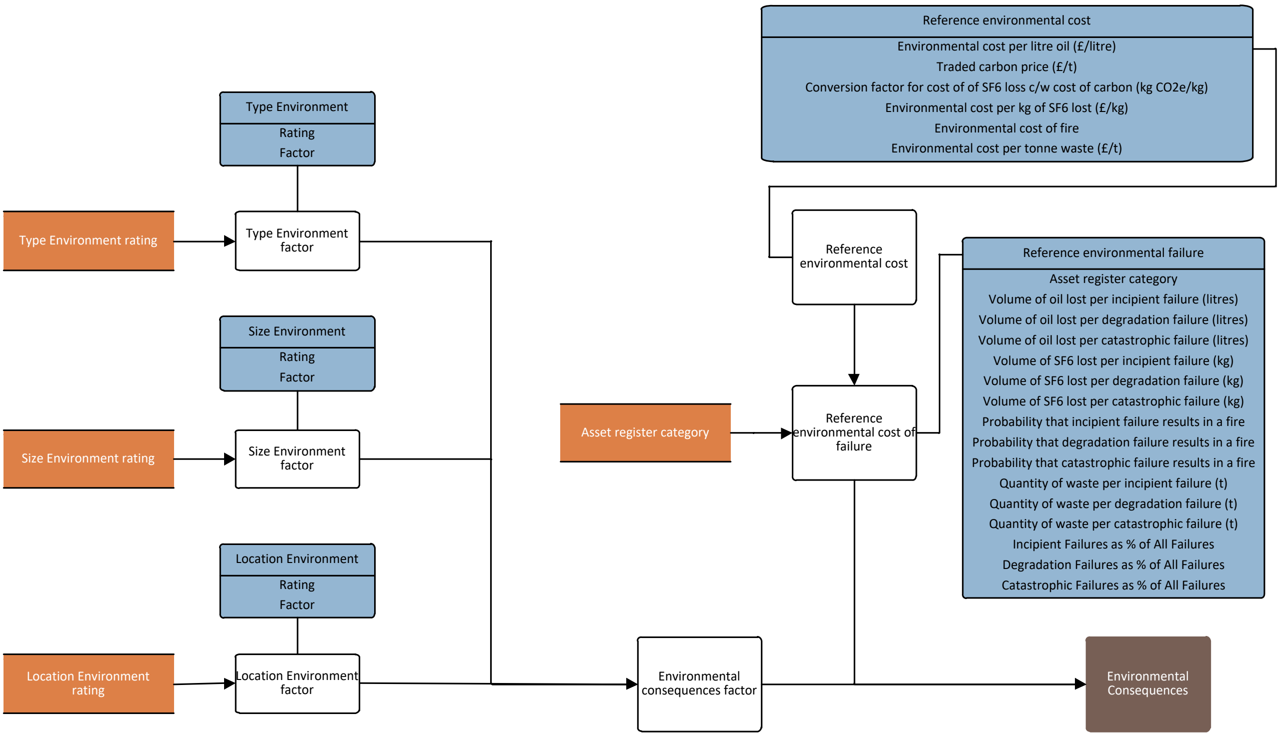

Figure 24 – Environmental Consequences of Failure

8.5.2 Reference Environmental Cost of Failure

The Environmental CoF value for an asset is derived using a Reference Environmental Cost of Failure, which is modified for individual assets using asset-specific factors. This is based on an assessment of the typical environmental impacts of a failure of the asset in each of its three failure modes; incipient, degraded and catastrophic. The Reference Environmental Cost of Failure that shall be used for each Asset Category is shown in Table 278 in Annex D.

This assessment considers four factors:

a) Volume of oil lost;
b) Volume of SF_6 lost;
c) Probability of the event leading to a fire; and

d) Quantity of waste produced.

$$\begin{aligned}&\textbf{Reference Environmental Cost of Failure} = (\textbf{\% of Incipient Failures}) \times \\ &((\textbf{Volume of oil lost per Incipient failure} \times \textbf{Environmental cost per litre oil} (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Incipient failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost} (\pounds/\textbf{kg})) + \\ &(\textbf{Probability of failure leading to a fire per Incipient failure} \times \\ &\textbf{Environmental cost of fire}) + (\textbf{Quantity of waste produced per incipient failure} \times \\ &\textbf{Environmental cost per tonne waste} (\pounds/\textbf{t}))) + (\textbf{\% of Degraded Failures}) \times \\ &((\textbf{Volume of oil lost per Degraded failure} \times \textbf{Environmental cost per litre oil} (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Degraded failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost} (\pounds/\textbf{kg})) + \\ &(\textbf{Probability of failure leading to a fire per Degraded failure} \times \\ &\textbf{Environmental cost of fire}) + (\textbf{Quantity of waste produced per Degraded failure} \times \\ &\textbf{Environmental cost per tonne waste} (\pounds/\textbf{t}))) + (\textbf{\% of Catastrophic Failures}) \times \\ &((\textbf{Volume of oil lost per Catastrophic failure} \times \textbf{Environmental cost per litre oil} (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Catastrophic failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost} (\pounds/ \\ &\textbf{kg})) + (\textbf{Probability of failure leading to a fire per Catastrophic failure} \times \\ &\textbf{Environmental cost of fire}) + \textbf{Quantity of waste produced per Catastophic failure} \times \\ &\textbf{Environmental cost per tonne waste} (\pounds/\textbf{t}))))\end{aligned}$$

EQ. 32

where:

- Environmental cost per litre oil = £43.35/litre;
- Environmental cost per kg of SF_6 lost = £1,723/kg; which is derived from:
    - Traded carbon price = £72.10/tonne;
    - Cost of SF_6 loss c/w cost of carbon = 23,900kg(CO_2)/kg.
- Environmental cost of fire = £6,007;
- Environmental cost per tonne waste = £180/tonne.

The sources for the above costs are shown in Table 19.

Table 19 – Sources of Information for Environmental Reference Case

Fixed value	Source
Environmental cost per litre oil (£/litre)	This is derived from the EU trading value for carbon emissions and is consistent with the value used in Ofgem's RIIO-ED2 Cost Benefit Analysis template (used for the RIIO-ED2 submissions) (at 2020/21 prices)
Traded carbon price (£/t)	Traded carbon price for 2028 from central scenario in Department for Business, Energy & Industrial Strategy's published 'Updated Short-Term Traded Carbon Values used for UK public policy appraisal (2018)' document (inflated to 2020/21 prices) – see https://www.gov.uk/government/publications/updated-short-term-traded-carbon-values-used-for-uk-policy-appraisal-2018
Conversion factor for cost of SF_6 loss c/w cost of carbon (kg CO_2e/kg)	2011/12 Defra conversion factor

8.5.3 Environmental Consequences Factors

The Methodology includes the ability to vary the Environmental Consequences value for an individual asset around the Reference Environmental Cost of Failure for its type, based on a consideration of three additional factors; the Type Environmental Factor, the Size Environmental Factor and the Location Environmental Factor. These are designed to capture the specific circumstances of individual assets insofar as they are likely to have a material impact on the Environmental Consequences of any failure of the asset and are applied as a combined Environmental Consequences Factor on the Reference Environmental Cost of Failure.

$$\textbf{Environmental Consequences of Failure} = \textbf{Reference Environmental Cost of Failure} \times \textbf{Environmental Consequences Factor}$$

EQ. 33

Where:

$$\textbf{Environmental Consequences Factor} = \textbf{Type Environmental Factor} \times \textbf{Size Environmental Factor} \times \textbf{Location Environmental Factor}$$

EQ. 34

8.5.3.1 Type environmental factor

This Factor allows for an adjustment to be made based on considerations specific to an asset or group of assets at a sub-level of the Asset Register Category. As the Reference Environmental Cost of Failure is built up using the impact from oil & SF_6, the Type

Environmental Factor is used to temper the effects for each switchgear type. The modifier values for the Type Environmental Factor can be found in Table 279 in Annex D.

8.5.3.2 Size environmental factor

This Factor allows for an adjustment to be made based on a consideration of the size of the asset in question, insofar as the size has a direct and material influence on the scale of Environmental Consequences, e.g. a larger than average transformer holding a greater quantity of oil than that assumed in the reference case for that asset type. The modifier values for the Size Environmental Factor can be found in Table 280 in Annex D.

8.5.3.3 Location environmental factor

This Factor allows for an adjustment to be made based on an assessment of the environmental sensitivity of the site on which an asset is located. The specific concerns will vary by asset type but include proximity to watercourses and other environmentally sensitive areas. The Factor also recognises any mitigation associated with the asset. The modifier values for the Location Environmental Factor can be found in

Table 281 in Annex D. This Factor is derived by combining separate Factors relating to proximity to a watercourse (Proximity Factor) and the presence of a bund (Bunding Factor) as shown in EQ. 35.

$$\textbf{Location Environment Factor} = \textbf{Proximity Factor} \times \textbf{Bunding Factor}$$

EQ. 35

Where no data is available to determine both the Proximity Factor and the Bunding Factor then the default values of 1 should be used. In the case where data is available to produce a Proximity Factor, but no data is available to determine the Bunding Factor (or vice-versa) then again a default value of 1 will be used to calculate the Location Environmental Factor.

8.6 Network Performance Consequences

8.6.1 Overview

The Network Performance CoF for an asset is derived from one of two approaches, depending on the voltage of the asset considered. For all assets operating at 20 kV and below, the LV & HV Asset Consequences process is followed. For all assets operating above 20 kV, the EHV & 132 kV Asset Consequences process is followed. The one exception to this is the EHV Transformers (PM) which follow the LV & HV Asset Consequences process. This is due to their typical position on the OHL circuit which means they are not secure assets (i.e. do not have N-1 capability).

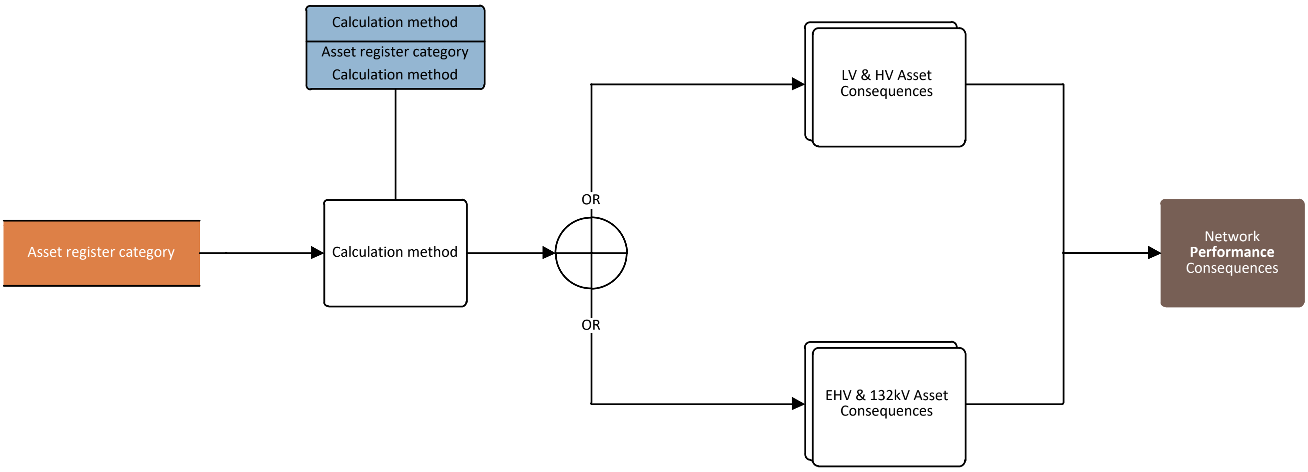

Figure 25 – Network Performance Consequences of Failure

8.6.2 Network Performance Consequences (LV & HV) and Transformer (PM) at HV & EHV)

For LV and HV assets, and Transformers (PM) at EHV, a Reference Network Performance Cost of Failure appropriate to the Asset Category is initially applied. The resulting value can then be modified for individual assets in two ways:

a) directly, based on the ratio of customers connected to an individual asset to the equivalent figure used in the average value; and/or

b) via the application of a Customer Sensitivity Factor to reflect customer characteristics (if appropriate).

Applying these Factors results in an LV or HV (or Transformer (PM) at HV & EHV) Asset Consequence value that reflects the network consequence characteristics of an individual asset of that type.

The overall process for deriving the Network Performance CoF is shown in Figure 26.

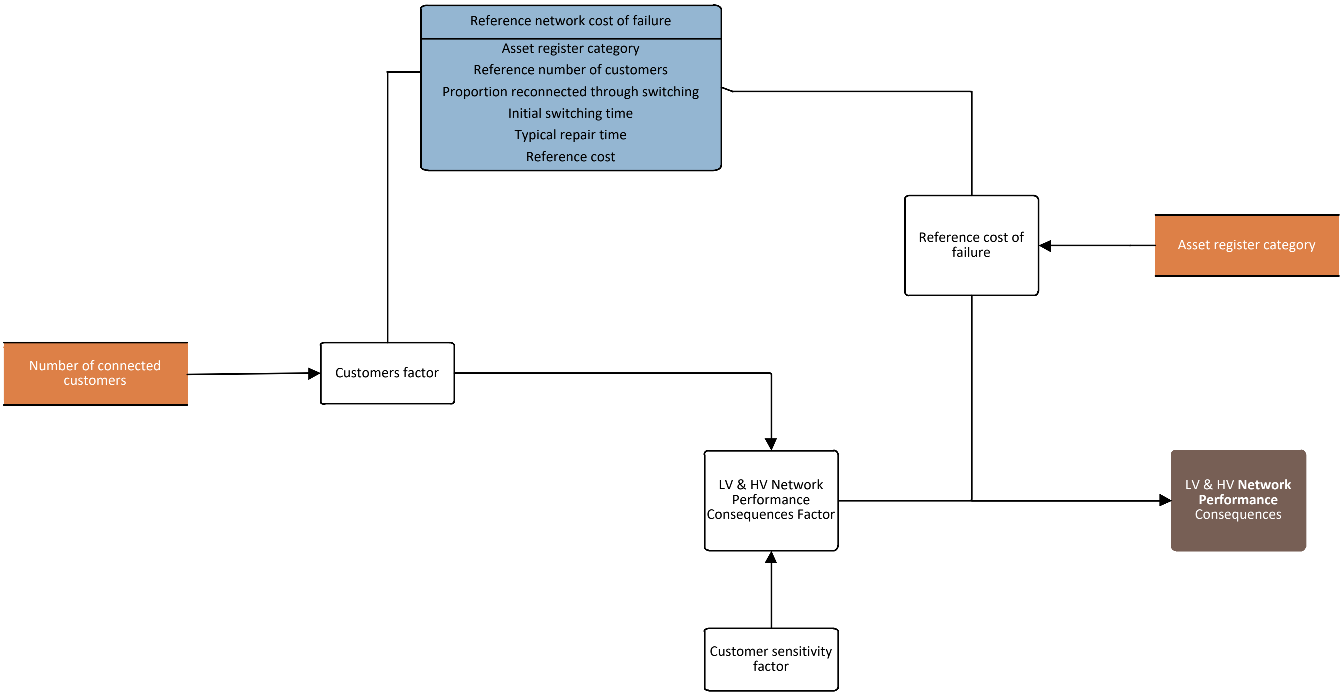

Figure 26 – Network Performance Asset Consequences of Failure (LV & HV)

8.6.2.1 Reference Network Performance Cost of Failure (LV & HV) and Transformer (PM) at HV & EHV)

The Reference Network Performance Cost of Failure is based on an assessment of the typical network costs incurred by a failure of the asset as measured through its impact in relation to the number of customers interrupted and the duration of those interruptions. For regulatory purposes, this is captured via the IIS mechanism.

An assessment is made of the typical numbers of customers interrupted by a failure, and the typical time to restore all supplies. This is based on a typical number of customers being connected to the section of distribution network that would be affected by failure of the asset (the Reference Number of Connected Customers).

The numbers of customers interrupted and customer minutes without supply are evaluated and multiplied by the relevant cost of a customer interruption (Cost of CI) and cost of a customer minute lost (Cost of CML) to produce a typical cost per failure for a given Reference Number of Connected Customers.

$$\textbf{Reference Network Performance Cost of Failure} =$$

$$[(\textbf{Cost of CML} \times \textbf{60} \times \textbf{Reference Number of CC} \times \textbf{Switching Time} \times (\textbf{100\%} - \textbf{\% of CC restored through immediate switching}))$$

$$+ (\textbf{Cost of CML} \times \textbf{60} \times \textbf{Reference Number of CC} \times \textbf{Restoration Time} \times (\textbf{100\%} - \textbf{\% of CC restored after manual switching}))$$

$$+ (\textbf{Cost of CI} \times \textbf{Reference Number of CC} \times (\textbf{100\%} - \textbf{\% of CC restored through immediate switching}))] \times \text{\% of failures that result in interruption to supply}$$

EQ. 36

Where:

- CC = Connected Customers;
- Switching Time and Restoration Time are durations (in hours).

Further explanation on the derivation of the values for the Reference Network Performance Cost of Failure (LV & HV) can be found in section D.4.1 in Annex D. The values of Reference Network Performance Cost of Failure (LV & HV) by Asset Category can be found in Annex D.

8.6.2.2 Network Performance Factors (LV & HV) and Transformer (PM) at HV & EHV)

The Reference Network Performance Cost of Failure can then be modified on an asset by asset basis as shown in EQ. 37.

$$\textbf{Network Performance Cost of Failure} = \textbf{Reference Network Performance Cost of Failure} \times \textbf{Network Performance Consequence Factor}$$

EQ. 37

where:

$$\textbf{Network Performance Consequence Factor} = \textbf{Customer Factor} \text{ x } \textbf{Customer Sensitivity Factor} \text{ x } \textbf{Network Protection Factor}$$

EQ. 38

Note: The Network Protection Factor is only applicable for Transformers (PM) at HV & EHV otherwise it is not applicable, see Table 285 for reference Network Protection Factors.

Customer Factor

This Factor is used to reflect the number of customers impacted by failure of an individual asset, relative to the reference number of customers used in the derivation of the Reference Network Performance Cost of Failure.

This is applied as a direct Factor, i.e. not via a lookup table. For example, if the number of customers used in the derivation of the Reference Network Performance Cost of Failure is 100, but for a specific example it is 80 (or 120), then a modifying factor of 0.8 (or 1.2) would be applied.

$$\textbf{Customer Factor} = \frac{\textbf{No. of Customers}}{\textbf{Reference No. of Customers}}$$

EQ. 39

Where a DNO identifies that the customers fed by an individual asset have an exceptionally high demand per customer, then the No. of Customers used in the derivation of EQ. 39 may be derived by applying an adjustment to the actual number of customers fed by the asset as shown in Table 20. This adjustment recognises that for high demand customers the cost of a customer interruption and a customer minute lost may not reflect the value of lost load to the customer. DNOs can elect whether to apply this adjustment within their implementation of the Methodology.

Table 20 – Customer number adjustment for LV & HV assets with high demand customers

Maximum demand on asset/total number of customers fed by the asset (kVA per Customer)	No. of customers to be used in the derivation of customer factor
< 50	1 x actual number of customers fed by the asset
≥ 50 and < 100	25 x actual number of customers fed by the asset
≥ 100 and < 500	100 x actual number of customers fed by the asset
≥ 500 and < 1000	250 x actual number of customers fed by the asset
≥ 1000 and < 2000	500 x actual number of customers fed by the asset
≥ 2000	1000 x actual number of customers fed by the asset

The default value for the Customer Factor is 1.

Customer Sensitivity Factor

The Customer Sensitivity Factor is used to reflect circumstances where the customer impact is increased due to customer reliance on electricity (e.g. vulnerable customers). DNOs may use this factor at their discretion in order to modify the Network Performance Consequence Factor.

The default value for the Customer Sensitivity Factor is 1. Individual DNOs are provided with the freedom within the Methodology to apply a Customer Sensitivity Factor, other than the default, to the Network Performance Consequences (LV & HV) for any asset, provided that:

a) the individual DNO documents all instances where a Customer Sensitivity Factor different from the default is applied within their individual Network Asset Indices Methodology; and

c) The Customer Sensitivity Factor shall not be less than 1, nor greater than 2.

Network Protection Factor (Transformers (PM))

The Network Protection Factor assumes a transformer failure that is locally protected for HV & EHV networks only. However, this may not always be the case and therefore impacts on circuits network performance cost should a failure occur.

As a result, the Network Protection Factor enables the impact for each assets configuration to be reflected by way of an additional factor.

8.6.3 Network Performance Consequences (EHV & 132 kV)

Similarly, for EHV and 132 kV assets, asset-specific Network Performance Consequence Factors are applied to the Reference Network Performance Cost of Failure in order to calculate the Network Performance Consequences associated with an individual asset.

For these assets, the Methodology reflects the fact that redundancy is usually designed into networks at these voltages due to the size of demand group they supply.

A significant proportion of these networks are constructed so that the supply to customers is secure for a single outage of any circuit within the network. For the purposes of the Methodology a network shall be considered secure if, in the event of a first circuit outage, there is either no interruption of supply to customers or supply is restored immediately through automatic switching as defined in ENA Engineering Recommendation P2/8 (‘Security of Supply’).

Once a first circuit outage has occurred within a secure network, there may be parts of the network that would experience a loss of supply if a further circuit outage were to occur. The load that could be expected to be impacted (i.e. would experience a loss of supply) during such a further circuit outage is referred to as Load at Risk.

Within EHV and 132 kV networks, there may also be some parts of the network where the supply to customers is not secure for a first circuit outage event. In such cases, a first circuit outage will directly impact any connected customers and restoration is achieved via switching in line with the timescales specified in Engineering Recommendation P2/8 for that demand group.

The methodology for determining Network Performance Consequences for EHV and 132 kV assets enables both these types of networks to be recognised.

The overall process for deriving the Network Performance Cost of Failure is shown in Figure 27.

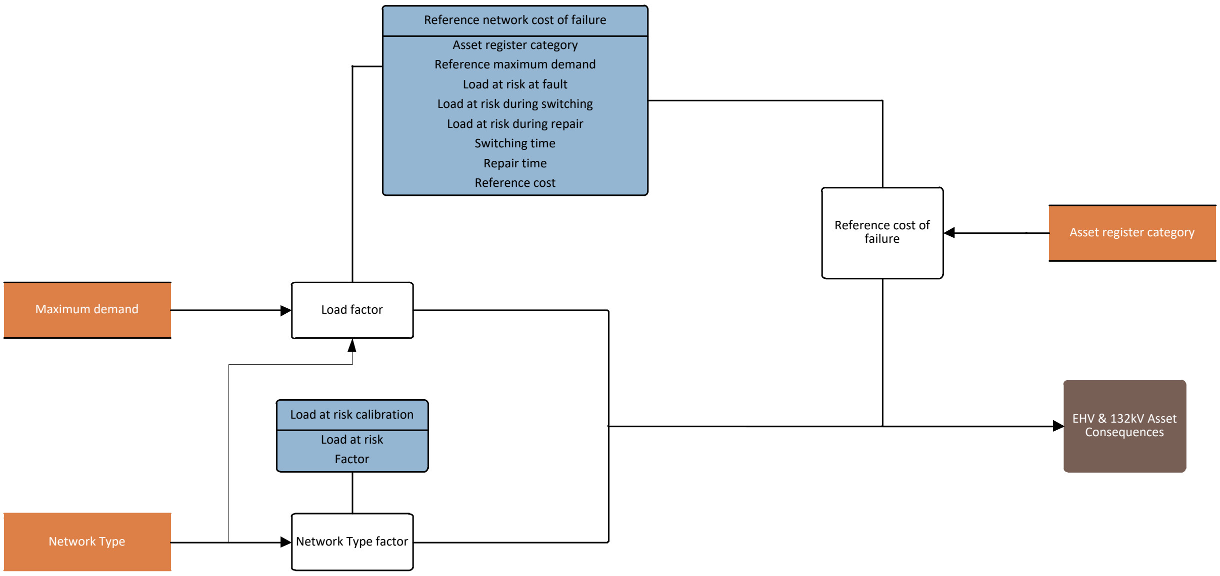

Figure 27 – Network Performance Consequences of Failure (EHV & 132 kV)

8.6.3.1 Reference Network Performance Cost of Failure (EHV & 132 kV)

The Reference Network Performance Cost of Failure is based on an assessment of the amount of Load at Risk during three stages of failure, and the typical duration of each stage:

a) During fault (T1): this is the time-period between initial circuit protection trip operation and automatic switching to reconfigure the network;

b) During initial switching (T2): this is the time-period during which further manual network switching is undertaken to reconfigure the network to minimise the risk associated with a further circuit outage; and

c) During repair time (T3).

The Load at Risk is evaluated based on a typical value of maximum demand under normal running conditions.

The load at risk is then multiplied by the relevant Value of Lost Load (VoLL) figure to derive a typical Reference Network Performance Cost of Failure for these assets, taking account of the probability of a further circuit outage.

$$\begin{aligned}&\textbf{Reference Network Performance Cost of Failure} = \\ &\big((\textbf{Load at risk in T1} \times \textbf{Duration of T1}) + (\textbf{Load at risk in T2} \times \textbf{Duration of T2}) + \\ &(\textbf{Load at risk in T3} \times \textbf{Duration of T3})\big) \times \\ &\%\ \textbf{of failures that result in an unplanned outage} \times \\ &\textbf{Probability of further coincident outage} \times \textbf{VoLL}\end{aligned}$$

EQ. 40

The value of VoLL used is consistent with the values for Cost of CI and Cost of CML used in the evaluation of the Reference Network Performance Cost of Failure for LV and HV assets. Therefore, the evaluation of the Reference Network Performance Cost of Failure for EHV and 132 kV assets is consistent with the evaluation of the impact in distribution assets.

Further explanation of the derivation of the Reference Network Performance Cost of Failure for EHV and 132 kV assets can be found in Section D.4.3 in Annex D.

8.6.3.2 Network Performance Factors (EHV & 132 kV)

The Network Performance CoF is derived on an asset by asset basis as shown in EQ. 41.

$$\begin{aligned}&\textbf{Network Performance Consequences of Failure} = \\ &\textbf{Reference Network Performance Cost of Failure} \times \textbf{Load Factor} \times \\ &\textbf{Network Type Factor}\end{aligned}$$

EQ. 41

Load Factor

This Factor allows for the Network Performance CoF to reflect the actual load at risk associated with the failure of the asset under consideration, relative to the value of maximum demand used to create the reference value.

The Load Factor is determined as shown in EQ. 42 (i.e. not via a lookup table).

$$\textbf{Load Factor} = \frac{\textbf{Actual Load at Risk Associated with the Failure of the Asset Under Consideration}}{\textbf{Maximum Demand Used To Derive Reference Network Performance Cost of Failure}}$$

EQ. 42

For example, if the Reference Network Performance Cost of Failure has been derived using a reference maximum demand of 12MVA, but for a specific asset the actual load at risk was 6MVA then a Load Factor of 0.5 would be applied.

The values of maximum demand used in derivation of the Reference Network Performance Cost of Failure can be found in Table 286 in Annex D.

Where the actual load is not known, the default value for Load Factor is dependent on the security of supply of the associated network.

A default Load Factor of 0.5 shall be applied where an individual asset is located in a network that is not secure for a first circuit outage event that would result from failure of the asset (i.e. the network would be considered not secure if the load normally supplied by the asset would be interrupted and not restored automatically, in such an event).

A default Load Factor of 1 shall apply to assets in secure networks or where the security of the network is unknown.

Network Type Factor

This Network Performance CoF is derived on an asset by asset basis by the application of a Network Type Factor to take account of the security of supply afforded by the topology of the network in which the individual asset is located.

A Network Type Factor of 2.5 shall be applied where an individual asset is located in a network that is not secure for a first circuit outage event that would result from failure of the asset (i.e. the network would be considered not secure if the load normally supplied by the asset would be interrupted and not restored automatically, in such an event).

A Network Type Factor of 1 shall apply to assets in secure networks.

The default value for Network Type Factor is 1.

9 References

9.1 A Note on Referencing

The content in many of the tables consists of factors and values which were decided (by agreement or by calculation) by internal working group agreement. There are also a number of table values determined by the RIGs. where the values have been dictated otherwise or by external sources there is an associated numbered reference.

This section of the document lists the external references and explains which tables require an external reference. It also describes, where that is not the case, what is meant by the reference to an “internal working group agreement”.

9.2 Reference to Internal Working Group Agreement

Decisions governing these values were made during a model calibration exercise first agreed in 2015 which pragmatically captured engineering experience and reliability-based concepts and subsequently reviewed through each iteration of CNAIM including this one based on best available industry data available at the time of review. Every table in the document was fully examined and discussed by the group.

The choice of the factors themselves came from DNO shared information about what factors existed in ethe models that DNOs were using in-house at that time. These models were built within the DNOs over the previous two decades. The principles guiding the decision included ensuring that DNOs collecting more information than others were not held back from continuing to do so, and to avoid duplication of factors that in essence indicated the same degradation mechanism.

The parameters for combination were also agreed collectively based on similar principles, so that while DNOs collecting more information than others should not be prevented from using their better information, DNOs collecting less should not be put in a position of not being able to achieve the kinds of Health Scores that accurately described their poorest assets. Hence the use of an MMI approach. The number of factors that can be combined also related to the number of existing factors for an asset category.

In terms of calibrating the weightings, experience with current models was drawn upon in situations where the combination method was the same as that for common methodology. The results of testing were then used so that if entire populations were tending to bias at one extreme, the weightings were revised to make sure that they resulted in a spread that was reasonable.

9.3 Table Reference Breakdown

Table 1, Table 2 and Table 3 summarise asset categories governed by the RIGs. This is referred to in the descriptive text above the tables.

The failure type descriptions in Table 4 were agreed by the working group.

Table 5 and Table 6 show the PoF bandings and were agreed by the working group. The calibration exercise for these considered the speed at which an asset moves through each band and judged that against engineering experience.

Table 7 shows the CoF bandings. It is governed by the RIGs and comes out of previous work by the Asset Health and Criticality working group that was incorporated in the RIGs for the RIIO-ED1 business plan submissions.

Table 8 to Table 17 show PoF factors for each of location, duty and condition; and parameter information for combining these factors within the methodology. These values were agreed by the working group.

Table 18 to Table 20 relate to CoF. Table 18 is merely a summary of the Reference Costs of Failure which are described in detail in the Annex D tables. As CoF values are very much governed by external sources of information there are appropriate references to these in the descriptive text along with Table 19 which explicitly lists the environmental sources. Table 20 shows customer bandings agreed by the working group.

Table 21 shows Functional Failure Definitions agreed by the working group. In this case agreement was based on an information gathering exercise across the DNOs of failure information derived from risk management over many years, including failure modes and effects analysis and a familiarity with the history of defects and faults for each asset category.

Table 22 summarises asset lives as agreed by the working group following an information sharing exercise. where there was a wide range in the same asset category the group looked at the mix of asset types that was driving the difference and determined appropriate sub-types accordingly. Work on asset lives was carried out in substantial detail in DNOs going back to before DPCR4 and they have been used and updated in annual RRP submissions during DPCR5 and RIIO-ED1.

Table 23 shows PoF curve parameters which were calculated by the working group. Their derivation is described in Section 7.1.2 and they come from shared DNO data consisting of the observed number of functional failures for each asset category per annum, considering Incipient, Degraded and Catastrophic Failures; from the 2014/15 Health Index distributions; and from the total volumes of assets within the population.

Table 24 to

Table 36 show location and Duty Factors and calibrations agreed by the working group.

Table 37 to Table 250 show Observed Condition and Measured Condition Factors and calibrations which were agreed by the working group. The decisions for these were based on a combination of obvious logical rules, engineering experience, and testing using the common methodology spreadsheet models. The obvious logical rules are that:

a) The maximum factor value will not push the Current Health Score above its cap of 10;

b) Weightings reflect condition so that, for example, a poor state will have a higher weighting than a moderate state for example;

c) The distance between two states describes the engineering conditions so for example, if corrosion indicating structural damage is much more serious than corrosion indicating cosmetic damage then the weightings have a proportionate distance between them.

d) The number of states is calculable and meaningful and in sync with DNO data collection.

e) Improvement factors are also appropriate in situations where signs of wear would have been expected indicating a Health Score better than initially indicated from age and expected life.

f) There should be a spread across Health Index bands within a representative asset population.

For the measured condition factor values it was also recognised that the condition criteria tend to be a function of how results from the test equipment are categorised in practice. For example, partial discharge typically might have a high, medium and low result.

Table 251 to Table 264 relate to transformer oil sampling and are covered by external reference [N5].

Table 265 is for the Ageing Reduction Factor and the basis for these is covered by reference [N3].

Table 266 is the Ageing Rate Adjustment Sets to reflect changing deterioration rates due to incremental climate change effects over time.

Table 267 in Annex C is covered by the RIGs working group for the categories and the working group agreed what HI factors were affected by the intervention.

Table 268 to Table 287 in Annex D show the Criticality Factors, their Reference Cost of Failure values, and how asset specific factors are weighted. Environmental, Safety and Network Performance Consequence Factors and criteria reference external sources as is already well described in Section 8. Financial Consequence Factors came from working group agreement based on an understanding of the Financial Factors at play in practice in the different DNOs.

The reference values are derived as described in Section 8, so the tables just show the results of calculations carried out using the externally given costs and the working group agreed assumptions about derivation.

Calibration decisions for the asset specific factors were made collectively by the working group, based on the logic that as things get more critical their weightings increase in a way that is proportionate to the underlying engineering criticality being described.

Table 288 to Table 293 in Annex E show the reference values associated with the CoF and PoF weightings for the Criticality Index and Health Index bands as well as the Risk Matrix weightings, typical forecast ageing rates all referenced in Section 5 with regard to the calculated Risk Index associated with the Long Term Risk.

Annex A
(normative)

Functional Failure Definitions

Table 21 – Functional Failure Definitions

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
Battery System	Provide an electrical supply to load in the event of a mains power failure.	Aged, deteriorated batteries. High impedance, poor Specific Gravity batteries. Defective chargers with limited to no electrical output.	Failure of charger to charge batteries. Failure of battery to operate switchgear and/or protection systems.	Reduced capacity and/or voltage but does not prevent operation.	NA.	Ancillaries associated with Batteries and Chargers systems, including supply and cabling to these assets. Battery links.
LV Circuit Breaker	Measure and break unsafe levels of current (over current), make load current, and provide a point of electrical isolation.	Failing to open on a fault. Failing to close reliably. Failing to open during manual operation. Failure to supply load current (i.e. failure during normal operating conditions). Opens Spuriously under normal conditions. Opens Intermittently (Faulty).	Failure of Housing. Disruptive Failure Resulting from Insulation Breakdown.	Nuisance tripping or failure to operate when required due to: - damage to contacts - loose internal connections -Damage to mechanism and drive rods.	Nuisance tripping or failure to operate when required due to: - Maladjusted linkage.	Failure of protection module. Failure of SCADA.
LV Pillar (ID)						Contact damage due to incorrect operation of board.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
LV Pillar (OD at Substation / LV Pillar (OD not at a Substation)	Provide a number of points of access to LV Cable Systems for electrical connection, isolation and flexibility with network reconfiguration. Depending on the complexity of pillar they may also offer monitoring and protection (fuse or circuit breaker) capabilities.	Failing to close reliably. Failing to open during manual operation. Failure to supply load current (i.e. failure during normal operating conditions).	Failure of Housing. Disruptive Failure Resulting from Insulation Breakdown requiring the replacement of one or all ways.	Failure of Housing requiring repair. Nuisance tripping or Failure of an LV Pillar's Fuse, MCB or RCBO to operate when required due to: - deteriorated fuse carriers - breaker stuck closed.	Nuisance tripping or Failure of an LV Pillar's Fuse, MCB or RCBO to operate when required due to: - incorrect fuse/breaker rating - breaker not latching closed.	
LV UGB	Provide a number of points of access to LV Cable Systems for electrical connection, isolation and flexibility with network reconfiguration. Depending on the complexity of the LV Box, they may also offer monitoring and protection (fuse or circuit breaker) capabilities.	Failing to open on a fault (if used in this mode. Failing to close reliably. Failing to open during manual operation. Failure to supply load current (i.e. failure during normal operating conditions). Opens Spuriously under normal conditions. Opens Intermittently (Faulty).	Disruptive Failure Resulting from Insulation Breakdown.	Failure to be operable when required due to: - damage to contacts - moisture ingress - deteriorated links.	Failure to be operable when required due to: - damage to contacts - loose internal connections.	Failure of housing. Contact Damage due to Incorrect operation of Box.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
LV Board (WM)	Provide a number of points of access to LV Cable Systems for electrical connection, isolation and flexibility with network reconfiguration. Depending on the complexity of LV Board, they may also offer monitoring and protection (fuse or circuit breaker) capabilities.	Failing to open on a fault. Failing to close reliably. Failing to open during manual operation. Failure to supply load current (i.e. failure during normal operating conditions). Opens Spuriously under normal conditions. Opens Intermittently (Faulty).	Disruptive Failure Resulting from Insulation Breakdown.	Nuisance tripping or failure to operate when required due to: - damage to contacts - moisture ingress - deteriorated fuse carriers.	Nuisance tripping or failure to operate when required due to: - damage to contacts - loose internal connections - failure of protection module.	Failure of housing. Contact Damage due to Incorrect operation of Board.
HV Switchgear (PM)	Ability to carry fault current. Ability to carry load current. Make or break continuous load or fault current, where appropriate to its design/function. Maintain or interrupt voltage on all three phases, where designed. Measurement of current and voltage, where designed. Provide isolation, where designed. Open and close when required to provide specific function, where designed.	Does not open or close on command (Where this is associated with the Breaker and not the control system). Mechanical Failure. Electrical Failure (Auxiliary & Control). Electrical Failure (Main Circuit).	Disruptive Failure Resulting from Insulation Breakdown.	SOP preventing operation. Failure to operate when required due to: - Failure of Mechanism - Protection module - CT Failure - VT Failure - Stuck Breaker.	Failure to operate when required due to: - Low Gas Lockout or Vacuum bottle condition. Heavy contamination of insulators Contacts degraded (able to be dressed) Contact misalignment Mechanism performance/ stiction	Unable to withstand impulse voltage. Unable to contain the insulating medium. Does not allow switch tank to breath.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
HV Switchgear (GM) – Primary / HV Switchgear (GM) - Distribution	Carry, make or break continuous load or fault current. Maintain or interrupt voltage on all three phases. Isolation & Earthing of Cables & Plant. Measurement of current and voltage.	Does not open or close on command (where this is associated with the Breaker and not the control system). Mechanical Failure. Electrical Failure (Auxiliary & Control). Electrical Failure (Main Circuit).	Disruptive Failure Resulting from Insulation Breakdown.	SOP preventing operation. Failure to operate when required due to: - Failure of Mechanism - Protection module - CT Failure - VT Failure - Stuck Breaker.	Failure to operate when required due to: - Low Gas Lockout or Vacuum bottle condition.	Unable to withstand impulse voltage. Unable to contain the insulating medium. Does not allow switch tank to breath. Unable to support its own weight. Does not provide a connection to the substation earth mat.
EHV Switchgear (PM)	Ability to carry fault current. Ability to carry load current. Make or break continuous load or fault current, where appropriate to its design/function. Maintain or interrupt voltage on all three phases, where designed. Measurement of current and voltage, where designed. Provide isolation, where designed. Open and close when required to provide specific function, where designed.	Does not open or close on command (Where this is associated with the Breaker and not the control system). Mechanical Failure. Electrical Failure (Auxiliary & Control). Electrical Failure (Main Circuit).	Disruptive Failure Resulting from Insulation Breakdown.	SOP preventing operation. Failure to operate when required due to: - Failure of Mechanism - Protection module - CT Failure - VT Failure - Stuck Breaker.	Failure to operate when required due to: - Low Gas Lockout or Vacuum bottle condition. Heavy contamination of insulators Contacts degraded (able to be dressed) Contact misalignment Mechanism performance/ stiction	Unable to withstand impulse voltage. Unable to contain the insulating medium. Does not allow switch tank to breath.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
EHV Switchgear (GM)	Carry, make or break continuous load or fault current. Maintain or interrupt voltage on all three phases. Isolation & Earthing of Cables & Plant. Measurement of current and voltage.	Does not open or close on command (where this is associated with the Breaker and not the control system). Mechanical Failure. Electrical Failure (Auxiliary & Control). Electrical Failure (Main Circuit).	Disruptive Failure Resulting from Insulation Breakdown.	SOP preventing operation. Failure to operate when required due to: - Failure of Mechanism - Protection module - CT Failure - VT Failure - Stuck Breaker.	Failure to operate when required due to: - Low Gas Lockout or Vacuum bottle condition.	Unable to withstand impulse voltage. Unable to contain the insulating medium. Does not allow switch tank to breath. Unable to support its own weight. Does not provide a connection to the substation earth mat. Failure of civil structures or associated disconnectors. Any asset classed by RIG definition as EHV Switchgear Other.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
EHV Switchgear Other	Ability to carry fault current. Ability to carry load current, where designed. Provide isolation, where designed. Maintain or interrupt voltage on all three phases, where designed. Provide earthing, where designed. To close when instructed by protection system to apply short onto a live busbar, where designed. Open and close when required to provide specific function.	Does not open or close correctly on command. Mechanical failure. Electrical failure (auxiliary & control). Electrical failure (main circuit). Failure of civil support structure.	Disruptive failure resulting from insulation breakdown. Civil support unsuitable to allow operation of main asset.	Failure of locking mechanism. Cracked metallic components i.e. U clamps. Loss of galvanization/ corrosion on metallic parts. Obsolescence. Contacts not fit for service (beyond repair). Civil support unsuitable for long term operation of the asset. Electrical failure of replaceable component - i.e. pot insulators. SOP preventing designed operation.	Heavy contamination of insulators. Contacts degraded (able to be dressed). Contact misalignment. Mechanism poor performance/ stiction.	N/A

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
132 kV Switchgear	Carry, make or break continuous load or fault current. Maintain or interrupt voltage on all three phases. Isolation & Earthing of Cables & Plant. Measurement of current and voltage.	Does not open or close on command (where this is associated with the Breaker and not the control system). Mechanical Failure. Electrical Failure (Auxiliary & Control).Electrical Failure (Main Circuit).	Disruptive Failure Resulting from Insulation Breakdown.	SOP preventing operation. Failure to operate when required due to: - Failure of Mechanism - Protection module - CT Failure - VT Failure - Stuck Breaker.	Failure to operate when required due to: - Low Gas Lockout or Vacuum bottle condition.	Unable to withstand impulse voltage. Unable to contain the insulating medium. Does not allow switch tank to breath. Unable to support its own weight. Does not provide a connection to the substation earth mat. Failure of civil structures or associated disconnectors. Any asset classed by RIG definition as EHV Switchgear Other.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
132kV Switchgear Other	Ability to carry fault current. Ability to carry load current, where designed. Provide isolation, where designed. Maintain or interrupt voltage on all three phases, where designed. Provide earthing, where designed. To close when instructed by protection system to apply short onto a live busbar, where designed. Open and close when required to provide specific function.	Does not open or close correctly on command Mechanical failure Electrical failure (auxiliary & control) Electrical failure (main circuit) Failure of civil support structure	Disruptive failure resulting from insulation breakdown. Civil support unsuitable to allow operation of main asset.	Failure of locking mechanism. Cracked metallic components i.e. U clamps. Loss of galvanization/ corrosion on metallic parts. Obsolescence. Contacts not fit for service (beyond repair). Civil support unsuitable for long term operation of the asset. Electrical failure of replaceable component - i.e. pot insulators. SOP preventing designed operation.	Heavy contamination of insulators. Contacts degraded (able to be dressed). Contact misalignment. Mechanism poor performance/ stiction.	N/A
Transformer (PM)	Step up or step down and provide a secondary output voltage which is within statutory limits. Carry full load current when required. Carry through fault current when required.	Bushing, windings, core, tank or insulation failure	Failure of the main tank or internal components – windings, core or insulation.	Failure of the bushing	Insulation Leaks	Civil or support structure related failures. Downleads or connectors.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
HV Transformer (GM)	Step up or step down and provide a secondary output voltage which is within statutory limits. Carry full load current when required. Carry through fault current when required.	Tapchanger, bushing, windings, core, tank or insulation failure.	Failure of the main internal components - windings, core or insulation.	Failure of the bushing, cable termination, including box and conservator tank.	Failure of the Tapchanger.	Oil condition corrected by an oil change and not re-conditioning, levels and leaks. Cable connection to controlling switchgear. Civil structure related failures.
EHV Transformer (GM) / 132 kV Transformer (GM)	Step up or step down and provide a secondary output voltage which is within statutory limits. Carry full load current when required. Carry through fault current when required.	Tapchanger, bushing, windings, core, tank, insulation or control/monitoring failure.	Failure of the tank or main internal components - windings, core or insulation.	Failure of the bushing, cable termination conservator tank and associated radiator.	Failure of the Tapchanger.	Oil condition corrected by an oil change and not re-conditioning, levels and leaks. CT's, VT's and on tank unit auxiliary transformers associated with the unit NER's and NEX's Neutral displacement VT's. Cable and busbar connection to controlling switchgear. Civil structure related failures. Buchholz.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
Poles	Support electrical equipment in compliance with the ESQCR and Construction Regulations.	Decayed Pole Decayed Struts Snapped Stays	Any structure whose components have either failed (broken) or whose residual strength has decreased to a level where immediate replacement of all or part of the structure is required.	Any structure whose components have a residual strength such that replacement is required within the timescale defined by the Company.	Vermin Damage resulting in Factor of Safety reduction requiring an intervention.	Broken Conductor. Broken or damaged fittings. Damaged or non-functioning plant. Broken or damaged insulation. Missing or degraded safety signs and anti-climbing fixtures. Leaning poles where statutory clearances are not impacted. Cable boxes and platforms, including sealing ends.
Towers	Support electrical equipment in compliance with the ESQCR.	Corrosion or distortion of the structure, i.e. bent member, failing foundations.	Any structure whose components have either failed (broken) or whose residual strength has decreased to a level where immediate replacement of all or part of the structure is required.	Any component of the structure whose condition is such that it prevents normal operation of the Tower, or degrades the residual strength of the Tower, requiring an intervention with in a defined period.	Corrosion to minor Tower components and land movements degrading the potential of the Towers stability.	Broken Conductor. Broken or damaged fittings. Broken or damaged insulation. Missing or degraded safety signs and anti-climbing fixtures. Cable boxes and platforms, including sealing ends.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
OHL Pole Line Conductor	Carry load and fault current within the ESQCR clearance levels Maintain continuity under normal and fault conditions. Provide phase-phase and phase-earth insulation.	Flashover Corroded Conductor Corroded Jumper	Full loss of integrity of the conductor, excluding any associated Pole mounted plant, such that the residual strength of the component required immediate intervention.	Loss of integrity of the conductor, excluding any associated Pole mounted plant, such that the residual strength of the component required intervention within a prescribed timescale.	Loss / damage of covering.	Loss of protection. Loss of plant. Earthing. Any issues relating to the support, safety notices and anti-climbing guards. Conductor icing which does not result in permanent damage to the conductor. Cable boxes and platforms (including sealing ends). Loss of Insulators / Fittings
Fittings / OHL Conductor	Carry load and fault current without annealing or sagging below the ESQCR limit. Maintain continuity under normal and fault conditions. Provide phase-phase and phase-earth insulation.	Flashover. Insulation failure. Corroded Conductor Corroded Jumper Corroded Fitting	Loss of structural integrity of any component associated with an overhead line supported on Steel Tower, excluding any associated Tower mounted plant, such that the residual strength of the component required immediate intervention.	Loss of structural integrity of any component associated with an overhead line supported on the Tower, excluding any associated Tower mounted plant, such that the residual strength of the component required intervention within a prescribed timescale.	Cracked insulator	Loss of protection. Loss of plant. Earthing. Any issues relating to the support, safety notices and anti-climbing guards. Conductor icing which does not result in permanent damage to the conductor. Cable boxes and platforms (including sealing ends).
Pressurised Cable	Carry load and fault current safely and reliably, without overheating or causing damage to the environment.	Oil or Gas leak / Top up. Cable Fault. Joint Failure.	Cable Fault. Joint Fault.	Accessory or joint failure causing loss of fluid.	Pressure gauges. Sheath deterioration.	Sheath damage and or repair. Third party damages.

Asset Category	Function	Failure modes	Catastrophic Failure	Degraded Failures	Incipient Failures	Functional failures excluded
Sub Cables	Carry load and fault current safely and reliably, without overheating or causing damage to the environment.	Cable Fault Joint Failure	Cable Fault Joint Fault	N/A	N/A	Sheath damage and or repair. Third party damages.
Non Pressurised Cable	Carry load and fault current safely and reliably, without overheating or causing damage to the environment.	Cable fault Joint failure	Cable Fault Joint Fault	N/A	N/A	Sheath damage and or repair. Third party damages.
Concrete Structures	Carries a piece of switchgear and is an integral part of the plant. This excludes plinths for plant which is designed with legs or other types of support for the operable parts of the plant and all power transformers	Loss of residual strength or loss of stability.	Failure of the structure resulting in the plant item becoming unstable, the plant tilts or in any other way cannot be operated as a result of the condition of the concrete.	Loss of section. Cracking and spilling of the concrete such that the residual strength is between 80 and 100% of current condition.	Loss of chemical structure and hence reduction in strength.	Plinths. Auxiliary structures not made of concrete. Busbar supports.

Annex B
(informative)

Calibration – probability of failure

B.1 Normal Expected Life

Table 22 – Normal expected life

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
Batteries at GM HV Substations	Batteries - Dry Cells	6	Set 1
	Batteries - Wet Cells	17	Set 1
	Chargers	17	Set 1
Batteries at 33kV Substations	Batteries - Dry Cells	6	Set 1
	Batteries - Wet Cells	17	Set 1
	Chargers	17	Set 1
Batteries at 66kV Substations	Batteries - Dry Cells	6	Set 1
	Batteries - Wet Cells	17	Set 1
	Chargers	17	Set 1
Batteries at 132kV Substations	Batteries - Dry Cells	6	Set 1
	Batteries - Wet Cells	17	Set 1
	Chargers	17	Set 1
LV Main (OHL) Conductor	PVCA	50	Set 1
	PVCCu	50	Set 1
	AL	60	Set 1
	Cad Cu	60	Set 1
	Cu	70	Set 1
	ABC	50	Set 1
	Other (FE)	50	Set 1
	Unknown	60	Set 1
LV Poles	Concrete	60	Set 1
	Steel	50	Set 1
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
	Other (e.g. fibreglass)	80	Set 1
LV Circuit Breaker	-	60	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
LV Pillar (ID)	-	60	Set 1
LV Pillar (OD at Substation)	-	60	Set 1
LV Pillar (OD not at a Substation)	-	60	Set 1
LV Board (WM)	-	60	Set 1
LV UGB	-	55	Set 1
LV Board (X-type Network) (WM)	-	60	Set 1
6.6/11 kV Poles	Concrete	60	Set 1
	Steel	50	Set 1
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
	Other (e.g. fibreglass)	80	Set 1
6.6/11 kV / 20 kV OHL (Conventional Conductor)	ACSR - greased	55	Set 1
	PVCA	50	Set 1
	PVCCu	50	Set 1
	AAAC	60	Set 1
	Cad Cu	60	Set 1
	Cu	70	Set 1
	Other (FE)	50	Set 1
	Unknown	60	Set 1
6.6/11 kV / 20 kV OHL (BLX or similar Conductor)	BLX - XLPE	55	Set 1
	Unknown	60	Set 1
20 kV Poles	Concrete	60	Set 1
	Steel	50	Set 1
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
	Other (e.g. fibreglass)	80	Set 1
33 kV / 66 kV / 132 kV OHL (Pole Line) Conductor	ACSR - greased	55	Set 1
	ACSR - non-greased	45	Set 1
	AAAC	60	Set 1
	Cad Cu	60	Set 1
	Cu	70	Set 1
	PVCA	50	Set 1
	PVCCu	50	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
33 kV / 66 kV / 132 kV OHL (Pole Line) Conductor	Other (FE, XLPE, PVCA, AL)	50	Set 1
	Unknown	60	Set 1
HV Sub Cable	Submarine Single Wire Armour	70	Set 1
	Submarine Double Wire Armour	80	Set 1
	Non-Marine cable	60	Set 1
	Default	60	Set 1
6.6/11 kV CB (PM)	-	40	Set 1
6.6/11 kV Switch (PM)	-	40	Set 1
6.6/11 kV Switchgear - Other (PM)	-	40	Set 1
20 kV CB (PM)	-	40	Set 1
20 kV Switch (PM)	-	40	Set 1
20 kV Switchgear - Other (PM)	-	40	Set 1
33 kV Switch (PM)	-	40	Set 1
6.6/11 kV CB (GM) Primary	-	55[1)]	Set 1
6.6/11 kV CB (GM) Secondary	-	55[1)]	Set 1
6.6/11 kV Switch (GM)	-	55	Set 1
6.6/11 kV RMU	-	55	Set 1
6.6/11 kV X-type RMU	-	55	Set 1
20 kV CB (GM) Primary	-	55[1)]	Set 1
20 kV CB (GM) Secondary	-	55[1)]	Set 1
20 kV Switch (GM)	-	55	Set 1
20 kV RMU	-	55	Set 1
6.6/11 kV Transformer (GM)	-	60	Set 1
6.6/11 kV Transformer (PM)	Transformer	55	Set 1
	Reactors & Regulators	40	Set 1
20 kV Transformer (GM)	-	60	Set 1
20 kV Transformer (PM)	Transformer	55	Set 1
	Reactors & Regulators	40	Set 1
33 kV Pole	Concrete	60	Set 1
	Steel	50	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
33 kV Pole	Other (e.g. fibreglass)	80	Set 1
66 kV Pole	Concrete	60	Set 1
	Steel	50	Set 1
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
	Other (e.g. fibreglass)	80	Set 1
33 kV OHL (Tower Line) Conductor	ACSR - greased	55	Set 1
	ACSR - non-greased	50	Set 1
	AAAC	60	Set 1
	Cad Cu	50	Set 1
	Cu	70	Set 1
	Other	50	Set 1
33 kV Tower	Steelwork	80	Set 1
	Foundation - Fully Encased Concrete	95	Set 1
	Foundation - Earth Grillage	60	Set 1
	Paint System - Galvanising	30	Set 1
	Paint System - Paint	20	Set 1
33 kV Fittings	-	40	Set 1
66 kV OHL (Tower Line) Conductor	ACSR - greased	55	Set 1
	ACSR - non-greased	50	Set 1
	AAAC	60	Set 1
	Cad Cu	50	Set 1
	Cu	70	Set 1
	Other	50	Set 1
66 kV Tower	Steelwork	80	Set 1
	Foundation - Fully Encased Concrete	95	Set 1
	Foundation - Earth Grillage	60	Set 1
	Paint System - Galvanising	30	Set 1
	Paint System - Paint	20	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
66 kV Fittings	-	40	Set 1
33 kV UG Cable (Non Pressurised)	Aluminium sheath - Aluminium conductor	100	Set 1
	Aluminium sheath - Copper conductor	100	Set 1
	Lead sheath - Aluminium conductor	100	Set 1
	Lead sheath - Copper conductor	100	Set 1
33 kV UG Cable (Oil)	Aluminium sheath - Aluminium conductor	75	Set 1
	Aluminium sheath - Copper conductor	75	Set 1
	Lead sheath - Aluminium conductor	80	Set 1
	Lead sheath - Copper conductor	80	Set 1
33 kV UG Cable (Gas)	Aluminium sheath - Aluminium conductor	65	Set 1
	Aluminium sheath - Copper conductor	70	Set 1
	Lead sheath - Aluminium conductor	75	Set 1
	Lead sheath - Copper conductor	75	Set 1
66 kV UG Cable (Non Pressurised)	Aluminium sheath - Aluminium conductor	100	Set 1
	Aluminium sheath - Copper conductor	100	Set 1
	Lead sheath - Aluminium conductor	100	Set 1
	Lead sheath - Copper conductor	100	Set 1
66 kV UG Cable (Oil)	Aluminium sheath - Aluminium conductor	75	Set 1
	Aluminium sheath - Copper conductor	75	Set 1
	Lead sheath - Aluminium conductor	80	Set 1
	Lead sheath - Copper conductor	80	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
66 kV UG Cable (Gas)	Aluminium sheath - Aluminium conductor	65	Set 1
	Aluminium sheath - Copper conductor	70	Set 1
66 kV UG Cable (Gas)	Lead sheath - Aluminium conductor	75	Set 1
	Lead sheath - Copper conductor	75	Set 1
EHV Sub Cable	Submarine Single Wire Armour	70	Set 1
	Submarine Double Wire Armour	80	Set 1
	Non-Marine cable	60	Set 1
	Default	60	Set 1
33 kV CB (Air Insulated Busbars)(ID)(GM)	-	60[1)]	Set 1
33 kV CB (Air Insulated Busbars)(OD)(GM)	-	50[1)]	Set 1
33 kV CB (Gas Insulated Busbars)(ID)(GM)	-	60[1)]	Set 1
33 kV CB (Gas Insulated Busbars)(OD)(GM)	-	50	Set 1
33 kV Switch (GM)	-	55	Set 1
33 kV RMU	-	55	Set 1
33 kV Switchgear - Other	Non-motorised	50	Set 1
	Motorised	45	Set 1
66 kV CB (Air Insulated Busbars)(ID)(GM)	-	55	Set 1
66 kV CB (Air Insulated Busbars)(OD)(GM)	-	50	Set 1
66 kV CB (Gas Insulated Busbars)(ID)(GM)	-	55	Set 1
66 kV CB (Gas Insulated Busbars)(OD)(GM)	-	50	Set 1
66 kV Switchgear - Other	Non-motorised	50	Set 1
	Motorised	45	Set 1
33kV Transformer (PM)	Transformer	55	Set 1
	Reactors & Regulators	40	Set 1
33 kV Transformer (GM)	Transformer - Pre 1980	60	Set 1
	Transformer - Post 1980	50	Set 1
	Tapchanger	60	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
66 kV Transformer (GM)	Transformer - Pre 1980	60	Set 1
66 kV Transformer (GM)	Transformer - Post 1980	50	Set 1
	Tapchanger	60	Set 1
132 kV Pole	Concrete	60	Set 1
	Steel	50	Set 1
	Wood (water soluble copper salt treated; excluding CCA)	25	Set 1
	Wood (other)	55	Set 1
	Other (e.g. fibreglass)	80	Set 1
132 kV OHL (Tower Line) Conductor	ACSR - greased	55	Set 1
	ACSR - non-greased	50	Set 1
	AAAC	60	Set 1
	Cad Cu	50	Set 1
	Cu	70	Set 1
	Other	50	Set 1
132 kV Tower	Steelwork	80	Set 1
	Foundation - Fully Encased Concrete	95	Set 1
	Foundation - Earth Grillage	60	Set 1
	Paint System - Galvanising	30	Set 1
	Paint System - Paint	20	Set 1
132 kV Fittings	-	40	Set 1
132 kV UG Cable (Non Pressurised)	Aluminium sheath - Aluminium conductor	100	Set 1
	Aluminium sheath - Copper conductor	100	Set 1
	Lead sheath - Aluminium conductor	100	Set 1
	Lead sheath - Copper conductor	100	Set 1
132 kV UG Cable (Oil)	Aluminium sheath - Aluminium conductor	75	Set 1
	Aluminium sheath - Copper conductor	75	Set 1
	Lead sheath - Aluminium conductor	80	Set 1

Asset Register Category	Sub-division	Normal Expected Life	Ageing Rate Adjustment Set
	Lead sheath - Copper conductor	80	Set 1
132 kV UG Cable (Gas)	Aluminium sheath - Aluminium conductor	65	Set 1
132 kV UG Cable (Gas)	Aluminium sheath - Copper conductor	70	Set 1
	Lead sheath - Aluminium conductor	75	Set 1
	Lead sheath - Copper conductor	75	Set 1
132 kV Sub Cable	Submarine Single Wire Armour	70	Set 1
	Submarine Double Wire Armour	80	Set 1
	Non-Marine cable	60	Set 1
	Default	60	Set 1
132 kV CB (Air Insulated Busbars)(ID)(GM)	-	60	Set 1
132 kV CB (Air Insulated Busbars)(OD)(GM)	-	50	Set 1
132 kV CB (Gas Insulated Busbars)(ID)(GM)	-	60	Set 1
132 kV CB (Gas Insulated Busbars)(OD)(GM)	-	55	Set 1
132 kV Switchgear - Other	Non-motorised	50	Set 1
	Motorised	45	Set 1
132 kV Transformer (GM)	Transformer - Pre 1980	60	Set 1
	Transformer - Post 1980	50	Set 1
	Tapchanger	60	Set 1

1) The Normal Expected Life will be increased where applicable in accordance with Table 267 for assets that have been refurbished as specified in Annex C.

B.2 PoF Curve Parameters

Table 23 – PoF curve parameters

Functional Failure Category		K-Value	C-Value	Health Score Limit
Battery System		0.0500%	1.087	4
LV UGB		0.0077%	1.087	4
LV Circuit Breaker		0.0041%	1.087	4
LV Pillar (ID)		0.0046%	1.087	4
LV Pillar (OD at Substation) / LV Pillar (OD not at a Substation)				
LV Board (WM)		0.0069%	1.087	4
HV Switchgear (PM)		0.0067%	1.087	4
HV Switchgear (GM) - Distribution (GM)		0.0067%	1.087	4
HV Switchgear (GM) - Primary		0.0052%	1.087	4
EHV Switchgear (PM)		0.0067%	1.087	4
EHV Switchgear (GM) (33 kV & 22 kV assets only)		0.0223%	1.087	4
EHV Switchgear - Other (33 kV and 22 kV assets only)		0.0167%	1.087	4
EHV Switchgear (GM) (66 kV assets only)		0.0512%	1.087	4
EHV Switchgear - Other (66 kV assets only)		0.0167%	1.087	4
132 kV Switchgear		0.0431%	1.087	4
132kV Switchgear - Other		0.0167%	1.087	4
Transformer (PM)		0.0078%	1.087	4
HV Transformer (GM)		0.0078%	1.087	4
EHV Transformer (GM)/ 132 kV Transformer (GM)		0.0454%	1.087	4
Poles	LV / HV	0.0086%	1.087	4
	EHV / 132 kV	0.0143%	1.087	4
Towers		0.0545%	1.087	4
Fittings		0.0096%	1.087	4
OHL Pole Conductor		0.0080%	1.087	4
OHL Tower Conductor		0.0080%	1.087	4
Pressurised Cable (EHV UG Cable (Oil) and 132 kV UG Cable (Oil))		2.0944%	1.087	4
Pressurised Cable (EHV UG Cable (Gas) and 132 kV UG Cable (Gas))		4.5036%	1.087	4
Sub Cables		0.0202%	1.087	4

Functional Failure Category	K-Value	C-Value	Health Score Limit
Non Pressurised Cable	0.0658%	1.087	4

B.3 Location Factor

B.3.1 General

Table 24 – Distance from coast factor lookup table

Distance from coast banding	Switch-gear	Trans-formers	Poles (Wood or other)	Poles (Steel)	Poles (Con-crete)	Towers (Struc-ture)	Towers (Fitting s)	Towers & Poles (Con-ductor)
≤ 1km	1.35	1.35	1.00	1.50	1.25	1.80	2.00	2.00
> 1km and ≤ 5km	1.10	1.10	1.00	1.20	1.10	1.45	1.50	1.50
> 5km and ≤ 10km	1.05	1.05	1.00	1.10	1.05	1.20	1.20	1.20
> 10km and ≤ 20km	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
>20km	0.90	0.90	1.00	1.00	1.00	0.85	1.00	1.00
Default	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 25 – Altitude factor lookup table

Altitude from sea level banding	Switch-gear	Trans-formers	Poles (Wood or other)	Poles (Steel)	Poles (Con-crete)	Towers (Struc-ture)	Towers (Fitting s)	Towers & Poles (Con-ductor)
≤ 100m	0.90	0.90	1.00	1.00	1.00	0.90	0.95	0.95
> 100m and ≤ 200m	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
> 200m and ≤ 300m	1.05	1.05	1.00	1.00	1.00	1.15	1.05	1.05
> 300m	1.10	1.10	1.00	1.00	1.00	1.30	1.15	1.15
Default	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 26 – Corrosion category factor lookup table

Corrosion Category Index	Switch-gear	Trans-formers	Poles (Wood or other)	Poles (Steel)	Poles (Con-crete)	Towers (Struc-ture)	Towers (Fittings)	Towers & Poles (Con-ductor)
1	0.90	0.90	1.00	0.90	0.90	0.75	0.95	0.95
2	0.95	0.95	1.00	0.95	0.95	0.90	0.95	0.95
3	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
4	1.10	1.10	10	1.15	1.05	1.30	1.05	1.05
5	1.25	1.25	1.00	1.35	1.10	1.60	1.20	1.20
Default	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

Table 27 – Increment constants

Increment Constant	Switch-gear	Trans-formers	Sub cables	Poles (Wood or other)	Poles (Steel)	Poles (Con-crete)	Towers (Struc-ture)	Towers (Fitt-ings)	Towers & Poles (Con-ductor)
INC	0.05	0.05	0.05	0	0	0	0	0	0

Table 28 – Default environment (indoor/outdoor)

Asset Register Category	Default 'environment' to be assumed when deriving Location Factor
Batteries at GM HV Substations	Indoor
Batteries at 33 kV Substations	Indoor
Batteries at 66 kV Substations	Indoor
Batteries at 132 kV Substations	Indoor
LV Poles	Outdoor
LV Main (OHL) Conductor	Outdoor
LV Circuit Breaker	Indoor
LV Pillar (ID)	Indoor
LV Pillar (OD at Substation)	Outdoor
LV Pillar (OD not at a Substation)	Outdoor
LV Board (WM)	Indoor
LV UGB	N/A
LV Board (X-type Network) (WM)	Indoor
6.6/11 kV OHL (BLX or similar Conductor)	Outdoor
6.6/11 kV OHL (Conventional Conductor)	Outdoor

Asset Register Category	Default 'environment' to be assumed when deriving Location Factor
6.6/11 kV Poles	Outdoor
20 kV OHL (BLX or similar Conductor)	Outdoor
20 kV OHL (Conventional Conductor)	Outdoor
20 kV Poles	Outdoor
HV Sub Cable	N/A
6.6/11 kV CB (PM)	Outdoor
6.6/11 kV CB (GM) Secondary	Indoor
6.6/11 kV CB (GM) Primary	Indoor
6.6/11 kV Switch (PM)	Outdoor
6.6/11 kV Switch (GM)	Indoor
6.6/11 kV Switchgear - Other (PM)	Outdoor
6.6/11 kV RMU	Indoor
6.6/11 kV X-type RMU	Indoor
20 kV CB (PM)	Outdoor
20 kV CB (GM) Secondary	Indoor
20 kV CB (GM) Primary	Indoor
20 kV Switch (PM)	Outdoor
20 kV Switch (GM)	Indoor
20 kV Switchgear - Other (PM)	Outdoor
20 kV RMU	Indoor
6.6/11kV Transformer (PM)	Outdoor
6.6/11 kV Transformer (GM)	Indoor
20 kV Transformer (PM)	Outdoor
20 kV Transformer (GM)	Indoor
33 kV OHL (Pole Line) Conductor	Outdoor
33 kV Pole	Outdoor
66 kV OHL (Pole Line) Conductor	Outdoor
66 kV Pole	Outdoor
33 kV OHL (Tower Line) Conductor	Outdoor
33 kV Tower	Outdoor
33 kV Fittings	Outdoor
66 kV OHL (Tower Line) Conductor	Outdoor
66 kV Tower	Outdoor
66 kV Fittings	Outdoor
33 kV UG Cable (Non Pressurised)	N/A

Asset Register Category	Default 'environment' to be assumed when deriving Location Factor
33 kV UG Cable (Oil)	N/A
33 kV UG Cable (Gas)	N/A
66 kV UG Cable (Non Pressurised)	N/A
66 kV UG Cable (Oil)	N/A
66 kV UG Cable (Gas)	N/A
EHV Sub Cable	N/A
33 kV CB (Air Insulated Busbars)(ID)(GM)	Indoor
33 kV CB (Air Insulated Busbars)(OD)(GM)	Outdoor
33 kV CB (Gas Insulated Busbars)(ID)(GM)	Indoor
33 kV CB (Gas Insulated Busbars)(OD)(GM)	Outdoor
33 kV Switch (PM)	Outdoor
33 kV Switch (GM)	Indoor
33 kV Switchgear Other	Outdoor
33 kV RMU	Indoor
66 kV CB (Air Insulated Busbars)(ID)(GM)	Indoor
66 kV CB (Air Insulated Busbars)(OD)(GM)	Outdoor
66 kV CB (Gas Insulated Busbars)(ID)(GM)	Indoor
66 kV CB (Gas Insulated Busbars)(OD)(GM)	Outdoor
66 kV Switchgear Other	Outdoor
33 kV Transformer (PM)	Outdoor
33 kV Transformer (GM)	Outdoor
66 kV Transformer (GM)	Outdoor
132 kV OHL (Pole Line) Conductor	Outdoor
132 kV OHL (Tower Line) Conductor	Outdoor
132 kV Pole	Outdoor
132 kV Tower	Outdoor
132 kV Fittings	Outdoor
132 kV UG Cable (Non Pressurised)	N/A
132 kV UG Cable (Oil)	N/A
132 kV UG Cable (Gas)	N/A
132 kV Sub Cable	N/A
132 kV CB (Air Insulated Busbars)(ID)(GM)	Indoor
132 kV CB (Air Insulated Busbars)(OD)(GM)	Outdoor
132 kV CB (Gas Insulated Busbars)(ID)(GM)	Indoor
132 kV CB (Gas Insulated Busbars)(OD)(GM)	Outdoor
132 kV Switchgear Other	Outdoor
132 kV Transformer (GM)	Outdoor

B.3.2 Sub Cables

Table 29 – Sub cable topography factor

Topography	Score (Sea)	Score (Land locked)
Low Detrimental Topography	1.25	0.5
Medium Detrimental Topography	1.50	0.6
High Detrimental Topography	2.25	0.9
Very High Detrimental Topography	3.00	1.2
Default	1.25	0.5

Table 30 – Sub cable situation factor

Situation	Score
Laid on bed	1.00
Covered Surface Laid - Self Buried	0.95
Surface Laid - Stabilised	0.90
Partially Buried	0.85
Partially Buried -Stabilised	0.80
Buried	0.80
Default	1.00

Table 31 – Sub cable wind/wave factor

Rating	Description	Score
1	Sheltered sea loch, Wind <200 W/m2	1.0
2	Wave <15kW/m, Wind 200-800 W/m2	1.2
3	Wave >15kW/m, Wind > 800 W/m2	1.4
	Default	1.0

Table 32 – Combined wave & current energy factor

Intensity	Score (Sea)	Score (Landlocked)
Low	1.10	1.00
Moderate	1.25	1.15
High	1.50	1.40
Default	1.10	1.00

B.4 Duty Factor

Table 33 – Duty Factor lookup tables - Cables

Duty Factor 1 (DF1)

Maximum % utilisation under normal operating conditions	Duty Factor (HV)	Duty Factor (EHV & 132 kV)
≤ 50%	0.8	1.0
> 50% and ≤ 70%	0.9	1.1
> 70% and ≤ 100%	1.0	1.3
> 100%	1.8	2.0
Default	1.0	1.0

Duty Factor 2 (DF2)

Operating Voltage / Design Voltage	Duty Factor
≤ 40%	0.7
> 40% and ≤ 55%	0.8
> 55% and ≤ 70%	0.9
> 70%	1.0
Default	1.0

Table 34 – Duty Factor lookup table - Switchgear

Number of operations	Duty Factor
Normal/Low	1.0
High (e.g.: Auto-reclosers)	1.2
Default	1.0

Note: not applicable to EHV & 132kV Switchgear Other

Table 35 – Duty Factor Lookup Table - Distribution Transformers

Max % Utilisation under normal operating conditions	Duty Factor
≤ 50%	0.90
> 50% and ≤ 70%	0.95
> 70% and ≤ 100%	1.00
>100%	1.40
Default	1.00

Table 36 – Duty Factor Lookup Tables - Grid & Primary Transformers

Transformer

Max % utilisation under normal operating conditions	Duty Factor
≤ 50%	1.00
> 50% and ≤ 70%	1.05
> 70% and ≤ 100%	1.10
>100%	1.40
Default	1.00

Tapchanger

Average number of daily taps	Duty Factor
≤ 7	0.9
> 7 and ≤ 14	1
> 14 and ≤ 28	1.2
> 28	1.3
Default	1

The above transformer and tapchanger duty factors will not be combined into a single factor, as separate Health Scores will be calculated for each element.

B.5 Observed Condition Factors

B.5.1 Overview

The following calibration tables shall be used to determine the value of each Observed Condition Input for individual assets.

The Observed Condition Inputs consist of three elements:

a) A Condition Input Factor, which is used in the derivation of the Observed Condition Factor;

b) a Condition Input Cap, which specifies a Health Score value that is used in the derivation of the Observed Condition Cap;

c) a Condition Input Collar, which specifies a Health Score value that is used in the derivation of the Observed Condition Collar.

The use of Observed Condition Inputs to create the Observed Condition Modifier is described in Section 7.10.

DNOs shall map their own observed condition data to the criteria shown in these calibration tables, in order to determine the appropriate values for each of the Observed Condition Inputs. Where no data is available the default values for the Observed Condition Inputs shall be applied.

B.5.2 Battery Systems

Table 37 – Observed condition input – Battery System: Batteries visual condition

Condition Criteria: observed condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No or Minor/Superficial Deterioration	No observed deterioration, minor/superficial. Fit for purpose	1.0	10	0.5
Substantial Deterioration	Asset is compromised – damage / degradation / end of life. E.g. Case bulging / deformed, visible cracks or evidence of acid escape. Mossing on the plates.	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 38 – Observed Condition Input - Battery System: Batteries environment temperature

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	Ambient temperature is at or below the rated value for the battery	1.0	10	0.5
Not Acceptable	Ambient temperature is persistently above the rated value for the battery	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 39 – Observed Condition Input - Battery System: Chargers visual condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No observed deterioration, performing as designed	1.0	10	0.5
Some Deterioration	The asset is fit for continued service. There is little deterioration, minor corrosion etc	1.2	10	0.5
Substantial Deterioration	Asset is compromised. External housing has severe corrosion, rust and/or signs of overheating observed	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.5.3 LV UGB

Table 40 – Observed condition input - LV UGB: steel cover & pit condition

Condition Criteria: observed condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some Deterioration	e.g. Minor corrosion	1.2	10	0.5
Substantial Deterioration	e.g. Major corrosion	1.4	10	0.5
Default	No data available	1.0	10	0.5

Table 41 – Observed Condition Input - LV UGB: Water / Moisture

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None	Dry	1.0	10	0.5
Present in Pit	Evidence of moisture observed in pit	1.1	10	0.5
Present in Bell Housing	Evidence of moisture observed in bell housing	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 42 – Observed Condition Input - LV UGB: Bell Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No observed deterioration	0.9	10	0.5
Some Deterioration	e.g. Minor corrosion	1.2	10	0.5
Substantial Deterioration	e.g. Major corrosion	1.4	10	0.5
Default	No data available	1.0	10	0.5

Table 43 – Observed Condition Input - LV UGB: Insulation Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Some deterioration	Chips and advanced aging	1.0	10	0.5
Substantial deterioration	Evidence of flashover or damage, or degradation of insulation material	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 44 – Observed Condition Input - LV UGB: Signs of Heating

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No observed deterioration	0.9	10	0.5
Some Deterioration	Observed running higher than ambient	1.0	10	0.5
Substantial Deterioration	Evidence of overheating	1.5	10	5.5
Default	No data available	1.0	10	0.5

Table 45 – Observed Condition Input - LV UGB: Phase Barriers

Condition Criteria: Phase barriers present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Yes	Phase barriers present	1.0	10	0.5
Missing	Phase barriers not present (in whole or part)	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.4 LV Circuit Breaker

Table 46 – Observed Condition Input - LV Circuit Breaker: External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.3	10	0.5
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.6	10	5.5
Default	No data available	1.0	10	0.5

B.5.5 LV Board (WM)

Table 47 – Observed Condition Input - LV Board (WM): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	0.5
Substantial deterioration	The switchgear is corroded to the point that one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 48 – Observed Condition Input - LV Board (WM): Compound Leaks

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No leakage	1.0	10	0.5
Superficial/minor deterioration	Evidence of slight compound leak	1.1	10	0.5
Substantial deterioration	Significant compound leak or multiple compound leaks on the same board.	1.3	10	5.5
Default	No data available	1.0	10	0.5

Table 49 – Observed Condition Input - LV Board (WM): Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 50 – Observed Condition Input - LV Board (WM): Insulation Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Satisfactory	No observed deterioration	0.9	10	0.5
Some deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Substantial deterioration	Degradation of insulation material	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 51 – Observed Condition Input - LV Board (WM): Signs of Heating

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No obvious degradation	1.0	10	0.5
Minor Deterioration	Observed running higher than ambient	1.2	10	0.5
Major Deterioration	Evidence of overheating	1.5	10	5.5
Default	No data available	1.0	10	0.5

Table 52 – Observed Condition Input - LV Board (WM): Phase Barriers

Condition Criteria: phase barriers present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Yes	Phase barriers present	1.0	10	0.5
Missing	Phase barriers not present (in whole or part)	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.6 LV Pillar

Table 53 – Observed Condition Input - LV Pillar: Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	0.5
Substantial deterioration	The switchgear is corroded to the point that one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 54 – Observed Condition Input - LV Pillar: Compound Leaks

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No leakage	1.0	10	0.5
Superficial/minor deterioration	Evidence of slight compound leak	1.1	10	0.5
Substantial deterioration	Significant compound leak or multiple compound leaks on the same pillar.	1.3	10	5.5
Default	No data available	1.0	10	0.5

Table 55 – Observed Condition Input - LV Pillar: Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 56 – Observed Condition Input - LV Pillar: Insulation Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Satisfactory	No observed deterioration	0.9	10	0.5
Some deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Substantial deterioration	Degradation of insulation material	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 57 – Observed Condition Input - LV Pillar: Signs of Heating

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	No obvious degradation	1.0	10	0.5
Minor Deterioration	Observed running higher than ambient	1.2	10	0.5
Major Deterioration	Evidence of overheating	1.5	10	5.5
Default	No data available	1.0	10	0.5

Table 58 – Observed Condition Input - LV Pillar: Phase Barriers

Condition Criteria: phase barriers Present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Yes	Phase Barriers Present	1.0	10	0.5
Missing	Phase Barriers Not Present (in whole or part)	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.7 HV Switchgear (PM)

Table 59 – Observed Condition Input – HV Switchgear (PM): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	There is little deterioration. The asset may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metal clad switchgear). Evidence of minor mechanism defects.	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through. Evidence of severe mechanism defects.	1.4	10	8.0
Default	No data available	1	10	0.5

Table 60 – Observed Condition Input – HV Switchgear (PM): Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.	0.9	10	0.5
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted.	1.0	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
	Repairs / intervention to the asset is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.			
Some deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

B.5.8 HV Switchgear (GM) - Distribution

Table 61 – Observed Condition Input - HV Switchgear (GM) - Distribution: Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss	1.0	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
	or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.			
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 62 – Observed Condition Input - HV Switchgear (GM) - Distribution: Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.	0.9	10	0.5
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted. Repairs / intervention to the asset (or a sub component) is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.	1.0	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Some Deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial Deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 63 – Observed Condition Input - HV Switchgear (GM) - Distribution: Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or Below	At or below ambient temperature	0.9	10	0.5
Above Ambient	Above ambient temperature	1.0	10	0.5
Substantially Above Ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 64 – Observed Condition Input - HV Switchgear (GM) - Distribution: Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 65 – Observed Condition Input - HV Switchgear (GM) - Distribution: Indoor Environment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Better than expected	Air conditioned	0.9	10	0.5
As expected	This is an environment which is typified as dry and has a degree of background heating or dehumidification which maintains this year round.	1.0	10	0.5
Deteriorated environment	Heating or dehumidification faulty; room temperature is hotter than recommended by environmental policy; condensation evident in switch room etc.	1.3	10	0.5
Severely deteriorated environment	The substation is showing major signs of dampness such as definite water marks around the building, significant amount of flaking paint and/or mould growth. No environmental controls (such as heating or dehumidification) are installed, or the installed environmental controls are not functioning adequately; room temperature is excessively hot; roof or structure permits water ingress; water stands in trenches or free water is observed in the switch room.	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 66 – Observed Condition Input - HV Switchgear (GM) - Distribution: Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial / minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the ‘No deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.9 HV Switchgear (GM) – Primary

Table 67 – Observed Condition Input – HV Switchgear (GM) – Primary: Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 68 – Observed Condition Input – HV Switchgear (GM) – Primary: Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.	0.9	10	0.5
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted. Repairs / intervention to the asset (or a sub component) is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.	1.0	10	0.5
Some deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 69 – Observed Condition Input – HV Switchgear (GM) – Primary: Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer’s recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 70 – Observed Condition Input – HV Switchgear (GM) – Primary: Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 71 – Observed Condition Input – HV Switchgear (GM) – Primary: Indoor Environment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Better than expected	Air conditioned	0.9	10	0.5
As expected	This is an environment which is typified as dry and has a degree of background heating or dehumidification which maintains this year round.	1.0	10	0.5
Deteriorated environment	Heating or dehumidification faulty; room temperature is hotter than recommended by environmental policy; condensation evident in switch room etc.	1.3	10	0.5
Severely deteriorated environment	The substation is showing major signs of dampness such as definite water marks around the building, significant amount of flaking paint and/or mould growth. No environmental controls (such as heating or dehumidification) are installed, or the installed environmental controls are not functioning adequately; room temperature is excessively hot; roof or structure permits water ingress; water stands in trenches or free water is observed in the switch room.	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 72 – Observed Condition Input – HV Switchgear (GM) – Primary: Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1	10	0.5
NOTE: as both the ‘No deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.10 EHV Switchgear (PM)

Table 73 – Observed Condition Input – EHV Switchgear (PM): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	There is little deterioration. The asset may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metal clad switchgear). Evidence of minor mechanism defects.	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through. Evidence of severe mechanism defects.	1.4	10	8.0
Default	No data available	1	10	0.5

Table 74 – Observed Condition Input – EHV Switchgear (PM): Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.	0.9	10	0.5
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted.	1.0	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
	Repairs / intervention to the asset is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.			
Some deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

B.5.11 EHV Switchgear (GM)

Table 75 – Observed Condition Input – EHV Switchgear (GM): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a subcomponent) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1	10	0.5

Table 76 – Observed Condition Input – EHV Switchgear (GM): Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.	0.9	10	0.5
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted. Repairs / intervention to the asset (or a sub component) is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.	1.0	10	0.5
Some deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 77 – Observed Condition Input – EHV Switchgear (GM): Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 78 – Observed Condition Input – EHV Switchgear (GM): Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 79 – Observed Condition Input - EHV Switchgear (GM): Indoor Environment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Better than expected	Air conditioned	0.9	10	0.5
As expected	This is an environment which is typified as dry and has a degree of background heating or dehumidification which maintains this year round.	1.0	10	0.5
Deteriorated environment	Heating or dehumidification faulty; room temperature is hotter than recommended by environmental policy; condensation evident in switch room etc.	1.3	10	0.5
Severely deteriorated environment	The substation is showing major signs of dampness such as definite water marks around the building, significant amount of flaking paint and/or mould growth. No environmental controls (such as heating or dehumidification) are installed, or the installed environmental controls are not functioning adequately; room temperature is excessively hot; roof or structure permits water ingress; water stands in trenches or free water is observed in the switch room.	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 80 – Observed Condition Input – EHV Switchgear (GM): Support Structures

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion or cracks.	0.9	10	0.5
Superficial/minor deterioration	Concrete Structures: Surface Deterioration Metal Structures: Minor localised surface corrosion	1	10	0.5
Some Deterioration	Concrete Structures: Evidence of previous concrete repairs, repairs have begun to fail in places. This may include minor cracks and loss of section. Metal structures: some surface level corrosion.	1.3	10	0.5
Substantial Deterioration	The support structure is corroded or damaged to the point that it can no longer fulfil its mechanical load carrying capacity. This may include: Concrete structures: extensive cracking, areas of concrete spalled exposing reinforcement causing corrosion. Metal structures: evidence of widespread or significant corrosion (e.g. perforation, holes in steelwork) or major physical damage.	1.5	10	5.5
Default	No data available	1	10	0.5

Table 81 – Observed Condition Input - EHV Switchgear (GM): Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the ‘No Deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.12 EHV Switchgear (Other)

Table 82 – Observed Condition Input – EHV Switchgear (Other): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a subcomponent) is fit for continued service.	1	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork or handle or evidence of a minor mechanism defect).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it affects the operation of the asset, or the switchgear operating mechanism is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1	10	0.5

Table 83 – Observed Condition Input – EHV Switchgear (Other): Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer’s recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 84 – Observed Condition Input – EHV Switchgear (Other): Support Structures

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion or cracks.	0.9	10	0.5
Superficial/minor deterioration	Concrete Structures: Surface Deterioration Metal Structures: Minor localised surface corrosion. Wood Pole Structures: No significant defects observed. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole.	1	10	0.5
Some Deterioration	Concrete Structures: Evidence of previous concrete repairs, repairs have begun to fail in places. This may include minor cracks and loss of section. Metal structures: some surface level corrosion. Wood Pole Structures: Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	0.5
Substantial Deterioration	The support structure is corroded or damaged to the point that it can no longer fulfil its mechanical load carrying capacity. This may include: Concrete structures: extensive cracking, areas of concrete spalled exposing reinforcement causing corrosion. Metal structures: evidence of widespread or significant corrosion (e.g. perforation, holes in steelwork) or major physical damage. Wood Pole Structures: Severe damage to pole. Parts may be chipped off, rotten or disfigured. E.g. visible splits, cracks, major physical damage affecting strength.	1.5	10	5.5
Default	No data available	1	10	0.5

B.5.13 132 kV Switchgear (GM)

Table 85 – Observed Condition Input – 132 kV Switchgear (GM): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a sub component) may exhibit signs of ageing, surface level scratches, moss or lichen that can be brushed off. This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion or minor compound leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork, door-hinges heavily rusted).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it can no longer hold its oil / SF6 insulation, one or more metalwork supports are rusted through, or the switchgear housing is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 86 – Observed Condition Input – 132 kV Switchgear (GM): Oil Leaks / Gas Pressure

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Oil: No Oil appears to be actively leaking from the component in question. This	0.9	10	0.5

Condition Criteria: Observed Condition	**Description**	**Condition Input Factor**	**Condition Input Cap**	**Condition Input Collar**
	may include assets with minor stains or marks. Gas: Gas pressure reading is within the expected limit and no or negligible levels of historical leakage.			
Superficial/minor deterioration	Oil: There is evidence of a small leak, but this is limited to staining of the asset or the ground around the asset AND oil still visible in the sight glass where fitted. Repairs / intervention to the asset (or a sub component) is not expected to be required between now and the next planned maintenance. Gas: Requires occasional intervention; OR minimal historical leakage.	1.0	10	0.5
Some deterioration	Oil: There is evidence of a small active oil leak from the switchgear e.g. droplets or weeping beneath the fixed portion. Minor maintenance or refurbishment activities (as a minimum) are required to address the identified issue(s) Gas: Gas pressure outside of acceptable range; Requires regular intervention; OR some historical leakage.	1.1	10	3.0
Substantial deterioration	Oil: There is evidence of a significant oil leak from the switchgear e.g. pool of oil under/around the equipment, the switchgear may be draining or completely drained of oil and / or compound. Gas: Severe unrepairable leak; Requires frequent intervention; OR substantial historical leakage	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 87 – Observed Condition Input – 132 kV Switchgear (GM): Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 88 – Observed Condition Input – 132 kV Switchgear (GM): Switchgear Internal Condition & Operation

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. light rust) or evidence of a minor mechanism defect.	1.2	10	3.0
Substantial deterioration	Evidence of significant corrosion, missing, defective or damaged internal insulation (e.g. evidence of severe discharge activity or breakdown of insulation) or a severe mechanism defect that affects the operation of the asset.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 89 – Observed Condition Input – 132 kV Switchgear (GM): Indoor Environment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Better than expected	Air conditioned	0.9	10	0.5
As expected	This is an environment which is typified as dry and has a degree of background heating or dehumidification which maintains this year round.	1.0	10	0.5
Deteriorated environment	Heating or dehumidification faulty; room temperature is hotter than recommended by environmental policy; condensation evident in switch room etc.	1.3	10	0.5
Severely deteriorated environment	The substation is showing major signs of dampness such as definite water marks around the building, significant amount of flaking paint and/or mould growth. No environmental controls (such as heating or dehumidification) are installed, or the installed environmental controls are not functioning adequately; room temperature is excessively hot; roof or structure permits water ingress; water stands in trenches or free water is observed in the switch room.	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 90 – Observed Condition Input – 132 kV Switchgear (GM): Support Structures

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion or cracks.	0.9	10	0.5
Superficial/minor deterioration	Concrete Structures: Surface Deterioration Metal Structures: Minor localised surface corrosion	1.0	10	0.5
Some deterioration	Concrete Structures: Evidence of previous concrete repairs, repairs have begun to fail in places. This may include minor cracks and loss of section. Metal structures: some surface level corrosion.	1.3	10	0.5
Substantial deterioration	The support structure is corroded or damaged to the point that it can no longer fulfil its mechanical load carrying capacity. This may include: Concrete structures: extensive cracking, areas of concrete spalled exposing reinforcement causing corrosion. Metal structures: evidence of widespread or significant corrosion (e.g. perforation, holes in steelwork) or major physical damage.	1.5	10	5.5
Default	No data available	1.0	10	0.5

Table 91 – Observed Condition Input – 132 kV Switchgear (GM): Air Systems

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	Minor surface corrosion observed on observable pipe work	1.0	10	0.5
Some deterioration	Minor Air Losses - System runs excessively to maintain pressure	1.3	10	0.5
Substantial deterioration	Major Air Losses - Loss of pressure pipe section observed. Air leaks can be found by inspection; Certification notes defects. Etc.	1.5	10	0.5
Default	No data available	1.0	10	0.5

Table 92 – Observed Condition Input – 132 kV Switchgear (GM): Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the 'No deterioration' and 'Superficial/minor deterioration' Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.14 132 kV Switchgear (Other)

Table 93 – Observed Condition Input – 132 kV Switchgear (Other): Switchgear External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration:	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion, stains or markings.	0.9	10	0.5
Superficial/minor deterioration	There is little deterioration. The asset (or a subcomponent) is fit for continued service.	1	10	0.5
Some deterioration	There is evidence of some degradation such as surface corrosion. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork or handle or evidence of a minor mechanism defect).	1.2	10	3.0
Substantial deterioration	The switchgear is corroded to the point that it affects the operation of the asset, or the switchgear operating mechanism is damaged beyond economical repair.	1.4	10	8.0
Default	No data available	1	10	0.5

Table 94 – Observed Condition Input – 132 kV Switchgear (Other): Thermographic Assessment

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer’s recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 95 – Observed Condition Input – 132 kV Switchgear (Other): Support Structures

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	Visual assessment gives a positive indication of asset condition. There are no obvious signs of any deterioration such as corrosion or cracks.	0.9	10	0.5
Superficial/minor deterioration	Concrete Structures: Surface Deterioration Metal Structures: Minor localised surface corrosion. Wood Pole Structures: No significant defects observed. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole.	1	10	0.5
Some Deterioration	Concrete Structures: Evidence of previous concrete repairs, repairs have begun to fail in places. This may include minor cracks and loss of section. Metal structures: some surface level corrosion. Wood Pole Structures: Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	0.5
Substantial Deterioration	The support structure is corroded or damaged to the point that it can no longer fulfil its mechanical load carrying capacity. This may include: Concrete structures: extensive cracking, areas of concrete spalled exposing reinforcement causing corrosion. Metal structures: evidence of widespread or significant corrosion (e.g. perforation, holes in steelwork) or major physical damage. Wood Pole Structures: Severe damage to pole. Parts may be chipped off, rotten or disfigured. E.g. visible splits, cracks, major physical damage affecting strength.	1.5	10	5.5
Default	No data available	1	10	0.5

B.5.15 HV Transformer (PM)

Table 96 – Observed Condition Input – HV Transformer (PM): Transformer External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The transformer may exhibit signs of ageing or marks (e.g. surface level scratches, moss or lichen). This has no material impact on the probability of failure for the asset. OR no recorded defects	1.0	10	0.5
Some deterioration	The asset shows a level of deterioration such as surface corrosion spots. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metal work); and/or there is evidence of a small active oil leak (e.g. droplets or weeping).	1.25	10	3.0
Substantial deterioration	There is evidence of major corrosion or historical oil leakage.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 97 – Observed Condition Input - HV Transformer (PM): Bushing Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	There are no signs of any deterioration such as cracks, markings, compound leaks, discharge etc. The bushings may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, or deterioration of insulation. OR no recorded defects.	1.0	10	0.5
Some deterioration	The bushings may exhibit minor damage or corrosion. No evidence of compound leaks, discharge, or deterioration of insulation.	1.1	10	0.5
Substantial deterioration	Evidence of cracks, markings on bushings. Evidence of discharge, deterioration/ damage of insulation.	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.5.16 HV Transformer (GM)

Table 98 – Observed Condition Input – HV Transformer (GM): Transformer External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Condition as new	0.9	10	0.5
Superficial/minor deterioration	The transformer may exhibit signs of ageing or marks (e.g. surface level scratches, moss or lichen that can be brushed off). This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Slight deterioration	Minor localised surface corrosion. There may be evidence of a small leak, but it does not present a significant impact to the overall probability of failure for the asset, for example: There is a small active leak from a sub component but this can be addressed through intervention of the sub component A small inactive leak which is limited to staining of the asset or the ground around the asset.	1.1	10	0.5
Some deterioration	The asset shows a level of deterioration such as surface corrosion spots. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork); and/or there is evidence of a small active oil leak (e.g. droplets or weeping).	1.25	10	3.0
Substantial deterioration	There is evidence of major corrosion or a significant active oil leak (e.g. pools of oil collecting on the ground or plinth).	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 99 – Observed Condition Input - HV Transformer (GM): Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the ‘No Deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.17 EHV Transformer (PM)

Table 100 – Observed Condition Input – EHV Transformer (PM): Transformer External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	Condition as new	0.9	10	0.5
Superficial/minor deterioration	The transformer may exhibit signs of ageing or marks (e.g. surface level scratches, moss or lichen). This has no material impact on the probability of failure for the asset. OR no recorded defects	1.0	10	0.5
Some deterioration	The asset shows a level of deterioration such as surface corrosion spots. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metal work); and/or there is evidence of a small active oil leak (e.g. droplets or weeping).	1.25	10	3.0
Substantial deterioration	There is evidence of major corrosion or historical oil leakage.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 101 – Observed Condition Input - EHV Transformer (PM): Bushing Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	There are no signs of any deterioration such as cracks, markings, compound leaks, discharge etc. The bushings may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, or deterioration of insulation. OR no recorded defects.	1.0	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Some deterioration	The bushings may exhibit minor damage or corrosion. No evidence of compound leaks, discharge, or deterioration of insulation.	1.1	10	0.5
Substantial deterioration	Evidence of cracks, markings on bushings. Evidence of discharge, deterioration/ damage of insulation.	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.5.18 EHV Transformer (GM) (Main Transformer component)

Table 102 – Observed Condition Input – EHV Transformer (GM): Main Tank Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The transformer may exhibit signs of ageing or marks (e.g. surface level scratches, moss or lichen that can be brushed off). This has no material impact on the probability of failure for the asset. There may be evidence of a small leak, but it does not present a significant impact to the overall probability of failure for the asset, for example: There is a small active leak from a sub component (e.g. a pressure relief device) but this can be addressed through intervention of the sub component. The leak this is limited to staining of the asset or the ground around the asset.	1.0	10	0.5
Some deterioration	The asset shows a level of deterioration such as surface corrosion spots or minor oil leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork); and/or there is evidence of a small active oil leak (e.g. droplets or weeping).	1.4	10	4.0

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Substantial deterioration	There is evidence of major corrosion or a significant active and unrepairable oil leak (e.g. pools of oil collecting on the ground or plinth).	1.8	10	8.0
Default	No data available	1.0	10	0.5

Table 103 – Observed Condition Input – EHV Transformer (GM): Coolers / Radiator Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset (or a sub component) may exhibit signs of ageing, minor stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off). This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some deterioration	Localised areas of surface corrosion or evidence of oil leaks not associated with the transformer fins (e.g. manifolds and associated pipework, flanges, couplings, valves)	1.2	10	0.5
Substantial deterioration	Widespread corrosion, loss of cross-sectional area or thinning or evidence of oil leakage from the fins.	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 104 – Observed Condition Input – EHV Transformer (GM): Bushings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion or evidence of a historic oil leak (e.g. stains) or minor damage (e.g. small chips or cracks). Bushings with high levels of pollution with associated evidence of localised discharge or tracking.	1.2	10	0.5
Substantial deterioration	Visible cracks, broken sheds, damage, surface degradation, widespread/significant discharge activity and/or active oil leak (e.g. droplets, pools of oil).	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 105 – Observed Condition Input – EHV Transformer (GM): Kiosk Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component exhibits some deterioration but is fit for continued service. There is no or little obvious signs of corrosion.	1.0	10	0.5
Some deterioration	The component asset shows a level of deterioration such as surface corrosion spots. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork).	1.1	10	0.5
Substantial deterioration	There is evidence of major corrosion or damage affecting the structural integrity.	1.2	10	0.5
Default	No data available	1.0	10	0.5

Table 106 – Observed Condition Input - EHV Transformer (GM): Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the ‘No Deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.19 EHV Transformer (GM) (Tapchanger component)

Table 107 – Observed Condition Input – EHV Transformer (GM): Tapchanger External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or evidence of low level oil leaks (If appropriate)	1.4	10	4.0
Substantial deterioration	e.g. major corrosion or evidence of significant oil leakage	1.8	10	8.0
Default	No data available	1.0	10	0.5

Table 108 – Observed Condition Input – EHV Transformer (GM): Internal Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or evidence of low level oil leaks (If appropriate)	1.2	10	3.0
Substantial deterioration	e.g. observed or potential mechanism defect, internal insulation, etc.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 109 – Observed Condition Input – EHV Transformer (GM): Drive Mechanism Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or wear to components	1.2	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Substantial deterioration	e.g. major corrosion or excessive wear in component and bearings	1.4	10	0.5
Default	No data available	1.0	10	0.5

Table 110 – Observed Condition Input – EHV Transformer (GM): Condition of Selector & Diverter Contacts

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or wear	1.1	10	0.5
Substantial deterioration	e.g. major corrosion or excessive wear in component and bearings	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 111 – Observed Condition Input – EHV Transformer (GM): Condition of Selector & Diverter Braids

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or wear	1.05	10	0.5
Substantial deterioration	e.g. major corrosion or fraying of braids	1.1	10	0.5
Default	No data available	1.0	10	0.5

B.5.20 132 kV Transformer (GM) (Main Transformer component)

Table 112 – Observed Condition Input – 132 kV Transformer (GM): Main Tank Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The transformer may exhibit signs of ageing or marks (e.g. surface level scratches, moss or lichen that can be brushed off). This has no material impact on the probability of failure for the asset. There may be evidence of a small leak, but it does not present a significant impact to the overall probability of failure for the asset, for example: There is a small active leak from a sub component (e.g. a pressure relief device) but this can be addressed through intervention of the sub component. The leak this is limited to staining of the asset or the ground around the asset.	1.0	10	0.5
Some deterioration	The asset shows a level of deterioration such as surface corrosion spots or minor oil leaks. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork); and/or there is evidence of a small active oil leak (e.g. droplets or weeping).	1.4	10	4.0
Substantial deterioration	There is evidence of major corrosion or a significant active and unrepairable oil leak (e.g. pools of oil collecting on the ground or plinth).	1.8	10	8.0
Default	No data available	1.0	10	0.5

Table 113 – Observed Condition Input – 132 kV Transformer (GM): Coolers / Radiator Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset (or a sub component) may exhibit signs of ageing, minor stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off). This has no material impact on the probability of failure for the asset.	1.0	10	0.5
Some Deterioration	Localised areas of surface corrosion or evidence of oil leaks not associated with the transformer fins (e.g. manifolds and associated pipework, flanges, couplings, valves)	1.2	10	0.5
Substantial Deterioration	Widespread corrosion, loss of cross-sectional area or thinning or evidence of oil leakage from the fins.	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 114 – Observed Condition Input – 132 kV Transformer (GM): Bushings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	Minor corrosion or evidence of a historic oil leak (e.g. stains) or minor damage (e.g. small chips or cracks). Bushings with high levels of pollution with associated evidence of localised discharge or tracking.	1.2	10	0.5
Substantial deterioration	Visible cracks, broken sheds, damage, surface degradation, widespread/significant discharge activity and/or active oil leak (e.g. droplets, pools of oil).	1.4	10	5.5
Default	No data available	1.0	10	0.5

Table 115 – Observed Condition Input – 132 kV Transformer (GM): Kiosk Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component exhibits some deterioration but is fit for continued service. There is no or little obvious signs of corrosion.	1.0	10	0.5
Some deterioration	The component asset shows a level of deterioration such as surface corrosion spots. The level of degradation may affect the operation of the asset if left untended (e.g. large patches of rust on the metalwork).	1.1	10	0.5
Substantial deterioration	There is evidence of major corrosion or damage affecting the structural integrity.	1.2	10	0.5
Default	No data available	1.0	10	0.5

Table 116 – Observed Condition Input – 132 kV Transformer (GM): Cable Boxes Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	There are no signs of any deterioration such as corrosion, stains, markings, compound leaks, discharge etc.	1.0	10	0.5
Superficial/minor deterioration	The cable box may exhibit minor exterior stains or marks (e.g. surface level scratches, moss or lichen that can be brushed off), but no damage or corrosion should be evident. No evidence of compound leaks, discharge, signs of heating, or deterioration of insulation.	1.0	10	0.5
Some deterioration	Minor corrosion (e.g. surface corrosion spots) or deterioration (e.g. minor breakthrough of paintwork but no loss of galvanising).	1.1	10	0.5
Substantial deterioration	Evidence of significant corrosion and perforation (e.g. holes). Severe breakthrough of paintwork with some loss of galvanising. Major compound leaks. Evidence of discharge, signs of heating, deterioration/ damage of insulation.	1.3	10	0.5
Default	No data available	1.0	10	0.5
NOTE: as both the ‘No Deterioration’ and ‘Superficial/minor deterioration’ Condition Criteria for this Condition Input are treated in the same way by the Methodology, the categorisations for these two Condition Criteria may be combined in individual implementations of the Methodology.				

B.5.21 132 kV Transformer (GM) (Tapchanger component)

Table 117 – Observed Condition Input – 132 kV Transformer (GM): Tapchanger External Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or evidence of low level oil leaks (If appropriate)	1.4	10	4.0
Substantial deterioration	e.g. major corrosion or evidence of significant oil leakage	1.8	10	8.0
Default	No data available	1.0	10	0.5

Table 118 – Observed Condition Input – 132 kV Transformer (GM): Internal Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or evidence of low level oil leaks (If appropriate)	1.2	10	3.0
Substantial deterioration	e.g. observed or potential mechanism defect, internal insulation, etc.	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 119 – Observed Condition Input – 132 kV Transformer (GM): Drive Mechanism Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some Deterioration	e.g. minor corrosion or wear to components	1.2	10	0.5
Substantial Deterioration	e.g. major corrosion or excessive wear in component and bearings	1.4	10	0.5
Default	No data available	1.0	10	0.5

Table 120 – Observed Condition Input – 132 kV Transformer (GM): Condition of Selector & Diverter Contacts

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or wear	1.1	10	0.5
Substantial deterioration	e.g. major corrosion or excessive wear in component and bearings	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 121 – Observed Condition Input – 132 kV Transformer (GM): Condition of Selector & Diverter Braids

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	10	0.5
Some deterioration	e.g. minor corrosion or wear	1.05	10	0.5
Substantial deterioration	e.g. major corrosion or fraying of braids	1.1	10	0.5
Default	No data available	1.0	10	0.5

B.5.22 EHV Cable (Oil)

Table 122 – Observed Condition Input – EHV Cable (Oil): Presence of crystalline lead

Condition Criteria: lead crystallisation present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	*Applicable to cables in the Lead sheath sub-division only:* No lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same hydraulic section, on any occasion where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.0	10	0.5
Yes	*Applicable to cables in the Lead sheath sub-division only:* Evidence of lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same hydraulic section, on one or more occasions where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.8	10	8
Not applicable	This condition input is not applicable because the exposed cable within the hydraulic section is in the Aluminium sheath sub-division or the Lead sheath cable section has not been exposed.	1.0	10	0.5

Condition Criteria: lead crystallisation present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Default	No data available	1.0	10	0.5
NOTE: This condition is only collected by exception, i.e. when the cable section is uncovered for fault repair, leak detection, construction works etc.				

B.5.23 EHV Cable (Gas)

Table 123 – Observed Condition Input – EHV Cable (Gas): Presence of crystalline lead

Condition Criteria: lead crystallisation present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	*Applicable to cables in the Lead sheath sub-division only:* No lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same pneumatic section, on any occasion where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.0	10	0.5
Yes	*Applicable to cables in the Lead sheath sub-division only:* Evidence of lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same pneumatic section, on one or more occasions where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.8	10	8
Not applicable	This condition input is not applicable because the exposed cable within the pneumatic section is in the Aluminium sheath sub-division or the Lead sheath cable section has not been exposed.	1.0	10	0.5
Default	No data available	1.0	10	0.5
NOTE: This condition is only collected by exception, i.e. when the cable section is uncovered for fault repair, leak detection, construction works etc.				

B.5.24 132 kV Cable (Oil)

Table 124 – Observed Condition Input – 132 kV Cable (Oil): Presence of Crystalline Lead

Condition Criteria: lead crystallisation present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	*Applicable to cables in the Lead sheath sub-division only:* No lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same hydraulic section, on any occasion where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.0	10	0.5
Yes	*Applicable to cables in the Lead sheath sub-division only:* Evidence of lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same hydraulic section, on one or more occasions where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.8	10	8
Not applicable	This condition input is not applicable because the exposed cable within the hydraulic section is in the Aluminium sheath sub-division or the Lead sheath cable section has not been exposed.	1.0	10	0.5
Default	No data available	1.0	10	0.5
NOTE: This condition is only collected by exception, i.e. when the cable section is uncovered for fault repair, leak detection, construction works etc.				

B.5.25 132 kV Cable (Gas)

Table 125 – Observed Condition Input – 132 kV Cable (Gas): Presence of Crystalline Lead

Condition Criteria: lead crystallisation present?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	*Applicable to cables in the Lead sheath sub-division only:* No lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same pneumatic section, on any occasion where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.0	10	0.5
Yes	*Applicable to cables in the Lead sheath sub-division only:* Evidence of lead crystallisation has been identified in the sheath of the cable or any other lead sheath cable within the same pneumatic section, on one or more occasions where the lead sheath of the cable has been exposed (e.g. during fault repair, leak location, construction works etc.).	1.8	10	8
Not applicable	This condition input is not applicable because the exposed cable within the pneumatic section is in the Aluminium sheath sub-division or the Lead sheath cable section has not been exposed.	1.0	10	0.5
Default	No data available	1.0	10	0.5
NOTE: This condition is only collected by exception, i.e. when the cable section is uncovered for fault repair, leak detection, construction works etc.				

B.5.26 Sub Cable

Table 126 – Observed Condition Input – Sub Cable: External Condition

Condition Criteria	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	Asset appears as new. No signs of deterioration or damage	1.0	10	0.5
Minor Deterioration	Small localised outer serving damaged or missing. Highlights abrasion points early. Cable crossings with no protection	1.2	10	0.5
Some Deterioration	Significant sections of outer serving missing Armour corrosion. Small sections of broken armour strands Boulder / objects pinning or damaging cable	1.6	10	5.5
Substantial Deterioration	Significant armour corrosion - effecting integrity of the cable. Significant sections of broken armour strands. Sections of armour missing / Exposed cores. Loops, Bends, Kinks exceeding cable bending radius Significant third-party interactions - anchor drag, etc	1.8	10	8.0
Default	No data available	1.0	10	0.5

Table 127 – Observed Condition Input – Sub Cable Shore End* Cable: Cable Erosion

Condition Criteria	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Cable Not Visible	Shore end inspection identifies there is no erosion around the cable and so remains buried.	1.0	10	0.5
Cable Visible	Shore end inspection identifies there is erosion around the cable making cable visible and prone to greater deterioration	1.05	10	5.5
Default	No data available	1.0	10	0.5

*Shore End refers to cable section which is above water level as defined by the Mean Low Water Springs, which is the average height of low tides during spring tides. It's a long-term average of two successive low tides that occur during the period of greatest tidal range.

Table 128 – Observed Condition Input – Sub Cable Shore End: Cable Protection

Condition Criteria	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No Deterioration	Cable not visible or cable protection is visible but has no damage.	1.0	10	0.5
Some Deterioration	Cable protection visible and is damaged	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 129 – Observed Condition Input – Sub Cable: Cable Suspensions

Condition Criteria	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None / Minor	No suspensions recorded on Sub cable or Suspension Present < 0.8m high or <10m long	1.0	10	0.5
Moderate	Suspension(s) Present 0.8m - 2m high or 10 - 25m long	1.05	10	0.5
Major	Suspension Present > 2m high or >25m Long	1.1	10	0.5
Default	No data available	1.0	10	0.5

Note - More significant criteria should be used where suspension falls between two descriptions. i.e. <0.8m but 15m long should go Moderate and not Minor.

B.5.27 LV Poles

Table 130 – Observed Condition Input – LV Pole: Visual Pole Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	No significant defects observed. Pole may be new with no/few marks. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole. For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the poles in this condition are Acceptable.	1.0	10	0.5
Some deterioration	Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	4.0
Substantial deterioration	Severe damage to pole. Parts may be chipped off, rotten or disfigured. e.g. visible splits, cracks, major physical damage affecting strength.	1.8	10	8.0
Default	No data available	1.0	10	0.5

* For strengthened poles, consideration should be given to the location on the pole of any identified defect. For example, physical damage at the ground line that is mitigated by the system itself may be disregarded, and the visual assessment applied to the remainder of the pole.

Table 131 – Observed Condition Input – LV Pole: Pole Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	1.0	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial Loss of required Structural Integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Default	No data available	1.0	10	0.5

Table 132 – Observed Condition Input – LV Pole: Pole Top Rot

Condition Criteria: Significant pole top rot	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	No significant pole top rot observed	1.0	10	0.5
Yes (suspect)	Pole top rot is suspected but not confirmed	1.2	10	5.5
Yes (confirmed)	Significant pole top rot is observed	1.3	10	8
Default	No data available	1.0	10	0.5

Table 133 – Observed Condition Input – LV Pole: Pole Leaning

Condition Criteria: pole leaning?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	The pole is vertical	1	10	0.5
Yes	The pole is not vertical	1.2	10	0.5
Default	No data available	1	10	0.5

Table 134 – Observed Condition Input – LV Pole: Bird/Animal Damage

Condition Criteria: bird/animal damage?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	There is no animal damage	1.0	10	0.5
Yes	There is animal damage	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.28 LV Main OHL Conductor (Pole Lines)

Table 135 – Observed Condition Input – LV Main OHL Conductor (Pole Lines): Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No damage	No observed damage	1.0	10	0.5
Damaged	Conductor shows sign of damage and / or Insulation is damaged and exposing the conductor underneath	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 136 – Observed Condition Input – LV Main OHL Conductor (Pole Lines): Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.0	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.1	10	0.5
>2	More than two joints in the span	1.2	10	5.5
Default	No data available	1.0	10	0.5

B.5.29 HV Poles

Table 137 – Observed Condition Input – HV Pole: Visual Pole Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	No significant defects observed. Pole may be new with no/few marks. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole. For “effectively” strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the poles in this condition are Acceptable.	1.0	10	0.5
Some deterioration	Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	4.0
Substantial deterioration	Severe damage to pole. Parts may be chipped off, rotten or disfigured. E.g. visible splits, cracks, major physical damage affecting strength.	1.8	10	8.0
Default	No data available	1.0	10	0.5

* For strengthened poles, consideration should be given to the location on the pole of any identified defect. For example, physical damage at the ground line that is mitigated by the system itself may be disregarded, and the visual assessment applied to the remainder of the pole.

Table 138 – Observed Condition Input – HV Pole: Pole Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	1.0	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Some deterioration	Partial Loss of required Structural Integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 139 – Observed Condition Input – HV Pole: Visual Pole Condition: Pole Top Rot

Condition Criteria: Significant pole top rot	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	No significant pole top rot observed	1.0	10	0.5
Yes (suspect)	Pole top is suspected but not confirmed	1.2	10	5.5
Yes (confirmed)	Significant pole top rot is observed	1.3	10	8
Default	No data available	1.0	10	0.5

Table 140 – Observed Condition Input – HV Pole: Pole Leaning

Condition Criteria: pole leaning?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	The pole is vertical	1.0	10	0.5
Yes	The pole is not vertical	1.2	10	0.5
Default	No data available	1.0	10	0.5

Table 141 – Observed Condition Input – HV Pole: Bird/Animal Damage

Condition Criteria: bird/animal damage?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	There is no animal damage	1.0	10	0.5
Yes	There is animal damage	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.30 HV OHL Conductor (Pole Lines)

Table 142 – Observed Condition Input – HV OHL Conductor (Pole Lines): Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No damage	No observed damage	1.0	10	0.5
Damaged	Conductor shows sign of damage and / or Insulation is damaged and exposing the conductor underneath	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 143 – Observed Condition Input – HV OHL Conductor (Pole Lines): Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.0	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.1	10	0.5
>2	More than two joints in the span	1.2	10	5.5
Default	No data available	1.0	10	0.5

B.5.31 EHV Poles

Table 144 – Observed Condition Input – EHV Pole: Visual Pole Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	No significant defects observed. Pole may be new with no/few marks. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole. For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the poles in this condition are Acceptable.	1.0	10	0.5
Some deterioration	Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	4.0
Substantial deterioration	Severe damage to pole. Parts may be chipped off, rotten or disfigured. e.g. visible splits, cracks, major physical damage affecting strength.	1.8	10	8.0
Default	No data available	1.0	10	0.5

* For strengthened poles, consideration should be given to the location on the pole of any identified defect. For example, physical damage at the ground line that is mitigated by the system itself may be disregarded, and the visual assessment applied to the remainder of the pole.

Table 145 – Observed Condition Input – EHV Pole: Pole Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	1.0	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial Loss of required Structural Integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 146 – Observed Condition Input – EHV Pole: Pole Top Rot

Condition Criteria: Significant pole top rot	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	No significant pole top rot observed	1.0	10	0.5
Yes (suspect)	Pole top rot is suspected but not confirmed	1.2	10	5.5
Yes (confirmed)	Significant pole top rot is observed	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 147 – Observed Condition Input – EHV Pole: Pole Leaning

Condition Criteria: pole leaning?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	The pole is vertical	1.0	10	0.5
Yes	The pole is not vertical	1.2	10	0.5
Default	No data available	1.0	10	0.5

Table 148 – Observed Condition Input – EHV Pole: Bird / Animal Damage

Condition Criteria: bird/animal damage?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	There is no animal damage	1.0	10	0.5
Yes	There is animal damage	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.32 EHV OHL Conductor (Pole Lines)

Table 149 – Observed Condition Input – EHV OHL Conductor (Pole Lines): Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No damage	No observed damage	1.0	10	0.5
Damaged	Conductor shows sign of damage and / or Insulation is damaged and exposing the conductor underneath	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 150 – Observed Condition Input – EHV OHL Conductor (Pole Lines): Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.0	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.1	10	0.5
>2	More than two joints in the span	1.2	10	5.5
Default	No data available	1.0	10	0.5

B.5.33 132kV Poles

Table 151 – Observed Condition Input – 132kV Pole: Visual Pole Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	No significant defects observed. Pole may be new with no/few marks. May include poles with slight damage including (but not limited to) splits and general wear where no material impact on residual strength of pole. For “effectively” strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the poles in this condition are Acceptable.	1.0	10	0.5
Some deterioration	Minor wear on pole or physical damage that will lead to loss of strength, but the short-term integrity of the pole is not compromised.	1.3	10	4.0
Substantial deterioration	Severe damage to pole. Parts may be chipped off, rotten or disfigured. e.g. visible splits, cracks, major physical damage affecting strength.	1.8	10	8.0
Default	No data available	1.0	10	0.5

* For strengthened poles, consideration should be given to the location on the pole of any identified defect. For example, physical damage at the ground line that is mitigated by the system itself may be disregarded, and the visual assessment applied to the remainder of the pole.

Table 152 – Observed Condition Input – 132 kV Pole: Pole Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	1.0	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial Loss of required Structural Integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 153 – Observed Condition Input – 132 kV Pole: Pole Top Rot

Condition Criteria: Significant pole top rot	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	No significant pole top rot observed	1.0	10	0.5
Yes (suspect)	Pole top rot is suspected but not confirmed	1.2	10	5.5
Yes (confirmed)	Significant pole top rot is observed	1.3	10	8.0
Default	No data available	1.0	10	0.5

Table 154 – Observed Condition Input – 132 kV Pole: Pole Leaning

Condition Criteria: pole leaning?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	The pole is vertical	1.0	10	0.5
Yes	The pole is not vertical	1.2	10	0.5
Default	No data available	1.0	10	0.5

Table 155 – Observed Condition Input – 132 kV Pole: Bird / Animal Damage

Condition Criteria: bird/animal damage?	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No	There is no animal damage	1.0	10	0.5
Yes	There is animal damage	1.3	10	0.5
Default	No data available	1.0	10	0.5

B.5.34 132 kV OHL Conductor (Pole Lines)

Table 156 – Observed Condition Input – 132 kV OHL Conductor (Pole Lines): Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No damage	No observed damage	1.0	10	0.5
Damaged	Conductor shows sign of damage and / or Insulation is damaged and exposing the conductor underneath	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 157 – Observed Condition Input – 132 kV OHL Conductor (Pole Lines): Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.0	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.1	10	0.5
>2	More than two joints in the span	1.2	10	5.5
Default	No data available	1.0	10	0.5

B.5.35 EHV Towers (Tower Steelwork component)

Table 158 – Observed Condition Input – EHV Tower: Tower Legs

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.8	10	8
Default	No data available	1.0	4.4	0.5

Table 159 – Observed Condition Input – EHV Tower: Bracings

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically Unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.2	10	5.5
Default	No data available	1.0	4.4	0.5

Table 160 – Observed Condition Input – EHV Tower: Crossarms

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically Unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.8	10	8
Default	No data available	1.0	4.4	0.5

Table 161 – Observed Condition Input – EHV Tower: Peak

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically Unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.2	10	5.5
Default	No data available	1.0	4.4	0.5

B.5.36 Towers (Tower Paintwork component)

Table 162 – Observed Condition Input – EHV Tower: Paintwork Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration		1.0	6.4	0.5
Superficial/minor deterioration	Slight rust breakthrough - up to 5% of surface area affected.	1.1	6.4	0.5
Some Deterioration	Moderate rust breakthrough - between 5% and 20% of surface area affected, and/or pitted rust	1.6	6.4	0.5
Substantial Deterioration	Severe rust breakthrough - more than 20% of surface area affected, AND/OR damaged or bent steelwork, AND/OR any blistered paintwork with evidence of severe rust underneath, painting/attention required urgently.	1.8	6.4	5.5
Default	No data available	1.0	6.4	0.5

B.5.37 EHV Towers (Tower Foundation component)

Table 163 – Observed Condition Input - EHV Tower: Foundation Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	4.4	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	4.4	0.5
Some deterioration	e.g. minor corrosion	1.4	10	4.0
Substantial deterioration	Insufficient integrity to support tower loading	1.8	10	8.0
Default	No data available	1.0	4.4	0.5

B.5.38 132 kV Towers (Tower steelwork component)

Table 164 – Observed Condition Input – 132 kV Tower: Tower Legs

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.8	10	8
Default	No data available	1.0	4.4	0.5

Table 165 – Observed Condition Input – 132 kV Tower: Bracings

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.2	10	5.5
Default	No data available	1.0	4.4	0.5

Table 166 – Observed Condition Input – 132 kV Tower: Crossarms

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.8	10	8
Default	No data available	1.0	4.4	0.5

Table 167 – Observed Condition Input – 132 kV Tower: Peak

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable		1.0	4.4	0.5
Mechanically unsafe	Signs of wasting of steel cross-section, laminated rust, holes or loss of steel at edges, severe damage - requires urgent replacement	1.2	10	5.5
Default	No data available	1.0	4.4	0.5

B.5.39 132 kV Towers (Tower Paintwork component)

Table 168 – Observed Condition Input – 132 kV Tower: Paintwork Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration		1.0	6.4	0.5
Superficial/minor deterioration	Slight rust breakthrough - up to 5% of surface area affected.	1.1	6.4	0.5
Some deterioration	Moderate rust breakthrough - between 5% and 20% of surface area affected, and/or pitted rust	1.6	6.4	0.5
Substantial deterioration	Severe rust breakthrough - more than 20% of surface area affected, AND/OR damaged or bent steelwork, AND/OR any blistered paintwork with evidence of severe rust underneath, painting/attention required urgently.	1.8	6.4	5.5
Default	No data available	1.0	6.4	0.5

B.5.40 132 kV Towers (Tower Foundation component)

Table 169 – Observed Condition Input – 132 kV Tower: Foundation Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.95	4.4	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.0	4.4	0.5
Some deterioration	e.g. minor corrosion	1.4	10	4.0
Substantial deterioration	Insufficient integrity to support tower loading	1.8	10	8.0
Default	No data available	1.0	4.4	0.5

B.5.41 EHV Fittings

Table 170 – Observed Condition Input – EHV Fittings: Tower Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required structural integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 171 – Observed Condition Input – EHV Fittings: Conductor Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required Structural Integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 172 – Observed Condition Input – EHV Fittings: Insulators - Electrical Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required electrical Integrity	1.3	10	4.0
Substantial deterioration	Loss of required electrical integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 173 – Observed Condition Input – EHV Fittings: Insulators - Mechanical Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required structural integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

B.5.42 132 kV Fittings

Table 174 – Observed Condition Input – 132 kV Fittings: Tower Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required structural integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 175 – Observed Condition Input – 132 kV Fittings: Conductor Fittings Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required structural integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 176 – Observed Condition Input – 132 kV Fittings: Insulators - Electrical Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required electrical integrity	1.3	10	4.0
Substantial deterioration	Loss of required electrical integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 177 – Observed Condition Input – 132 kV Fittings: Insulators - Mechanical Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	Partial loss of required structural integrity	1.3	10	4.0
Substantial deterioration	Loss of required structural integrity	1.4	10	8.0
Default	No data available	1.0	10	0.5

B.5.43 EHV Tower Line Conductor

Table 178 – Observed Condition Input – EHV Tower Line Conductor: Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	e.g. minor corrosion	1.3	10	4.0
Substantial deterioration	e.g. bird caging, broken strands, loss of section	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 179 – Observed Condition Input – EHV Tower Line Conductor: Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.0	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.1	10	0.5
>2	More than two joints in the span	1.2	10	5.5
Default	No data available	1.0	10	0.5

B.5.44 132 kV Tower Line Conductor

Table 180 – Observed Condition Input – 132 kV Tower Line Conductor: Visual Condition

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No deterioration	No observed deterioration	0.9	10	0.5
Superficial/minor deterioration	The asset component is fit for continued service. There is little deterioration	1.1	10	0.5
Some deterioration	e.g. minor corrosion	1.3	10	4.0

Condition Criteria: Observed Condition	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Substantial deterioration	e.g. bird caging, broken strands, loss of section	1.4	10	8.0
Default	No data available	1.0	10	0.5

Table 181 – Observed Condition Input – 132 kV Tower Line Conductor: Midspan Joints

Condition Criteria: No. of midspan joints	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
0	No joints in the span. A span includes all conductors in that span	1.00	10	0.5
1	1 joint in the span	1.05	10	0.5
2	2 joints in the span	1.10	10	0.5
>2	More than two joints in the span	1.20	10	5.5
Default	No data available	1.00	10	0.5

B.6 Measured Condition Factors

B.6.1 Overview

The following calibration tables shall be used to determine the value of each Measured Condition Input for individual assets.

The Measured Condition Inputs consist of three elements.

a) A Condition Input Factor, which is used in the derivation of the Measured Condition Factor;

b) A Condition Input Cap, which specifies a Health Score value that is used in the derivation of the Measured Condition Cap;

c) A Condition Input Collar, which specifies a Health Score value that is used in the derivation of the Measured Condition Collar.

The use of Measured Condition Inputs to create the Measured Condition Modifier is described in Section 7.11.

DNOs shall map their own observed condition data to the criteria shown in these calibration tables, in order to determine the appropriate values for each of the Measured Condition Inputs.

Where no data is available the default values for the Measured Condition Inputs shall be applied.

B.6.2 Battery System

Table 182 – Measured Condition Input – Battery System: Batteries load test

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	No observed deterioration	1.0	10	0.5
Fail	Failed load/discharge test	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 183 – Measured Condition Input – Battery System: Batteries impedance test

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	No observed deterioration	1.0	10	0.5
Fail	Failed impedance test	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 184 – Measured Condition Input – Battery System: Batteries specific gravity test

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	No observed deterioration	1.0	10	0.5
Fail	Failed specific gravity test	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 185 – Measured Condition Input – Battery System: Chargers Low/No Output

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Rated output achieved or in the case where rated output is not achieved, the battery function is still maintained	1.0	10	0.5
Fail	Low/No Output	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.3 LV UGB

Table 186 – Measured Condition Input – LV UGB: Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The LV UGB can be operated safely	1.0	10	0.5
Inoperable	The LV UGB cannot be operated or repaired	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.4 LV Circuit Breaker

Table 187 – Measured Condition Input – LV Circuit Breaker: Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Acceptable	The device can be operated safely	1.0	10	0.5
Unacceptable	The device cannot be operated safely	1.6	10	8.0
Default	No data available	1.0	10	0.5

B.6.5 LV Board (WM)

Table 188 – Measured Condition Input – LV Board (WM): Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The LV board can be operated safely	1.0	10	0.5
Inoperable - secure	The LV board cannot be operated but is physically secure	1.3	10	4.0
Inoperable - hazardous	The LV board cannot be operated and presents a hazard to either operator, the public or both	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.6 LV Pillar

Table 189 – Measured Condition Input – LV Pillar: Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The LV pillar can be operated safely	1.0	10	0.5
Inoperable - secure	The LV pillar cannot be operated but is physically secure	1.3	10	4.0
Inoperable - hazardous	The LV pillar cannot be operated and presents a hazard to either operator, the public or both	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.7 HV Switchgear (PM)

Table 190 – Measured Condition Input – HV Switchgear (PM): Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The device can be operated safely	1.0	10	0.5
Inoperable	The device cannot be operated safely	1.6	10	8.0
Default	No data available	1.0	10	0.5

B.6.8 HV Switchgear (GM) - Distribution

Table 191 – Measured Condition Input – HV Switchgear (GM) - Distribution: Partial Discharge

Condition Criteria: partial discharge test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 192 – Measured Condition Input – HV Switchgear (GM) - Distribution: Ductor Test

Condition Criteria: Ductor test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The joint test result meets the manufacturer's recommended value	1	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1	10	0.5

Table 193 – Measured Condition Input – HV Switchgear (GM) – Distribution: Oil Tests

Condition Criteria: oil test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The oil test result meets the required European Standard for new oil	1.0	10	0.5
Up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 194 – Measured Condition Input – HV Switchgear (GM) – Distribution: Temperature Readings

Condition Criteria: Temperature Readings	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 195 – Measured Condition Input – HV Switchgear (GM) - Distribution: Trip Test

Condition Criteria: trip timing test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Trip time within acceptable range for the type of switchgear	1.0	10	0.5
Fail	Trip time slower than acceptable time for the type of switchgear	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.6.9 HV Switchgear (GM) – Primary

Table 196 – Measured Condition Input – HV Switchgear (GM) – Primary: Partial Discharge

Condition Criteria: partial discharge test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 197 – Measured Condition Input – HV Switchgear (GM) – Primary: Ductor Test

Condition Criteria: Ductor test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As New	The joint test result meets the manufacturer's recommended value	1.0	10	0.5
Up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 198 – Measured Condition Input – HV Switchgear (GM) – Primary: IR Test

Condition Criteria: IR test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The insulation test result meets the manufacturer's recommended value	1.0	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 199 – Measured Condition Input – HV Switchgear (GM) – Primary: Oil Tests

Condition Criteria: oil test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The oil test result meets the required European Standard for new oil	1.0	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 200 – Measured Condition Input – HV Switchgear (GM) – Primary: Temperature Readings

Condition Criteria: temperature readings	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 201 – Measured Condition Input – HV Switchgear (GM) – Primary: Trip Test

Condition Criteria: Trip Timing Test Result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Trip time within acceptable range for the type of switchgear	1.0	10	0.5
Fail	Trip time slower than acceptable time for the type of switchgear	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.6.10 EHV Switchgear (PM)

Table 202 – Measured Condition Input – HV Switchgear (PM): Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The device can be operated safely	1.0	10	0.5
Inoperable	The device cannot be operated safely	1.6	10	8.0
Default	No data available	1.0	10	0.5

B.6.11 EHV Switchgear (GM)

Table 203 – Measured Condition Input – EHV Switchgear (GM): Partial Discharge

Condition Criteria: partial discharge test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 204 – Measured Condition Input – EHV Switchgear (GM): Ductor Test

Condition Criteria: Ductor test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The joint test result meets the manufacturer's recommended value	1.0	10	0.5
Up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 205 – Measured Condition Input – EHV Switchgear (GM): IR Test

Condition Criteria: IR test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The insulation test result meets the manufacturer's recommended value	1.0	10	0.5
Up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 206 – Measured Condition Input – EHV Switchgear (GM): Oil Tests / Gas Tests

Condition Criteria: oil test/ gas test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The oil or gas test result meets the required European Standard for new oil or gas	1.0	10	0.5
Up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 207 – Measured Condition Input – EHV Switchgear (GM): Temperature Readings

Condition Criteria: temperature readings	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 208 – Measured Condition Input – EHV Switchgear (GM): Trip Test

Condition Criteria: trip timing test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Trip time within acceptable range for the type of switchgear	1.0	10	0.5
Fail	Trip time slower than acceptable time for the type of switchgear	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.6.12 EHV Switchgear (other)

Table 209 – Measured Condition Input – EHV Switchgear (other): Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The device can be operated safely	1.0	10	0.5
Inoperable	The device cannot be operated safely	1.6	10	8.0
Default	No data available	1.0	10	0.5

B.6.13 132 kV Switchgear (GM)

Table 210 – Measured Condition Input – 132 kV Switchgear (GM): Partial Discharge

Condition Criteria: partial discharge test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 211 – Measured Condition Input – 132 kV Switchgear (GM): Ductor Test

Condition Criteria: Ductor test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The joint test result meets the manufacturer's recommended value	1.0	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 212 – Measured Condition Input – 132 kV Switchgear (GM): IR Test

Condition Criteria: IR test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The insulation test result meets the manufacturer's recommended value	1.0	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 213 – Measured Condition Input – 132 kV Switchgear (GM): Oil Tests / Gas Tests

Condition Criteria: oil test/ gas test results	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
As new	The oil or gas test result meets the required European Standard for new oil or gas	1.0	10	0.5
up to 10% deterioration from new	Up to 10% deterioration from the 'As New' condition	1.1	10	0.5
> 10% deterioration from new	Over 10% deterioration from the 'As New' condition	1.3	10	0.5
Default	No data available	1.0	10	0.5

Table 214 – Measured Condition Input – 132 kV Switchgear (GM): Temperature Readings

Condition Criteria: temperature readings	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Ambient or below	At or below ambient temperature	0.9	10	0.5
Above ambient	Above ambient temperature	1.0	10	0.5
Substantially above ambient	Operating above the manufacturer's recommended maximum temperature	1.1	10	0.5
Default	No data available	1.0	10	0.5

Table 215 – Measured Condition Input – 132 kV Switchgear (GM): Trip Test

Condition Criteria: trip timing test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Trip time within acceptable range for the type of switchgear	1.0	10	0.5
Fail	Trip time slower than acceptable time for the type of switchgear	1.4	10	0.5
Default	No data available	1.0	10	0.5

B.6.14 132 kV Switchgear (other)

Table 216 – Measured Condition Input – 132 kV Switchgear (other): Operational Adequacy

Condition Criteria: Operational Adequacy	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Operable	The device can be operated safely	1.0	10	0.5
Inoperable	The device cannot be operated safely	1.6	10	8.0
Default	No data available	1.0	10	0.5

B.6.15 HV Transformer (GM)

Table 217 – Measured Condition Input – HV Transformer (GM): Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 218 – Measured Condition Input – HV Transformer (GM): Temperature Readings

Condition Criteria: temperature reading	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Normal	Normally expected temperature for transformer loading	1.0	10	0.5
Moderately High	Slightly above normally expected temperature for transformer loading	1.2	10	0.5
Very High	Significantly above normally expected temperature for transformer loading	1.4	10	5.5
Default	No data available	1.0	10	0.5

B.6.16 EHV Transformer (GM) (Main Transformer Component)

Table 219 – Measured Condition Input – EHV Transformer (GM): Main Transformer Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturer's recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturer's recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturer's recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 220 – Measured Condition Input – EHV Transformer (GM): Temperature Readings

Condition Criteria: temperature reading	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Normal	Normally expected temperature for transformer loading	1.0	10	0.5
Moderately high	Slightly above normally expected temperature for transformer loading	1.2	10	0.5
Very high	Significantly above normally expected temperature for transformer loading	1.4	10	5.5
Default	No data available	1.0	10	0.5

B.6.17 EHV Transformer (GM) (Tapchanger component)

Table 221 – Measured Condition Input - EHV Transformer (GM): Tapchanger Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturers recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. ‘Amber’ result from TEV measuring device or between 10% and 30% of the manufacturers recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. ‘Red’ result from TEV measuring device or above manufacturers recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.18 132 kV Transformer (GM) (Main Transformer Component)

Table 222 – Measured Condition Input – 132 kV Transformer (GM): Main Transformer Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturers recommendation	1	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturers recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturers recommendation)	1.3	10	5.5
High (confirmed)	High partial discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

Table 223 – Measured Condition Input – 132 kV Transformer (GM): Temperature Readings

Condition Criteria: Temperature Reading	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Normal	Normally expected temperature for transformer loading	1.0	10	0.5
Moderately high	Slightly above normally expected temperature for transformer loading	1.2	10	0.5
Very high	Significantly above normally expected temperature for transformer loading	1.4	10	5.5
Default	No data available	1.0	10	0.5

B.6.19 132 kV Transformer (GM) (Tapchanger component)

Table 224 – Measured Condition Input – 132 kV Transformer (GM): Tapchanger Partial Discharge

Condition Criteria: Partial Discharge Test Result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Low or negligible levels of partial discharge indicating no issues identified (e.g. a green condition using a TEV or <10% of manufacturers recommendation	1.0	10	0.5
Medium	Some moderate levels of partial discharge recorded (e.g. 'Amber' result from TEV measuring device or between 10% and 30% of the manufacturers recommendation)	1.1	10	0.5
High (not confirmed)	High levels of partial discharge indicating possible defect with plant / equipment, requiring further investigation (e.g. 'Red' result from TEV measuring device or above manufacturers recommendation)	1.3	10	5.5
High (confirmed)	High Partial Discharge. Source of partial discharge confirmed as potential source of failure	1.5	10	8.0
Default	No data available	1.0	10	0.5

B.6.20 EHV Cable (Non Pressurised)

Table 225 – Measured Condition Input – EHV Cable (Non Pressurised): Sheath Test

Condition Criteria: sheath test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Satisfactory	1.0	10	0.5
Failed minor	Failure requiring minor repair	1.3	10	0.5
Failed major	Unacceptable sheath leakage or condition	1.6	10	5.5
Default	No data available	1.0	10	0.5

Table 226 – Measured Condition Input – EHV Cable (Non Pressurised): Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No unusual activity detected	1.00	10	0.5
Medium	PD detected requiring regular monitoring	1.15	10	0.5
High	Intervention required	1.50	10	5.5
Default	No data available	1.00	10	0.5

Table 227 – Measured Condition Input – EHV Cable (Non Pressurised): Fault History

Condition Criteria: fault rate (faults per annum)	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No historic faults recorded	No recorded faults or failures in the period	1.0	5.4	0.5
<0.01 per km	The calculated fault rate for the asset in the period	1.3	10.0	0.5
≥0.01 and <0.1 per km		1.6	10.0	5.5
≥0.1 per km		1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

B.6.21 EHV Cable (Oil)

Table 228 – Measured Condition Input – EHV Cable (Oil): Leakage

Condition Criteria: leakage rate	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No (or very low) historic leakage recorded	No or negligible levels of leakage	1.0	10	0.5
Low/ moderate	Requires occasional intervention to maintain pressure	1.3	10	0.5
High	Requires regular intervention to maintain pressure	1.8	10	5.5
Very high	Requires intervention at the point of oil loss	2.0	10	8.0
Default	No data available	1.0	10	0.5

B.6.22 EHV Cable (Gas)

Table 229 – Measured Condition Input – EHV Cable (Gas): Leakage

Condition Criteria: leakage rate	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No (or very low) historic leakage recorded	No or negligible levels of leakage	1.0	10	0.5
Low/ moderate	Requires occasional intervention to maintain pressure	1.3	10	0.5
High	Requires regular intervention to maintain pressure	1.8	10	5.5
Very High	Requires intervention at the point of gas loss	2.0	10	8.0
Default	No data available	1.0	10	0.5

B.6.23 132 kV Cable (Non Pressurised)

Table 230 – Measured Condition Input – 132 kV Cable (Non Pressurised): Sheath Test

Condition Criteria: sheath test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Satisfactory	1.0	10	0.5
Failed minor	Failure requiring minor repair	1.3	10	0.5
Failed major	Unacceptable sheath leakage or condition	1.6	10	5.5
Default	No data available	1.0	10	0.5

Table 231 – Measured Condition Input – 132 kV Cable (Non Pressurised): Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No unusual activity detected	1.00	10	0.5
Medium	PD detected requiring regular monitoring	1.15	10	0.5
High	Intervention required	1.50	10	5.5
Default	No data available	1.00	10	0.5

Table 232 – Measured Condition Input - 132 kV Cable (Non Pressurised): Fault History

Condition Criteria: fault rate (faults per annum)	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No historic faults recorded	No recorded faults or failures in the period	1.0	5.4	0.5
<0.01 per km	The calculated fault rate for the asset in the period	1.3	10	0.5
≥0.01 and <0.1 per km		1.6	10	5.5
≥0.1 per km		1.8	10	8.0
Default	No data available	1.0	10	0.5

B.6.24 132 kV Cable (Oil)

Table 233 – Measured Condition Input – 132 kV Cable (Oil): Leakage

Condition Criteria: leakage rate	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No (or very low) historic leakage recorded	No or negligible levels of leakage	1.0	10	0.5
Low/moderate	Requires occasional intervention to maintain pressure	1.3	10	0.5
High	Requires regular intervention to maintain pressure	1.8	10	5.5
Very High	Requires intervention at the point of oil loss	2.0	10	8.0
Default	No data available	1.0	10	0.5

B.6.25 132 kV Cable (Gas)

Table 234 – Measured Condition Input – 132 kV Cable (Gas): Leakage

Condition Criteria: leakage rate	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No (or very low) historic leakage recorded	No or negligible levels of leakage	1.0	10	0.5
Low/ moderate	Requires occasional intervention to maintain pressure	1.3	10	0.5
High	Requires regular intervention to maintain pressure	1.8	10	5.5
Very high	Requires intervention at the point of gas loss	2.0	10	8.0
Default	No data available	1.0	10	0.5

B.6.26 Sub Cable

Table 235 – Measured Condition Input – Sub Cable: Sheath Test

Condition Criteria: sheath test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Pass	Satisfactory	1.0	10	0.5
Failed minor	Failure requiring minor repair	1.3	10	0.5
Failed major	Unacceptable sheath leakage or condition	1.6	10	5.5
Default	No data available	1.0	10	0.5

Table 236 – Measured Condition Input – Sub Cable: Partial Discharge

Condition Criteria: partial discharge test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No unusual activity detected	1.0	10	0.5
Medium	PD detected requiring regular monitoring	1.15	10	0.5
High	Intervention required	1.5	10	5.5
Default	No data available	1.0	10	0.5

Table 237 – Measured Condition Input – Sub Cable: Fault History

Condition Criteria: fault rate (faults per annum)	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
No historic faults recorded	No recorded faults or failures in the period	1.0	5.4	0.5
<0.01 per km	The calculated fault rate for the asset in the period	1.3	10.0	0.5
≥0.01 and <0.1 per km		1.6	10.0	5.5
≥0.1 per km		1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

B.6.27 LV Poles

Table 238 – Measured Condition Input – LV Pole: Pole Decay / Deterioration

Condition Criteria: degree of decay/ deterioration	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None	Zero measured loss of strength	0.8	5.4	0.5
No significant decay/deterioration	Minor loss of strength For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the pole has no significant deterioration.	1.0	6.4	0.5
High	Significant loss of residual strength, still within acceptable level	1.4	10.0	5.5
Very high	Residual strength below acceptable level	1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

* For strengthened poles, consideration should be given to the residual strength of the remainder of the wood pole

B.6.28 HV Poles

Table 239 – Measured Condition Input – HV Pole: Pole Decay / Deterioration

Condition Criteria: degree of decay/ deterioration	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None	Zero measured loss of strength	0.8	5.4	0.5
No significant decay/deterioration	Minor loss of strength For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the pole has no significant deterioration.	1.0	6.4	0.5
High	Significant loss of residual strength, still within acceptable level	1.4	10.0	5.5
Very high	Residual strength below acceptable level	1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

* For strengthened poles, consideration should be given to the residual strength of the remainder of the wood pole

B.6.29 EHV Poles

Table 240 – Measured Condition Input – EHV Pole: Pole Decay / Deterioration

Condition Criteria: degree of decay/ deterioration	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None	Zero measured loss of strength	0.8	5.4	0.5
No significant decay/deterioration	Minor loss of strength For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the pole has no significant deterioration.	1.0	6.4	0.5
High	Significant loss of residual strength, still within acceptable level	1.4	10.0	5.5
Very high	Residual strength below acceptable level	1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

* For strengthened poles, consideration should be given to the residual strength of the remainder of the wood pole

B.6.30 EHV Fittings

Table 241 – Measured Condition Input – EHV Fittings: Thermal Imaging

Condition Criteria: thermal imaging result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Ambient plus or minus 10^0C	1.0	5.4	0.5
Medium	Ambient plus 10 - 25^0C	1.1	10.0	0.5
High	Ambient plus more than 25^0C	1.4	10.0	5.5
Default	No data available	1.0	10.0	0.5

Table 242 – Measured Condition Input – EHV Fittings: Ductor Test

Condition Criteria: Ductor test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	As commissioned or up to 2.5% variance	1.0	5.4	0.5
Medium	As commissioned or up to 5% variance	1.1	10.0	0.5
High	As commissioned or over 5% variance	1.4	10.0	5.5
Default	No data available	1.0	10.0	0.5

B.6.31 132 kV Poles

Table 243 – Measured Condition Input – 132 kV Pole: Pole Decay / Deterioration

Condition Criteria: degree of decay/deterioration	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
None	Zero measured loss of strength	0.8	5.4	0.5
No significant decay/deterioration	Minor loss of strength For "effectively" strengthened poles the installed pole truss allows the bending loads to effectively bypass the decayed or damaged ground line area of the pole, transferring the loads to sound wood foundation below ground line. It can therefore be assumed that the pole has no significant deterioration.	1.0	6.4	0.5
High	Significant loss of residual strength, still within acceptable level	1.4	10.0	5.5
Very high	Residual strength below acceptable level	1.8	10.0	8.0
Default	No data available	1.0	10.0	0.5

* For strengthened poles, consideration should be given to the residual strength of the remainder of the wood pole

B.6.32 132 kV Fittings

Table 244 – Measured Condition Input – 132 kV Fittings: Thermal Imaging

Condition Criteria: thermal imaging result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	Ambient plus or minus 10^{0}C	1.0	5.4	0.5
Medium	Ambient plus 10 - 25^{0}C	1.1	10.0	0.5
High	Ambient plus more than 25^{0}C	1.4	10.0	5.5
Default	No data available	1.0	10.0	0.5

Table 245 – Measured Condition Input – 132 kV Fittings: Ductor Test

Condition Criteria: Ductor test result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	As commissioned or up to 2.5% variance	1.0	5.4	0.5
Medium	As commissioned or up to 5% variance	1.1	10.0	0.5
High	As commissioned or over 5% variance	1.4	10.0	5.5
Default	No data available	1.0	10.0	0.5

B.6.33 Pole Line Conductor

Table 246 – Measured Condition Input – Pole Line Conductor: Conductor Sampling

Condition Criteria: conductor sampling result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No obvious or minor deterioration	1.0	5.4	0.5
Medium/normal	Wear is consistent with the duty and environment of the circuit	1.1	10.0	3.0
High	Wear indicated that an end of life condition exists	1.4	10.0	8.0
Default	No data available	1.0	10.0	0.5

B.6.34 EHV Tower Line Conductor

Table 247 – Measured Condition Input – EHV Tower Line Conductor: Conductor Sampling

Condition Criteria: conductor sampling result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No obvious or minor deterioration	1.0	5.4	0.5
Medium/normal	Wear is consistent with the duty and environment of the circuit	1.1	10.0	3.0
High	Wear indicated that an end of life condition exists	1.4	10.0	8.0
Default	No data available	1.0	10.0	0.5

Table 248 – Measured Condition Input – EHV Tower Line Conductor: Corrosion Monitoring Survey

Condition Criteria: corrosion monitoring survey result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No obvious or minor deterioration	1.0	5.4	0.5
Medium/normal	Wear is consistent with the duty and environment of the circuit	1.1	10.0	3.0
High	Wear indicated that an end of life condition exists	1.4	10.0	8.0
Default	No data available	1.0	10.0	0.5

B.6.35 132 kV Tower Line Conductor

Table 249 – Measured Condition Input – 132 kV Tower Line Conductor: Conductor Sampling

Condition Criteria: conductor sampling result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No obvious or minor deterioration	1.0	5.4	0.5
Medium/normal	Wear is consistent with the duty and environment of the circuit	1.1	10.0	3.0
High	Wear indicated that an end of life condition exists	1.4	10.0	8.0
Default	No data available	1.0	10.0	0.5

Table 250 – Measured Condition Input – 132 kV Tower Line Conductor: Corrosion Monitoring Survey

Condition Criteria: corrosion monitoring survey result	Description	Condition Input Factor	Condition Input Cap	Condition Input Collar
Low	No obvious or minor deterioration	1.0	5.4	0.5
Medium/normal	Wear is consistent with the duty and environment of the circuit	1.1	10.0	3.0
High	Wear indicated that an end of life condition exists	1.4	10.0	8.0
Default	No data available	1.0	10.0	0.5

B.7 Oil Test Modifier

Table 251 – Moisture condition state calibration

Oil Type	HV transformer (GM) EHV transformer (GM)			132 kV Transformer (GM)		
	> Moisture (ppm)	<= Moisture (ppm)	Moisture Score	> Moisture (ppm)	<= Moisture (ppm)	Moisture score
Mineral Oil (Default)	-0.01	15.00	0	-0.01	15.00	0
	15.00	30.00	2	15.00	20.00	2
	30.00	40.00	4	20.00	30.00	4
	40.00	50.00	8	30.00	40.00	8
	50.00	10 000.00	10	40.00	10 000.00	10
Synthetic Ester	-0.01	100.00	0	-0.01	50.00	0
	100.00	200.00	2	50.00	150.00	2
	200.00	400.00	4	150.00	350.00	4
	400.00	500.00	8	350.00	450.00	8
	500.00	10 000.00	10	450.00	10 000.00	10
Natural Ester	-0.01	100.00	0	-0.01	50.00	0
	100.00	200.00	2	50.00	150.00	2
	200.00	400.00	4	150.00	350.00	4
	400.00	500.00	8	350.00	450.00	8
	500.00	10 000.00	10	450.00	10 000.00	10

Table 252 – Acidity Condition State Calibration

Oil Type	HV transformer (GM)			EHV transformer (GM)			132 kV Transformer (GM)		
	> Acidity (mg KOH/g)	<= Acidity (mg KOH/g)	Acidity score	> Acidity (mg KOH/g)	<= Acidity (mg KOH/g)	Acidity score	> Acidity (mg KOH/g)	<= Acidity (mg KOH/g)	Acidity score
Mineral Oil (Default)	-0.01	0.10	0	-0.01	0.10	0	-0.01	0.05	0
	0.1	0.15	2	0.10	0.15	2	0.05	0.10	2
	0.15	0.30	4	0.15	0.30	4	0.10	0.20	4
	0.30	0.50	8	0.30	0.40	8	0.20	0.30	8
	0.50	10 000.00	10	0.40	10 000.00	10	0.30	10 000.00	10
Synthetic Ester	-0.01	0.30	0	-0.01	0.30	0	-0.01	0.30	0
	0.30	0.50	2	0.30	0.50	2	0.30	0.50	2
	0.50	1.00	4	0.50	1.00	4	0.50	1.00	4
	1.00	1.50	8	1.00	1.30	8	1.00	1.20	8
	1.50	10 000.00	10	1.30	10 000.00	10	1.20	10 000.00	10
Natural Ester	-0.01	0.15	0	-0.01	0.15	0	-0.01	0.15	0
	0.15	0.30	2	0.15	0.30	2	0.15	0.30	2
	0.30	0.50	4	0.30	0.50	4	0.30	0.50	4
	0.50	1.00	8	0.50	0.80	8	0.50	0.70	8
	1.00	10 000.00	10	0.80	10 000.00	10	0.70	10 000.00	10

Table 253 – Breakdown Strength Condition State Calibration

Oil Type	HV transformer (GM) EHV transformer (GM)			132 kV Transformer (GM)		
	> BD strength (kV)	<= BD strength (kV)	BD strength score	> BD strength (kV)	<= BD strength (kV)	BD strength score
Mineral Oil / Synthetic Ester / Natural Ester	-0.01	30.00	10	-0.01	40.00	10
	30.00	40.00	4	40.00	50.00	4
	40.00	50.00	2	50.00	60.00	2
	50.00	10 000.00	0	60.00	10 000.00	0

Table 254 – Oil Test Factor Calibration

HV transformer (GM)			EHV transformer (GM) 132 kV Transformer (GM)		
> Oil condition score	<= Oil condition score	Oil test factor	> Oil condition score	<= Oil condition score	Oil test factor
-	-	-	-0.01	50	0.90
-0.01	250	1.00	50	200	1.00
250	500	1.10	200	500	1.05
500	1 000	1.20	500	1 000	1.10
1,000	10 000	1.40	1 000	10 000	1.20

Table 255 – Oil Test Collar Calibration

HV transformer (GM)			EHV transformer (GM) 132 kV Transformer (GM)		
> Oil condition score	<= Oil condition score	Oil Test Collar	> Oil condition score	<= Oil condition score	Oil Test Collar
-	-	-	-0.01	50	0.5
-0.01	250	0.5	50	200	0.5
250	500	0.5	200	500	0.5
500	1 000	0.5	500	1 000	0.5
1,000	10 000	5.5	1 000	10 000	5.5

B.8 DGA Test Modifier

Table 256 – Hydrogen Condition State Calibration

Oil Type	HV transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)		
	> Hydrogen (ppm)	<= Hydrogen (ppm)	Hydrogen Condition State
Mineral Oil (Default)	-0.01	25.00	0
	25.00	50.00	2
	50.00	100.00	4
	100.00	150.00	10
	150.00	10 000.00	16
Synthetic Ester	-0.01	26.00	0
	26.00	52.00	2
	52.00	67.00	4
	67.00	82.00	10
	82.00	10 000.00	16
Natural Ester	-0.01	52.50	0
	52.50	105.00	2
	105.00	111.50	4
	111.50	118.00	10
	118.00	10 000.00	16

Table 257 – Methane Condition State Calibration

Oil Type	HV transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)		
	> Methane (ppm)	<= Methane (ppm)	Methane Condition State
Mineral Oil (Default)	-0.01	15.00	0
	15.00	30.00	2
	30.00	80.00	4
	80.00	130.00	10
	130.00	10 000.00	16
Synthetic Ester	-0.01	24.50	0
	24.50	49.00	2
	49.00	92.00	4
	92.00	135.00	10
	135.00	10 000.00	16
Natural Ester	-0.01	9.50	0
	9.50	19.00	2
	19.00	20.50	4
	20.50	22.00	10
	22.00	10 000.00	16

Table 258 – Ethylene Condition State Calibration

Oil Type	HV Transformer (GM) EHV Transformer (GM) 132 kV Transformer (GM)		
	> Ethylene (ppm)	<= Ethylene (ppm)	Ethylene Condition State
Mineral Oil (Default)	-0.01	30.00	0
	30.00	60.00	2
	60.00	170.00	4
	170.00	280.00	10
	280.00	10 000.00	16

Oil Type	HV Transformer (GM) EHV Transformer (GM) 132 kV Transformer (GM)		
	> Ethylene (ppm)	<= Ethylene (ppm)	Ethylene Condition State
Synthetic Ester	-0.01	39.50	0
	39.50	79.00	2
	79.00	147.00	4
	147.00	215.00	10
	215.00	10 000.00	16
Natural Ester	-0.01	8.50	0
	8.50	17.00	2
	17.00	18.50	4
	18.50	20.00	10
	20.00	10 000.00	16

Table 259 – Ethane Condition State Calibration

Oil Type	HV transformer (GM) EHV transformer (GM) 132 kV transformer (GM)		
	> Ethane (ppm)	<= Ethane (ppm)	Ethane Condition State
Mineral Oil (Default)	-0.01	10.00	0
	10.00	20.00	2
	20.00	55.00	4
	55.00	90.00	10
	90.00	10 000.00	16
Synthetic Ester	-0.01	52.50	0
	52.50	105.00	2
	105.00	233.50	4
	233.50	362.00	10
	362.00	10 000.00	16
Natural Ester	-0.01	109.50	0
	109.50	219.00	2
	219.00	233.00	4
	233.00	247.00	10
	247.00	10 000.00	16

Table 260 – Acetylene Condition State Calibration

Oil Type	HV transformer (GM) EHV transformer (GM) 132 kV transformer (GM)		
	> Acetylene (ppm)	<= Acetylene (ppm)	Acetylene Condition State
Mineral Oil (Default)	-0.01	1.00	0
	1.00	2.00	2
	2.00	11.00	4
	11.00	20.00	10
	20.00	10 000.00	16
Synthetic Ester	-0.01	1.00	0
	1.00	2.00	2
	2.00	17.50	4
	17.50	33.00	10
	33.00	10 000.00	16
Natural Ester	-0.01	0.25	0
	0.25	0.50	2
	0.50	0.75	4
	0.75	1.00	10
	1.00	10 000.00	16

Table 261 – DGA Change Category Calibration

HV Transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)		
> % Change	<= % Change	Change Category
-1,000.00	-5.00	Negative
-5.00	5.00	Neutral
5.00	25.00	Small
25.00	100.00	Significant
100.00	10 000.00	Large

Table 262 – DGA Test Factor Calibration

HV Transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)	
> % Change	**DGA Test Factor**
Negative	1.00 - (0.1 x MIN (DGA Score ÷ DGA Threshold, 1))
Neutral	1.00
Small	1.00 + (0.1 x MIN (DGA Score ÷ DGA Threshold, 1))
Significant	1.00 + (0.2 x MIN (DGA Score ÷ DGA Threshold, 1))
Large	1.00 + (0.5 x MIN (DGA Score ÷ DGA Threshold, 1))

The DGA Threshold is to be set to 1040, which corresponds to the case with a DGA Test Collar of 4. If this is the Health Score, it represents the tipping point where PoF starts to change (note that PoF is constant for a Health Score ≤ 4 as shown in Figure 3: HI Banding).

B.9 FFA test modifier

Table 263 – FFA Change Category Calibration

HV transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)		
> % Change	**<= % Change**	**Change Category**
-1,000.00	-5.00	Negative
-5.00	5.00	Neutral
5.00	25.00	Small
25.00	100.00	Significant
100.00	1,000.00	Large

Table 264 – FFA Test Factor Calibration

HV transformer (GM) EHV transformer (GM) 132 kV Transformer (GM)	
> % Change	**FFA Test Factor**
Negative	1.00 - (0.1 x MIN (S ÷ FFA Threshold, 1))
Neutral	1.00
Small	1.00 + (0.1 x MIN (S ÷ FFA Threshold, 1))
Significant	1.00 + (0.2 x MIN (S ÷ FFA Threshold, 1))
Large	1.00 + (0.5 x MIN (S ÷ FFA Threshold, 1))

Note that S is the FFA value in ppm.

The FFA Threshold is to be set to 0.9. This FFA value of 0.9 ppm corresponds to the case with a FFA Test Collar of 4. If this is the Health Score, it represents the tipping point where PoF starts to change (note that PoF is constant for a Health Score ≤ 4 as shown in Figure 3: HI Banding).

B.10 Ageing Reduction Factor

Table 265 – Ageing Reduction Factor

Current Health Score	Ageing Reduction Factor
< 2	1
2 to 5.5	((Current Health Score - 2)/ 7) + 1
> 5.5	1.5

B.11 Ageing Rate Adjustment Sets

Table 266 – Ageing Rate Adjustment Sets

Regulatory Year	y	$c(y)$	
		Set 1	Future Sets
2028/29	2029	1	
2029/30	2030	1	
2030/31	2031	1	
2031/32	2032	1	
2032/33	2033	1	
2033/34	2034	1	
2034/35	2035	1	
2035/36	2036	1	
2036/37	2037	1	
2037/38	2038	1	
2038/39	2039	1	
2039/40	2040	1	
2040/41	2041	1	
2041/42	2042	1	
2042/43	2043	1	
All future years*		1	

Note: Additional Sets will be provided once information becomes available to be applied.

Annex C
(informative)

Interventions

Where work is carried out to either replace or refurbish an asset, that work will impact the value of the PoF and in some cases the CoF of the asset and hence a revised value of risk can be calculated for that asset. The change in the risk of the asset will be calculated by changes to the assets condition as observed or measured, being placed in the model and the model run to determine these changes. The change in risk will be calculated as the level of risk pre-intervention less the risk post-intervention.

Where a DNO needs to predict changes to the value of the overall risk present on their network due to their proposed work programme prior to that work being carried out, then the actual condition of the plant post intervention will not be able to be recorded. This is especially a problem where a refurbishment is proposed. In these cases, the principles within this Annex will be used and suitable assumption will be permitted. These assumptions will be stated when submitting the results to Ofgem.

Table 267 – Input Data Affected by Refurbishment Interventions

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement of battery charger	Battery System	Batteries at HV (GM), 33kV,66kV and 132kV.	Reassess Health Score Modifier by reassessing the relevant Observed and Measured Condition Inputs
Replacement of complete battery string	Battery System	Batteries at HV (GM), 33kV,66kV and 132kV.	Reassess Health Score Modifier by reassessing the relevant Observed and Measured Condition Inputs
Complete replacement of the operating mechanism (ACB)	LV Switchgear	LV Circuit Breaker	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of complete feeder way	LV Switchgear	LV Pillar (ID), LV Pillar (OD at Substation) & LV Pillar (OD not at Substation)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete factory refurbishment	HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary, 6.6/11 kV RMU, 6.6/11 kV Switch (GM), 6.6/11 kV X-type RMU, 20 kV CB (GM) Secondary, 20 kV RMU & 20 kV Switch (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete Refurbishment (factory or onsite) e.g. strip down & rebuild, replacing all worn parts	HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary, 6.6/11 kV RMU, 6.6/11 kV Switch (GM), 6.6/11 kV X-type RMU, 20 kV CB (GM) Secondary, 20 kV RMU & 20 kV Switch (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete replacement of the operating mechanism	HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary, 6.6/11 kV RMU, 6.6/11 kV Switch (GM), 6.6/11 kV X-type RMU, 20 kV CB (GM) Secondary, 20 kV RMU & 20 kV Switch (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cable boxes	HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary, 6.6/11 kV RMU, 6.6/11 kV Switch (GM), 6.6/11 kV X-type RMU, 20 kV CB (GM) Secondary, 20 kV RMU & 20 kV Switch (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of the moving portion (truck) in withdrawable equipment	HV Switchgear (GM) - Distribution	6.6/11 kV CB (GM) Secondary & 20 kV CB (GM) Secondary	i) Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) Increase the Expected Life by 20 years
Complete factory refurbishment	HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary & 20 kV CB (GM) Primary	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete Refurbishment (factory or onsite) e.g. strip down & rebuild, replacing all worn parts	HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary & 20 kV CB (GM) Primary	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete replacement of the operating mechanism	HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary & 20 kV CB (GM) Primary	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cable boxes	HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary & 20 kV CB (GM) Primary	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of the moving portion (truck) in withdrawable equipment	HV Switchgear (GM) - Primary	6.6/11 kV CB (GM) Primary & 20 kV CB (GM) Primary	i) Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) Increase the Expected Life by 20 years
Complete Refurbishment (factory or onsite) e.g. strip down & rebuild, replacing all worn parts	EHV Switchgear (GM)	33 kV CB (Air Insulated Busbars)(ID)(GM), 33 kV CB (Air Insulated Busbars)(OD)(GM), 33 kV CB (Gas Insulated Busbars)(ID)(GM), 33 kV CB (Gas Insulated Busbars)(OD)(GM), 33 kV RMU, 33 kV Switch (GM), 66 kV CB (Air Insulated Busbars)(ID)(GM), 66 kV CB (Air Insulated Busbars)(OD)(GM), 66 kV CB (Gas Insulated Busbars)(ID)(GM) & 66 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete replacement of the operating mechanism	EHV Switchgear (GM)	33 kV CB (Air Insulated Busbars)(ID)(GM), 33 kV CB (Air Insulated Busbars)(OD) (GM), 33 kV CB (Gas Insulated Busbars)(ID)(GM), 33 kV CB (Gas Insulated Busbars)(OD) (GM), 33 kV RMU, 33 kV Switch (GM), 66 kV CB (Air Insulated Busbars)(ID)(GM), 66 kV CB (Air Insulated Busbars)(OD) (GM), 66 kV CB (Gas Insulated Busbars)(ID)(GM) & 66 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cable boxes	EHV Switchgear (GM)	33 kV CB (Air Insulated Busbars)(ID)(GM), 33 kV CB (Air Insulated Busbars)(OD) (GM), 33 kV CB (Gas Insulated Busbars)(ID)(GM), 33 kV CB (Gas Insulated Busbars)(OD) (GM), 33 kV RMU, 33 kV Switch (GM), 66 kV CB (Air Insulated Busbars)(ID)(GM), 66 kV CB (Air Insulated Busbars)(OD)(GM), 66 kV CB (Gas Insulated Busbars)(ID)(GM) & 66 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of the moving portion (truck) in withdrawable equipment	EHV Switchgear (GM)	33 kV CB (Air Insulated Busbars)(ID)(GM), 33 kV CB (Air Insulated Busbars)(OD) (GM) & 33 kV CB (Gas Insulated Busbars)(ID)(GM)	i) Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) Increase the Expected Life by 20 years

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete replacement of the operating mechanism	EHV Switchgear - Other	33kV and 66kV Switchgear - Other	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of associated/supporting structures (e.g. wooden post, concrete or steel gantry)	EHV Switchgear - Other	33kV and 66kV Switchgear - Other	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete Refurbishment (factory or onsite) e.g. strip down & rebuild, replacing all worn parts	132 kV Switchgear	132 kV CB (Air Insulated Busbars)(ID)(GM), 132 kV CB (Air Insulated Busbars)(OD) (GM), 132 kV CB (Gas Insulated Busbars)(ID)(GM) & 132 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete replacement of the operating mechanism	132 kV Switchgear	132 kV CB (Air Insulated Busbars)(ID)(GM), 132 kV CB (Air Insulated Busbars)(OD) (GM), 132 kV CB (Gas Insulated Busbars)(ID)(GM) & 132 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cable boxes	132 kV Switchgear	132 kV CB (Air Insulated Busbars)(ID)(GM), 132 kV CB (Air Insulated Busbars)(OD)(GM), 132 kV CB (Gas Insulated Busbars)(ID)(GM) & 132 kV CB (Gas Insulated Busbars)(OD)(GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Complete factory refurbishment	HV Transformer (GM)	6.6/11 kV Transformer (GM) & 20 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete replacement of the operating mechanism	132kV Switchgear - Other	132kV Switchgear - Other	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of associated/supporting structures (e.g. wooden post, concrete or steel gantry)	132kV Switchgear - Other	132kV Switchgear - Other	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Installation of replacement windings	HV Transformer (GM)	6.6/11 kV Transformer (GM) & 20 kV Transformer (GM)	i) Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) Revise age to reflect time elapsed since Refurbishment undertaken
On site processing to recondition oil to remove moisture and acidity from windings	HV Transformer (GM)	6.6/11 kV Transformer (GM) & 20 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cooling radiators	HV Transformer (GM)	6.6/11 kV Transformer (GM) & 20 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs
Replacement of cable boxes	HV Transformer (GM)	6.6/11 kV Transformer (GM) & 20 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete factory refurbishment	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Installation of replacement windings	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	i) Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs, Oil Test Modifier, DGA Test Modifier, FFA Test Modifier and Reliability Modifier; and ii) Revise age to reflect time elapsed since Refurbishment undertaken
On site processing to recondition oil to remove moisture and acidity from windings	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing Oil Test Modifier
Replacement of bushings	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cooling radiators	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement of cable boxes	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of gaskets & seals	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of Tapchangers or full replacement of Tapchanger mechanism	EHV Transformer	33 kV Transformer (GM) & 66 kV Transformer (GM)	i) Reassess Health Score Modifier for Tapchanger subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) where Tapchanger is replaced: revise age of Tapchanger subcomponent, used in the calculation of Initial Health Score, to the age of the new Tapchanger
Complete factory refurbishment	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Installation of replacement windings	132 kV Transformer	132 kV Transformer (GM)	i) Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs, Oil Test Modifier, DGA Test Modifier, FFA Test Modifier and Reliability Modifier; and ii) Revise age to reflect time elapsed since Refurbishment undertaken
On site processing to recondition oil to remove moisture and acidity from windings	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing Oil Test Modifier
Replacement of bushings	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cooling radiators	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of cable boxes	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement of gaskets & seals	132 kV Transformer	132 kV Transformer (GM)	Reassess Health Score Modifier for Main Transformer subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier
Replacement of Tapchangers or full replacement of Tapchanger mechanism	132 kV Transformer	132 kV Transformer (GM)	i) Reassess Health Score Modifier for Tapchanger subcomponent by reassessing relevant Observed Condition Inputs, Measured Condition Inputs and Reliability Modifier; and ii) where Tapchanger is replaced: revise age of Tapchanger subcomponent, used in the calculation of Initial Health Score, to the age of the new Tapchanger
Pole Strengthening (e.g. clamping a steelwork supporting bracket to an existing pole)	LV Poles	LV Poles	Reassess Health Score Modifier by reassessing Pole Decay/Deterioration Measured Condition Inputs
Replacement of a complete set of insulators associated with an existing pole	LV Poles	LV Poles	Complete replacement of pole top steelwork (including associated insulators and fittings)
Complete replacement of pole top steelwork (including associated insulators and fittings)	LV Poles	LV Poles	Complete replacement of pole top steelwork (including associated insulators and fittings)

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Small footprint steel masts: Replacement of individual steelwork members	LV Poles	LV Poles	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs
Pole Strengthening (e.g. clamping a steelwork supporting bracket to an existing pole)	HV Poles	6.6/11 kV Poles & 20 kV Poles	Reassess Health Score Modifier by reassessing Pole Decay/Deterioration Measured Condition Inputs
Replacement of a complete set of insulators associated with an existing pole	HV Pole	6.6/11 kV Poles & 20 kV Poles	Complete replacement of pole top steelwork (including associated insulators and fittings)
Complete replacement of pole top steelwork (including associated insulators and fittings)	HV Pole	6.6/11 kV Poles & 20 kV Poles	Complete replacement of pole top steelwork (including associated insulators and fittings)
Small footprint steel masts: Replacement of individual steelwork members	HV Poles	6.6/11 kV Poles & 20 kV Poles	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs
Pole Strengthening (e.g. clamping a steelwork supporting bracket to an existing pole)	EHV Pole	33 kV Pole & 66 kV Pole	Reassess Health Score Modifier by reassessing Pole Decay/Deterioration Measured Condition Inputs
Replacement of a complete set of insulators associated with an existing pole	EHV Pole	33 kV Pole & 66 kV Pole	Complete replacement of pole top steelwork (including associated insulators and fittings)

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Complete replacement of pole top steelwork (including associated insulators and fittings)	EHV Pole	33 kV Pole & 66 kV Pole	Complete replacement of pole top steelwork (including associated insulators and fittings)
Small footprint steel masts: Replacement of individual steelwork members	EHV Pole	33 kV Pole & 66 kV Pole	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs
Pole Strengthening (e.g. clamping a steelwork supporting bracket to an existing pole)	132 kV Pole	132 kV Pole	Reassess Health Score Modifier by reassessing Pole Decay/Deterioration Measured Condition Inputs
Replacement of a complete set of insulators associated with an existing pole	132 kV Pole	132 kV Pole	Complete replacement of pole top steelwork (including associated insulators and fittings)
Complete replacement of pole top steelwork (including associated insulators and fittings)	132 kV Pole	132 kV Pole	Complete replacement of pole top steelwork (including associated insulators and fittings)
Small footprint steel masts: Replacement of individual steelwork members	132 kV Pole	132 kV Pole	Reassess Health Score Modifier by reassessing relevant Observed Condition Inputs and Measured Condition Inputs

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Painting of Tower	EHV Tower	33 kV Tower & 66 kV Tower	i) Reassess Health Score Modifier for Tower Paintwork subcomponent by reassessing Paintwork Condition Input; and ii) revise age of Tower Paintwork subcomponent, used in the calculation of Initial Health Score, to the time elapsed since the Tower was most recently painted
Replacement of individual steelwork members	EHV Tower	33 kV Tower & 66 kV Tower	Reassess Health Score Modifier for the Tower Steelwork subcomponent by reassessing relevant Observed Condition Inputs
Replacement of Tower foundations	EHV Tower	33 kV Tower & 66 kV Tower	Reassess Health Score Modifier for the Tower Foundation subcomponent by reassessing relevant Observed Condition Inputs
Painting of Tower	132 kV Tower	132 kV Tower	i) Reassess Health Score Modifier for Tower Paintwork subcomponent by reassessing Paintwork Condition Input ii) revise age of Tower Paintwork subcomponent, used in the calculation of Initial Health Score, to the time elapsed since the Tower was most recently painted

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement of individual steelwork members	132 kV Tower	132 kV Tower	Reassess Health Score Modifier for the Tower Steelwork subcomponent by reassessing relevant Observed Condition Inputs
Replacement of Tower foundations	132 kV Tower	132 kV Tower	Reassess Health Score Modifier for the Tower Foundation subcomponent by reassessing relevant Observed Condition Inputs
Replacement/ remaking of all cable joints and terminations (including sealing ends) within a pneumatic section – where undertaken as a single planned intervention	EHV Cable (Gas)	33 kV UG Cable (Gas) & 66 kV UG Cable (Gas)	Reassess Health Score Modifier by reassessing relevant Measured Condition Inputs (incl. Leakage Rate Condition Input) This shall be performed by regarding the leakage history for any period prior to the completion of the refurbishment work as having no leakage, when determining the Leakage Rate Condition Input for the refurbished cable section, in any assessment of Health Score subsequent to the refurbishment works having been undertaken.

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement/ remaking of all cable joints and terminations (including sealing ends) within a pneumatic section – where undertaken as a single planned intervention	EHV Cable (Oil)	33 kV UG Cable (Oil) & 66 kV UG Cable (Oil)	Reassess Health Score Modifier by reassessing relevant Measured Condition Inputs (incl. Leakage Rate Condition Input) This shall be performed by regarding the leakage history for any period prior to the completion of the refurbishment work as having no leakage, when determining the Leakage Rate Condition Input for the refurbished cable section, in any assessment of Health Score subsequent to the refurbishment works having been undertaken.
Replacement/ remaking of all cable joints and terminations (including sealing ends) within a pneumatic section – where undertaken as a single planned intervention	132 kV Cable (Gas)	132 kV UG Cable (Gas)	Reassess Health Score Modifier by reassessing relevant Measured Condition Inputs (incl. Leakage Rate Condition Input) This shall be performed by regarding the leakage history for any period prior to the completion of the refurbishment work as having no leakage, when determining the Leakage Rate Condition Input for the refurbished cable section, in any assessment of Health Score subsequent to the refurbishment works having been undertaken.

Refurbishment Intervention Activity	Health Index Asset Category	Asset Register Category	Input Data Affected by Intervention
Replacement/ remaking of all cable joints and terminations (including sealing ends) within a pneumatic section – where undertaken as a single planned intervention	132 kV Cable (Oil)	132 kV UG Cable (Oil)	Reassess Health Score Modifier by reassessing relevant Measured Condition Inputs (incl. Leakage Rate Condition Input) This shall be performed by regarding the leakage history for any period prior to the completion of the refurbishment work as having no leakage, when determining the Leakage Rate Condition Input for the refurbished cable section, in any assessment of Health Score subsequent to the refurbishment works having been undertaken.

Annex D
(informative)

Calibration – Consequences of Failure

D.1 Financial

D.1.1 Reference Financial Cost of Failure

The Reference Financial Cost of Failure is derived from an assessment of the likely repair costs incurred by the failure of the asset in each of its three failure modes[3]; incipient, degraded and catastrophic and relative proportions of each failure mode type (as a proportion of the total number of failures).

$$\textbf{Reference Financial Cost of Failure} =$$

$$(\textbf{Proportion of Failures that are Incipient Failure} \times \textbf{Likely Cost of Incipient Failure})$$

$$+ (\textbf{Proportion of Failures that are Degraded Failures} \times \textbf{Likely Cost of Degraded Failure})$$

$$+ (\textbf{Proportion of Failures that are Catastrophic Failures} \times \textbf{Likely Cost of Catastrophic Failure})$$

EQ. 27

Where:

- Proportion of Failures that are Incipient Failures represents the expected number of Incipient Failures as a percentage of the total number of Functional Failures;
- Proportion of Failures that are Degraded Failures represents the expected number of Degraded Failures as a percentage of the total number of Functional Failures;
- Proportion of Failures that are Catastrophic Failures represents the expected number of Catastrophic Failures as a percentage of the total number of Functional Failures;
- Likely Cost of Failure is the cost to return the asset to service (which may extend to full replacement of the asset). This is determined based on the three failure modes considered:
    - Incipient: The costs associated with addressing an Incipient Failure would not usually necessitate full asset replacement. Unless otherwise stated, a value equivalent to 10% of the Asset Replacement Costs[4] has been adopted.

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3 As defined in Annex A – Functional Failures

4 As defined in Ofgem's expert view of industry costs as used in the cost assessment for the RIIO-ED1 Final Determination

- Degraded: The costs associated with addressing a Degraded Failure would not usually necessitate full asset replacement; however, the works would normally be over and above those associated with addressing an Incipient Failure. Unless otherwise stated, a value equivalent to 25% of the Asset Replacement Costs has been adopted.

- Catastrophic: A failure of this type would necessitate full asset replacement. Asset Replacement Costs have therefore been adopted, unless otherwise stated.

For Pressurised Cables (i.e. UG Cable (Gas) or UG Cable (Oil) assets), leakage of the pressurising fluid (i.e. gas or oil) that is addressed by topping up the fluid is considered, within the Functional Failures, as an Incipient Failure. The financial costs associated with Incipient Failures for these Asset Categories reflect the costs of such activity.

In establishing the generic and common PoF curves to describe the relative relationship between asset Health Score and PoF (Section 7.1) the number of failures by failure type (Incipient/Degraded/Catastrophic Failure) has been established in accordance with the definitions described in Section 5.2.

Based on this understanding the relative proportions of a failure being an Incipient, Degraded or Catastrophic Failure have been determined for each Asset Category as outlined in Table 268.

Table 268 – Reference Financial Cost of Failure

Asset Register Category	Relative Proportion of Failure Modes (as a % of total Functional Failures)			Likely Cost of Failure			Reference Financial Cost of Failure
	I	D	C	I	D	C[5]	
Batteries at GM HV Substations	0%	70%	30%	£0	£472	£1 887	£896
Batteries at 33kV Substations	0%	70%	30%	£0	£1 981	£7 926	£3 765
Batteries at 66kV Substations	0%	70%	30%	£0	£1 981	£7 926	£3 765
Batteries at 132kV Substations	0%	70%	30%	£0	£2 051	£8 202	£3 896
LV Main (OHL) Conductor	0%	75%	25%	£0	£2 506	£5 012	£3 132
LV Poles	20%	70%	10%	£163	£1 631	£1 631	£1 337
6.6/11kV OHL (Conventional Conductor)	0%	75%	25%	£0	£3 509	£7 018	£4 386
6.6/11kV OHL (BLX or similar Conductor)	0%	75%	25%	£0	£5 522	£11 044	£6 902
6.6/11 kV Poles	20%	70%	10%	£233	£2 333	£2 333	£1 913

Asset Register Category	Relative Proportion of Failure Modes (as a % of total Functional Failures)			Likely Cost of Failure			Reference Financial Cost of Failure
	I	D	C	I	D	C5	
20kV OHL (Conventional Conductor)	0%	75%	25%	£0	£4 542	£9 085	£5 678
20kV OHL (BLX or similar Conductor)	0%	75%	25%	£0	£7 011	£14 021	£8 763
20 kV Poles	20%	70%	10%	£280	£2 799	£2 799	£2 295
33kV OHL (Pole Line) Conductor	0%	75%	25%	£0	£6 749	£13 498	£8 437
33 kV Pole	20%	70%	10%	£300	£3 007	£3 007	£2 466
66kV OHL (Pole Line) Conductor	0%	75%	25%	£0	£7 884	£15 768	£9 855
66 kV Pole	20%	70%	10%	£453	£4 534	£4 534	£3 718
132kV OHL (Pole Line) Conductor	0%	75%	25%	£0	£11 958	£23 916	£14 948
132kV Pole	20%	70%	10%	£560	£5 596	£5 596	£4 589
33 kV Tower	80%	19.95%	0.05%	£5 177	£12 942	£51 771	£6 749
66 kV Tower	80%	19.95%	0.05%	£9 700	£24 251	£97 000	£12 647
132 kV Tower	80%	19.95%	0.05%	£11 216	£28 041	£112 163	£14 623
33 kV Fittings	80%	15%	5%	£136	£339	£1 353	£227
66 kV Fittings	80%	15%	5%	£174	£436	£1 742	£292
132 kV Fittings	80%	15%	5%	£290	£724	£2 896	£485
33 kV OHL (Tower Line) Conductor	0%	85%	15%	£0	£15 472	£30 945	£17 793
66 kV OHL (Tower Line) Conductor	0%	85%	15%	£0	£20 522	£41 043	£23 600
132 kV OHL (Tower Line) Conductor	0%	85%	15%	£0	£17 746	£35 493	£20 408
HV Sub Cable	0%	0%	100%	£3 640	£9 100	£181 996	£181 996
33 kV UG Cable (Non Pressurised)	0%	0%	100%	£3 164	£7 911	£31 644	£31 644
33 kV UG Cable (Oil)	99%	0.09%	0.01%	£120	£7 911	£31 644	£129
33 kV UG Cable (Gas)	99%	0.50%	0.50%	£120	£7 911	£31 644	£317
66 kV UG Cable (Non Pressurised)	0%	0%	100%	£6 402	£16 006	£64 021	£64 021
66 kV UG Cable (Oil)	99%	0.09%	0.01%	£120	£16 006	£64 021	£140
66 kV UG Cable (Gas)	99%	0.50%	0.50%	£120	£16 006	£64 021	£519

Asset Register Category	Relative Proportion of Failure Modes (as a % of total Functional Failures)			Likely Cost of Failure			Reference Financial Cost of Failure
	I	D	C	I	D	C[5]	
132 kV UG Cable (Non Pressurised)	0%	0%	100%	£10 924	£27 310	£109 244	£109 244
132 kV UG Cable (Oil)	99%	0.09%	0.01%	£120	£27 310	£109 244	£154
132 kV UG Cable (Gas)	99%	0.50%	0.50%	£120	£27 310	£109 244	£802
EHV Sub Cable	0%	0%	100%	£5 706	£14 266	£285 322	£285 322
132 kV Sub Cable	0%	0%	100%	£9 611	£24 027	£480 542	£480 542
LV Circuit Breaker	15%	25%	60%	£601	£1 502	£6 007	£4 070
LV Pillar (ID)	15%	25%	60%	£837	£2 092	£8 367	£5 669
LV Pillar (OD at Substation)	15%	25%	60%	£911	£2 277	£9 107	£6 170
LV Pillar (OD not at a Substation)	15%	25%	60%	£506	£1 265	£5 061	£3 429
LV Board (WM)	15%	25%	60%	£1 156	£2 890	£11 562	£7 833
LV Board (X-type Network) (WM)	15%	25%	60%	£1 365	£3 411	£13 644	£9 244
LV UGB	15%	25%	60%	£506	£1 265	£5 061	£3 429
6.6/11kV Switch (PM)	30%	20%	50%	£3 654	£7 309	£7 309	£6 213
6.6/11kV CB (PM)	30%	20%	50%	£4 916	£9 832	£9 832	£8 358
6.6/11 kV CB (GM) Secondary	15%	25%	60%	£1 027	£2 567	£10 272	£6 959
6.6/11 kV CB (GM) Primary	45%	50%	5%	£3 448	£8 621	£34 485	£7 586
6.6/11 kV Switch (GM)	15%	25%	60%	£777	£1 944	£7 774	£5 267
6.6/11 kV RMU	15%	25%	60%	£1 452	£3 630	£14 523	£9 839
6.6/11 kV X-type RMU	15%	25%	60%	£1 965	£4 914	£19 652	£13 314
6.6/11kV Switchgear - Other (PM)	30%	20%	50%	£4 916	£9 832	£9 832	£8 358
20kV Switch (PM)	30%	20%	50%	£2 815	£5 629	£5 629	£4 785
20kV CB (PM)	30%	20%	50%	£5 737	£11 475	£11 475	£9 753
20 kV CB (GM) Secondary	15%	25%	60%	£1 064	£2 662	£10 648	£7 214
20 kV CB (GM) Primary	45%	50%	5%	£4 320	£10 800	£43 202	£9 504

Asset Register Category	Relative Proportion of Failure Modes (as a % of total Functional Failures)			Likely Cost of Failure			Reference Financial Cost of Failure
	I	D	C	I	D	C[5]	
20 kV Switch (GM)	15%	25%	60%	£901	£2 253	£9 010	£6 104
20 kV RMU	15%	25%	60%	£1 479	£3 699	£14 795	£10 024
20kV Switchgear - Other (PM)	30%	20%	50%	£2 815	£5 629	£5 629	£4 785
33kV Switch (PM)	30%	20%	50%	£2 360	£4 720	£4 720	£4 012
33 kV CB (Air Insulated Busbars)(ID)(GM)	45%	50%	5%	£6 597	£16 492	£65 971	£14 513
33 kV CB (Air Insulated Busbars)(OD)(GM)	45%	50%	5%	£8 122	£20 307	£81 224	£17 870
33 kV CB (Gas Insulated Busbars)(ID)(GM)	45%	50%	5%	£9 993	£24 981	£99 924	£21 984
33 kV CB (Gas Insulated Busbars)(OD)(GM)	45%	50%	5%	£9 993	£24 981	£99 924	£21 984
33 kV Switch (GM)	45%	50%	5%	£4 662	£11 656	£46 621	£10 257
33 kV RMU	45%	50%	5%	£11 521	£28 804	£115 214	£25 347
33kV Switchgear - Other	25%	25%	50%	£815	£2 037	£8 149	£4 788
66 kV CB (Air Insulated Busbars)(ID)(GM)	45%	50%	5%	£13 150	£32 875	£131 499	£28 930
66 kV CB (Air Insulated Busbars)(OD)(GM)	45%	50%	5%	£21 024	£52 559	£210 237	£46 252
66 kV CB (Gas Insulated Busbars)(ID)(GM)	45%	50%	5%	£23 716	£59 291	£237 163	£52 176
66 kV CB (Gas Insulated Busbars)(OD)(GM)	45%	50%	5%	£23 716	£59 291	£237 163	£52 176
66kV Switchgear - Other	25%	25%	50%	£888	£2 221	£8 882	£5 218
132 kV CB (Air Insulated Busbars)(ID)(GM)	45%	50%	5%	£36 860	£92 150	£368 601	£81 092
132 kV CB (Air Insulated Busbars)(OD)(GM)	45%	50%	5%	£17 355	£43 387	£173 549	£38 181
132 kV CB (Gas Insulated Busbars)(ID)(GM)	45%	50%	5%	£76 769	£191 923	£767 691	£168 892

Asset Register Category	Relative Proportion of Failure Modes (as a % of total Functional Failures)			Likely Cost of Failure			Reference Financial Cost of Failure
	I	D	C	I	D	C[5]	
132 kV CB (Gas Insulated Busbars)(OD)(GM)	45%	50%	5%	£76 769	£191 923	£767 691	£168 892
132kV Switchgear - Other	25%	25%	50%	£1 802	£4 505	£18 020	£10 587
6.6/11kV Transformer (PM)	25%	25%	50%	£401	£4 009	£4 009	£3 107
6.6/11 kV Transformer (GM)	15%	25%	60%	£1 372	£3 431	£13 722	£9 297
20kV Transformer (PM)	25%	25%	50%	£517	£5 166	£5 166	£4 004
20 kV Transformer (GM)	15%	25%	60%	£1 563	£3 906	£15 624	£10 585
33kV Transformer (PM)	25%	25%	50%	£342	£3 418	£3 418	£2 649
33 kV Transformer (GM)	45%	50%	5%	£39 863	£99 657	£398 629	£87 698
66 kV Transformer (GM)	45%	50%	5%	£61 270	£153 178	£612 709	£134 796
132 kV Transformer (GM)	45%	50%	5%	£119 552	£298 880	£1 195 522	£263 015
NOTE: values rounded to nearest £ for presentation in this table							

[5]These are based on Ofgem's expert view of industry costs from the final determination cost assessment process from RIIO-ED1, inflated to 2020/21 prices. For cables and conductor are expressed on a per km basis; however, the lengths replaced under fault conditions are typically less than that. Further, the cost of replacing these shorter lengths of cable or conductor is not directionally proportional to the cost of replacing much greater lengths as part of planned replacements works (i.e. the basis on which replacement costs are established). For the purposes of establishing the Reference Financial Consequence it is assumed that 10% of the costs incurred per km of activity would be incurred in carrying out a repair (typical length of 50m with a factor of 2 to reflect the lower efficiency for these types of works). For subsea cable the typical length replaced during a repair is 500m and therefore the cost of a Catastrophic Failure has been assumed to be 50% of the costs incurred per km (i.e. with no further efficiency adjustment factor).

D.1.2 Financial Consequence Factors

As described in Section 8.3.3 the resulting Reference Financial Cost of Failure value can then be modified for individual assets within an Asset Category based on the application of a Type Financial Factor and/or an Access Financial Factor to result in a Financial CoF that reflects the characteristics of an individual asset of that type.

D1.2.1 Type Financial Factors

Type Financial Factors other than 1, may be applied to those Asset Categories shown in Table 269, using the Type Financial Factor criteria shown. For all other Asset Categories this Factor shall be set to 1. Similarly, the default value of the Type Financial Factor shall be 1.

Table 269 – Type Financial Factors

Asset Register Category	Type Financial Factor Criteria	Type Financial Factor
LV Poles	Pole (excluding terminal poles)	1
	Pole (terminal poles)	1.2
	Steel Poles	2
LV OHL Pole Conductor - ABC		1.5
LV Board (WM)	Non Asbestos clad	1
	Asbestos clad	2
LV Board (X-type Network) (WM)	Non Asbestos clad	1
	Asbestos clad	2
6.6/11 kV Poles	Pole (supporting conductor only)	1
	Pole (supporting plant or equipment)	1.7
	Small footprint steel masts	2
20 kV Poles	Pole (supporting conductor only)	1
	Pole (supporting plant or equipment)	1.7
	Small footprint steel masts	2
6.6/11 kV Transformer (GM)	6.6/11 kV - LV ≥750kVA	1.15
	6.6/11 kV - LV ≥500kVA and <750kVA	1
	6.6/11 kV - LV <500-kVA	0.85
	6.6/11 kV - 6.6/11 kV Inter-system transformers (HV/HV)	2
	6.6/11 kV Reactors & Regulators	2
20 kV Transformer (GM)	20 kV - LV ≥750kVA	1.15
	20 kV - LV ≥500kVA and <750kVA	1
	20 kV - LV <500-kVA	0.85
	20 kV - 6.6/11 kV Inter-system transformers (HV/HV)	2
	20 kV Reactors & Regulators	2
6.6/11 kV Transformer (PM)	6.6/11 kV - LV < 50kVA,1P	0.5
	6.6/11 kV - LV ≥ 50kVA, 1P	0.6
	6.6/11 kV - LV < 50kVA, 3P	0.7

Asset Register Category	Type Financial Factor Criteria	Type Financial Factor
	6.6/11 kV - LV ≥ 50kVA and < 200kVA, 3P	0.8
	6.6/11 kV – LV ≥ 200kVA, 3P	1
	6.6/11 kV - LV Reactors & Regulators	2
20 kV Transformer (PM)	20 kV - LV < 50kVA,1P	0.5
	20 kV - LV ≥ 50kVA, 1P	0.6
	20 kV - LV < 50kVA, 3P	0.7
	20 kV - LV ≥ 50kVA and < 200kVA, 3P	0.8
	20 kV - LV ≥ 200kVA, 3P	1
	20 kV Reactors & Regulators	2
33 kV Transformer (PM)	33 kV - LV < 50kVA,1P	0.5
	33 kV - LV ≥ 50kVA, 1P	0.6
	33 kV - LV < 50kVA, 3P	0.7
	33 kV - LV ≥ 50kVA and < 200kVA, 3P	0.8
	33 kV - LV ≥ 200kVA, 3P	1
	33 kV Reactors & Regulators	2
HV Sub Cable	Submarine Single Wire Armour	1
	Submarine Double Wire Armour	1.1
	Non-Marine cable	0.8
	Default	1
33 kV Pole	Pole (supporting conductor only)	1
	Pole (supporting plant or equipment)	1.7
	Small footprint steel masts	2
66 kV Pole	Pole (supporting conductor only)	1
	Pole (supporting plant or equipment)	1.7
	Small footprint steel masts	2
33 kV Tower	Suspension	1
	Tension	1.05
	Terminal	1.1
66 kV Tower	Suspension	1
	Tension	1.05
	Terminal	1.1
EHV Sub Cable	Submarine Single Wire Armour	1
	Submarine Double Wire Armour	1.1
	Non-Marine cable	0.8
	Default	1

Asset Register Category	Type Financial Factor Criteria	Type Financial Factor
33 kV Switchgear – Other	Motorised disconnector	1.5
	Non-motorised disconnector	1
	Earth switch	0.7
	Fault thrower	0.7
66 kV Switchgear – Other	Motorised disconnector	1.5
	Non-motorised disconnector	1
	Earth switch	0.7
	Fault thrower	0.7
132 kV Switchgear – Other	Motorised disconnector	1.5
	Non-motorised disconnector	1
	Earth switch	0.7
	Fault thrower	0.7
132 kV Pole*	Pole (supporting conductor only)	1
	Small footprint steel masts	2
33 kV Transformer (GM)	33/20 kV, >20MVA CMR equivalent	1.25
	33/20 kV, >10MVA and ≤20MVA CMR equivalent	1.1
	33/20 kV, ≤10MVA CMR equivalent	1
	33/11 or 6.6 kV, >20MVA CMR equivalent	1.1
	33/11 or 6.6 kV, >10MVA and ≤20MVA CMR equivalent	1
	33/11 or 6.6 kV, ≤10MVA CMR equivalent	0.9
	33 kV Reactors & Regulators	2
66 kV Transformer (GM)	66/20 kV, >20MVA CMR equivalent	1.25
	66/20 kV, >10MVA and ≤20MVA CMR equivalent	1.1
	66/20 kV, ≤10MVA CMR equivalent	1
	66/33 kV	1.1
	66/11/11 kV	1.1
	66/11 or 6.6 kV, >20MVA CMR equivalent	1.1
	66/11 or 6.6 kV, >10MVA and ≤20MVA CMR equivalent	1
	66/11 or 6.6 kV, ≤10MVA CMR equivalent	0.9
	66 kV Reactors & Regulators	2
33 kV Fittings	Suspension	1
	Tension	2
66 kV Fittings	Suspension	1

Asset Register Category	Type Financial Factor Criteria	Type Financial Factor
	Tension	2
132 kV Fittings	Suspension	1
	Tension	2
132 kV Tower	Suspension	1
	Tension	1.05
	Terminal	1.1
132 kV Sub Cable	Submarine Single Wire Armour	1
	Submarine Double Wire Armour	1.1
	Non-Marine cable	0.8
	Default	1
132 kV Transformer (GM)	132/66 kV, ≤60MVA	1.05
	132/66 kV, >60MVA	1.15
	132/33 kV, ≤60MVA	0.9
	132/33 kV, >60MVA	1
	132/11/11 kV	1.1
	132/11 kV	0.85
	132/20 kV	0.95
	132/20/20 kV	1.1
	132 kV Reactors & Regulators	2

Note: For LV Main (OHL) Conductor, the use of ABC type conductor is more costly compared to other conductor types. Therefore, to account for the increased expense, a factor of 1.5 should be applied when the LV Main (OHL) conductor type is ABC.

D1.2.2 Access Financial Factors

Access Financial Factors other than 1, may be applied to those Asset Categories shown in Table 270 and Table 271, using the criteria shown. For all other Asset Categories this factor shall be set to 1. Similarly, the default value of Access Financial Factor shall be 1.

Table 270 – Access Factor: OHL

	Access Factor		
Asset Category	**Type A Criteria - Normal Access (& Default Value)**	**Type B Criteria – Constrained Access (e.g. landlocked or difficult to access)**	**Type C Criteria - Major Crossing (e.g. associated span crosses railway line, major road, large waterway etc.)**
LV OHL Support	1	1.25	3
LV Main (OHL) Conductor	1	1	3
HV Switchgear (PM)	1	1.1	N/A
HV Transformer (PM)	1	1.1	N/A
HV OHL Support - Poles	1	1.25	3
6.6/11 kV OHL (BLX or similar Conductor)	1	1	3
6.6/11 kV OHL (Conventional Conductor)	1	1	3
20 kV OHL (Conventional Conductor)	1	1	3
20 kV OHL (BLX or similar Conductor)	1	1	3
EHV OHL Support - Poles	1	1.25	3
33 kV OHL (Pole Line) Conductor	1	1	3
66 kV OHL (Pole Line) Conductor	1	1	3
EHV OHL Support - Towers	1	1.1	1.5
EHV OHL Fittings (Tower Lines)	1	1.1	2
EHV OHL Conductors (Tower Lines)	1	1.1	2
EHV Switchgear - Other	1	1.1	N/A
EHV Switchgear (PM)	1	1.1	N/A
EHV Transformer (PM)	1	1.1	N/A
132 kV Poles	1	1.25	3
132kV Switchgear - Other	1	1.1	N/A
132 kV OHL (Pole Line) Conductor	1	1	3
132 kV OHL Support - Tower	1	1.1	1.5
132 kV OHL Fittings (Tower Lines)	1	1.1	2
132 kV OHL Conductors (Tower Lines)	1	1.1	2

Table 271 – Access Factor: Battery System, Switchgear & Transformer Assets

Asset Category	Access Factor		
	Type A Criteria - Normal Access (& Default Value)	Type B Criteria - Constrained Access or Confined Working Space	Type C Criteria - Underground substation
Battery System at GM HV	1	1.25	1.25
Battery System at 33 kV, 66 kV, 132 kV	1	1.15	1.15
LV Switchgear	1	1.25	1.7
HV Transformer (GM)	1	1.25	2
HV Switchgear (GM) - Distribution	1	1.25	1.7
HV Switchgear (GM) - Primary	1	1.15	1.3
EHV Switchgear (GM)	1	1.1	1.25
132 kV Switchgear	1	1.1	1.2
EHV Transformer (GM)	1	1.1	1.35
132 kV Transformer (GM)	1	1.1	1.25

D.2 D.2 Safety

D.2.1 Reference Safety Cost of Failure

The Reference Safety Cost of Failure is derived by considering the probability that a failure could result in an accident, serious injury or fatality; and the cost of a Lost Time Accident (LTA) or Death or Serious Injury (DSI) as appropriate.

$$\textbf{Reference Safety Cost of Failure} = \left(\left(\textbf{Probability of LTA} \times \textbf{Cost of LTA}\right) + \left(\left(\textbf{Probability of DSI to the Public} + \textbf{Probability of DSI to the Staff}\right) \times \left(\textbf{Cost of DSI}\right)\right)\right) \times \textbf{Disproportion Factor}$$

EQ. 30

Where:

- Cost of LTA is the Reference Cost of a Lost Time Accident as shown in Table 272;

- Cost of DSI is the Reference Cost of a Death or Serious Injury as shown in Table 272;

- Disproportion Factor is explained later in this section.

The Reference Safety Costs for 'death or serious injury' and 'accident' are based on the HSE's GB cross-industry wide appraisal values for fatal injuries and for non-fatal injuries. These represent a quantification of the societal value of preventing an LTA or DSI.

Table 272 – Reference Safety Cost

Reference Safety Cost	Value (£)
Lost Time Accident	£9 130
Death or Serious Injury to public	£1 810 495
Death or Serious Injury to staff	£1 810 495

In addition, a disproportion factor recognising the high risk nature of the electricity distribution industry is applied. Such disproportion factors are described by the HSE guidance when identifying reasonably practicable costs of mitigation. This value is not mandated by the HSE, but they state that they believe that "the greater the risk, the more should be spent in reducing it, and the greater the bias should be on the side of safety". They also suggest that the extent of the bias must be argued in the light of all the circumstances and that the factor is unlikely to be higher than 10.

In the Methodology, the factor is set to 6.25, which serves to set the current value of a DSI at £11.3m.

Table 273 – Reference Safety Cost - Disproportion Factor

Reference Safety Cost	Value
Disproportion Factor	6.25

In terms of the probability that a failure could result in an LTA or DSI event, the values have been derived from an assessment of both disruptive and non-disruptive failure probabilities for these events based on bottom up assessments of faults. The results of this analysis are shown in Table 274. These have been evaluated for each Asset Category using the following event tree.

a) Probability that event could be hazardous;

b) Probability that person who is present suffers the effect; and

c) Probability that affected person is present when fault occurs.

The Reference Safety Cost of Failure for each Asset Category calculated based on EQ. 30 is also shown in Table 274.

Table 274 – Reference Safety Probabilities and Cost of Failure

Asset Register Category	PROBABILITY OF EVENT PER ASSET FAILURE			Reference Safety Cost of Failure
	Lost Time Accident	Death or Serious Injury to public	Death or Serious Injury to staff	
LV Main (OHL) Conductor	0.0085	0.00225	0.0000544	£26 561
LV Poles	0.000816	0.000032640	0.000016320	£601
LV Circuit Breaker	0.00004916	0.000434412	0.000370311	£9 109
LV Pillar (ID)	0.00004916	0.000434412	0.000370311	£9 109
LV Pillar (OD at Substation)	0.00004916	0.000434412	0.000370311	£9 109
LV Pillars (OD not at Substation)	0.00005193	0.000458912	0.000391196	£9 622
LV Board (WM)	0.00004916	0.000434412	0.000370311	£9 109
LV UGB	0.00005193	0.000458912	0.000391196	£9 622
LV Board (X-type Network) (WM)	0.00004916	0.000434412	0.000370311	£9 109
6.6/11 kV OHL (Conventional Conductor)	0.0034	0.003	0.000001088	£34 153
6.6/11 kV OHL (BLX or similar Conductor)	0.0034	0.003	0.000001088	£34 153
20 kV OHL (Conventional Conductor)	0.0034	0.003	0.000001088	£34 153
20 kV OHL (BLX or similar Conductor)	0.0034	0.003	0.000001088	£34 153
6.6/11 kV Poles	0.000272	0.00001088	0.00000544	£200
20 kV Poles	0.000272	0.00001088	0.00000544	£200
HV Sub Cable	0.00000075	0.000000075	0.000000075	£2
6.6/11 kV CB (PM)	0.000017123	0.000000228	0.000000114	£5
6.6/11 kV CB (GM) Primary	0.000260274	0.000115	0.001960616	£23 502
6.6/11 kV CB (GM) Secondary	0.0000260274	0.00023	0.000196062	£4 823
6.6/11 kV Switch (PM)	0.000085616	0.000005708	0.000085616	£1 038
6.6/11 kV Switchgear - Other (PM)	0.000085616	0.000005	0.000085616	£1 030
6.6/11 kV Switch (GM)	0.0000260274	0.00023	0.000196062	£4 823
6.6/11 kV RMU	0.0000260274	0.00023	0.000196062	£4 823
6.6/11 kV X-type RMU	0.0000260274	0.00023	0.000196062	£4 823
20 kV CB (PM)	0.000085616	0.000005708	0.000085616	£1 038
20 kV CB (GM) Primary	0.000260274	0.000115	0.001960616	£23 502
20 kV CB (GM) Secondary	0.0000260274	0.00023	0.000196062	£4 823
20 kV Switch (PM)	0.000085616	0.000005708	0.000085616	£1 038
20 kV Switchgear - Other (PM)	0.000085616	0.000005708	0.000085616	£1 038

Asset Register Category	PROBABILITY OF EVENT PER ASSET FAILURE			Reference Safety Cost of Failure
	Lost Time Accident	Death or Serious Injury to public	Death or Serious Injury to staff	
20 kV Switch (GM)	0.0000260274	0.00023	0.000196062	£4 823
20 kV RMU	0.0000260274	0.00023	0.000196062	£4 823
6.6/11 kV Transformer (PM)	0.000085616	0.000005708	0.000085616	£1 038
6.6/11 kV Transformer (GM)	0.0000260274	0.00023	0.000196062	£4 823
20 kV Transformer (PM)	0.000085616	0.000005708	0.000085616	£1 038
20 kV Transformer (GM)	0.0000260274	0.00023	0.000196062	£4 823
Batteries at GM HV Substations	0.000017123	0.000000228	0.000000114	£5
33 kV OHL (Pole Line) Conductor	0.0034	0.005	0.000001088	£56 784
33 kV Pole	0.000272	0.00001088	0.00000544	£200
66 kV OHL (Pole Line) Conductor	0.0034	0.005	0.000001088	£56 784
66 kV Pole	0.000272	0.00001088	0.00000544	£200
33 kV OHL (Tower Line) Conductor	0.0034	0.0051	0.0001088	£59 135
33 kV Tower	0.000136	0.00000544	0.0000272	£377
33 kV Fittings	0.000544	0.00002176	0.0001088	£1 508
66 kV OHL (Tower Line) Conductor	0.0034	0.00612	0.0001088	£70 677
66 kV Tower	0.000136	0.00000544	0.0000272	£377
66 kV Fittings	0.000544	0.00002176	0.0001088	£1 508
33 kV UG Cable (Non Pressurised)	0.00000075	0.000000075	0.000000075	£2
33 kV UG Cable (Oil)	0.00000075	0.000000075	0.000000075	£2
33 kV UG Cable (Gas)	0.00000075	0.000000075	0.000000075	£2
66 kV UG Cable (Non Pressurised)	0.00000075	0.000000075	0.000000075	£2
66 kV UG Cable (Oil)	0.00000075	0.000000075	0.000000075	£2
66 kV UG Cable (Gas)	0.00000075	0.000000075	0.000000075	£2
EHV Sub Cable	0.00000075	0.000000075	0.000000075	£2
33 kV CB (Air Insulated Busbars)(ID) (GM)	0.000260274	0.000115	0.001960616	£23 502
33 kV CB (Air Insulated Busbars)(OD) (GM)	0.000260274	0.000115	0.001960616	£23 502
33 kV CB (Gas Insulated Busbars)(ID) (GM)	0.000260274	0.000115	0.001960616	£23 502
33 kV CB (Gas Insulated Busbars)(OD) (GM)	0.000260274	0.000115	0.001960616	£23 502
33 kV Switch (GM)	0.000260274	0.000115	0.001960616	£23 502
33 kV Switchgear - Other	0.000017123	0.0000001	0.000000114	£3
33 kV Switch (PM)	0.00010274	0.000005708	0.00010274	£1 233
33 kV RMU	0.000260274	0.000115	0.001960616	£23 502

Asset Register Category	PROBABILITY OF EVENT PER ASSET FAILURE			Reference Safety Cost of Failure
	Lost Time Accident	Death or Serious Injury to public	Death or Serious Injury to staff	
66 kV CB (Air Insulated Busbars)(ID) (GM)	0.000260274	0.000115	0.001960616	£23 502
66 kV CB (Air Insulated Busbars)(OD) (GM)	0.000260274	0.000115	0.001960616	£23 502
66 kV CB (Gas Insulated Busbars)(ID) (GM)	0.000260274	0.000115	0.001960616	£23 502
66 kV CB (Gas Insulated Busbars)(OD) (GM)	0.000260274	0.000115	0.001960616	£23 502
66 kV Switchgear - Other	0.000017123	0.0000001	0.000000114	£3
33 kV Transformer (PM)	0.000085616	0.000005708	0.000085616	£1 038
33 kV Transformer (GM)	0.000260274	0.000115	0.001960616	£23 502
66 kV Transformer	0.000260274	0.000115	0.001960616	£23 502
Batteries at 33 kV Substations	0.000017123	0.000000228	0.000000114	£5
Batteries at 66 kV Substations	0.000017123	0.000000228	0.000000114	£5
132 kV OHL (Pole Line) Conductor	0.0034	0.009	0.000001088	£102 047
132 kV Pole	0.000272	0.00001088	0.00000544	£200
132 kV OHL (Tower Line) Conductor	0.0034	0.00612	0.0001088	£70 677
132 kV Tower	0.000136	0.00000544	0.0000272	£377
132 kV Fittings	0.000544	0.00002176	0.0001088	£1 508
132 kV UG Cable (Non Pressurised)	0.00000075	0.000000075	0.000000075	£2
132 kV UG Cable (Oil)	0.00000075	0.000000075	0.000000075	£2
132 kV UG Cable (Gas)	0.00000075	0.000000075	0.000000075	£2
132 kV Sub Cable	0.00000075	0.000000075	0.000000075	£2
132 kV CB (Air Insulated Busbars)(ID) (GM)	0.000416438	0.0000575	0.003136986	£36 171
132 kV CB (Air Insulated Busbars)(OD) (GM)	0.000416438	0.0000575	0.003136986	£36 171
132 kV CB (Gas Insulated Busbars)(ID) (GM)	0.000416438	0.0000575	0.003136986	£36 171
132 kV CB (Gas Insulated Busbars)(OD) (GM)	0.000416438	0.0000575	0.003136986	£36 171
132 kV Switchgear - Other	0.000017123	0.0000001	0.000000114	£3
132 kV Transformer	0.000416438	0.0000575	0.003136986	£36 171
Batteries at 132 kV Substations	0.000017123	0.000000228	0.000000114	£5
NOTE: values rounded to nearest £ for presentation in this table				

D.2.2 Safety Consequence Factors

As described in Section 8.4.3 the Safety CoF can then be derived for individual assets by the application of a Type Safety Factor and/or a Location Safety Factor so that it reflects the characteristics of an individual asset. These are detailed by Asset Category Grouping in Table 275 and Table 276. where a Type or Location rating has not been determined, then the Medium (Default) rating shall be assumed.

D.2.2.1 Switchgear, Transformers & Overhead Lines

Under the Electricity Safety Quality and Continuity Regulations 2002 (ESQCR) [Ref N5], risk assessments must be carried out on substation sites and overhead lines to assess the risk of interference, vandalism or unauthorised access to the asset by the public.

The overall risk value is built from the following components:

- Type (Risk that the asset presents to the public by its characteristics and particular situation); and
- Location (Proximity to areas that may affect its likelihood of trespass or interference).

The overall Safety CoF Factors for Switchgear, Transformers and Overhead Lines are determined by these Type and Location Risk Ratings as shown in Table 275.

Table 275 – Safety Consequence Factor – Switchgear, Transformers & Overhead Lines

Safety Consequence Factor – Switchgear, Transformers & Overhead Lines		TYPE RISK RATING		
		Low	Medium (Default)	High
LOCATION RISK RATING	Low	0.7	0.9	1.2
	Medium (Default)	0.9	1	1.4
	High	1.2	1.4	1.6

D.2.2.3 Cables

For cables there is a significant level of inherent safety of these asset types given the majority of the assets are buried. However, it is considered appropriate to modify the Reference Safety Cost of Failure to account for those situations where cables are exposed above ground, e.g. cable structures or where cables terminate onto overhead line supports.

The overall Safety CoF Factors for cable asset types are determined according to Table 276.

Table 276 – Safety Consequence Factor - Cables

SAFETY CONSEQUENCE FACTOR - CABLES	
Buried	1.0
Exposed (e.g. cable structure)	2.0

D.2.3 Safety Risk Reduction Factor

As described in Section 8.4.3, a Safety Risk Reduction Factor is included in the derivation of Safety CoF. This is used to reflect the impact of measures that are taken to mitigate safety risks associated with individual assets. For LV UGB assets this applies to the mitigation of safety risks through the installation of safety protection blankets. The Safety Risk Reduction Factor is determined as shown in Table 277.

Table 277 – Safety Risk Reduction Factor

SAFETY RISK REDUCTION FACTOR	
LV UGB with Safety Blanket	0.5
All other assets – including LV UGB without Safety Blanket, Battery Systems, Switchgear, Transformers, Cables & Overhead Lines	1.0
Default (no data available)	1.0

D.3 Environmental

D.3.1 Reference Environmental Cost of Failure

The Environmental CoF value for an asset is derived using a Reference Environmental Cost of Failure, which is modified for individual assets using asset-specific factors. This is based on an assessment of the typical environmental impacts of a failure of the asset in each of its three failure modes; incipient, degraded and catastrophic. The Reference Environmental Cost of Failure that shall be used for each Asset Category is shown in Table 278.

This assessment considers four factors.

a) Volume of oil lost;
b) Volume of SF_6 lost;
c) Probability of the event leading to a fire; and
d) Quantity of waste produced.

$$\begin{aligned}&\textbf{Reference Environmental Cost of Failure} = (\textbf{\% of Incipient Failures}) \times \\ &((\textbf{Volume of oil lost per Incipient failure} \times \textbf{Environmental cost per litre oil } (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Incipient failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost } (\pounds/\textbf{kg})) + \\ &(\textbf{Probability of failure leading to a fire per Incipient failure} \times \\ &\textbf{Environmental cost of fire}) + (\textbf{Quantity of waste produced per incipient failure} \times \\ &\textbf{Environmental cost per tonne waste } (\pounds/\textbf{t}))) + (\textbf{\% of Degraded Failures}) \times \\ &((\textbf{Volume of oil lost per Degraded failure} \times \textbf{Environmental cost per litre oil } (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Degraded failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost } (\pounds/\textbf{kg})) + \\ &(\textbf{Probability of failure leading to a fire per Degraded failure} \times \\ &\textbf{Environmental cost of fire}) + (\textbf{Quantity of waste produced per Degraded failure} \times \\ &\textbf{Environmental cost per tonne waste } (\pounds/\textbf{t}))) + (\textbf{\% of Catastrophic Failures}) \times \\ &((\textbf{Volume of oil lost per Catastrophic failure} \times \textbf{Environmental cost per litre oil } (\pounds/\textbf{litre})) + \\ &(\textbf{Volume of SF}_6 \textbf{ lost per Catastrophic failure} \times \textbf{Environmental cost per kg of SF}_6 \textbf{ lost } (\pounds/ \\ &\textbf{kg})) + (\textbf{Probability of failure leading to a fire per Catastrophic failure} \times \\ &\textbf{Environmental cost of fire}) + \textbf{Quantity of waste produced per Catastophic failure} \times \\ &\textbf{Environmental cost per tonne waste } (\pounds/\textbf{t}))))\end{aligned}$$

EQ. 32

Where:

- Environmental cost per litre oil = £43.35/litre;
- Environmental cost per kg of SF_6 lost = £1,723/kg;
  which is derived from:
  - Traded carbon price = £72.10/tonne;
  - Cost of SF_6 loss c/w cost of carbon = 23,900kg(CO_2)/kg.
- Environmental cost of fire = £6,007;
- Environmental cost per tonne waste = £180/tonne;

The sources for the above costs are shown in Table 19 in Section 7.5.2.

The detailed breakdown of the Reference Environmental Cost of Failure by Asset Category is shown in Table 278.

Table 278 – Reference Environmental Cost of Failure

Asset Register Category	Average volume of oil lost per failure (litres)			Average volume of SF6 lost per failure (kg)			Average probability that failure results in a fire			Average quantity of waste per failure (t)			Failures as % of all failures			Reference Environ-mental Consequence
	I	D	C	I	D	C	I	D	C	I	D	C	I	D	C	
LV Main (OHL) Conductor	0	0	0	0	0	0	0	0.001	0.001	0	0.1	0.1	0%	85%	15%	£24
LV OHL Support/Poles	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90
LV Circuit Breaker	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
LV Pillar (ID)	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
LV Pillar (OD at Substation)	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
LV Pillar (OD not at a Substation)	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
LV Board (WM)	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
LV UGB	0	0	0	0	0	0	0	0.0002	0.05	0.01	0.1	0.5	50%	30%	20%	£85
LV Board (X-type Network) (WM)	0	0	0	0	0	0	0	0.0002	0.005	0.01	0.1	0.25	50%	30%	20%	£22
6.6/11 kV OHL (Conventional Conductor)	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
6.6/11 kV OHL (BLX or similar Conductor)	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
20 kV OHL (Conventional Conductor)	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
20 kV OHL (BLX or similar Conductor)	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
6.6/11 kV Poles	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90
20 kV Poles	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90
HV Sub Cable	0	0	0	0	0	0	0	0	0	0	0	20	0%	0%	100%	£3 600
6.6/11 kV CB (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192

Asset Register Category	Average volume of oil lost per failure (litres)			Average volume of SF6 lost per failure (kg)			Average probability that failure results in a fire			Average quantity of waste per failure (t)			Failures as % of all failures			Reference Environ-mental Consequence
6.6/11 kV CB (GM) Primary	10	50	150	0.1	0.2	0.5	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 547
6.6/11 kV CB (GM) Secondary	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
6.6/11 kV Switch (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192
6.6/11 kV Switchgear - Other (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192
6.6/11 kV Switch (GM)	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
6.6/11 kV RMU	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
6.6/11 kV X-type RMU	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
20 kV CB (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192
20 kV CB (GM) Primary	10	50	150	0.1	0.2	0.5	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 547
20 kV CB (GM) Secondary	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
20 kV Switch (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192
20 kV Switchgear - Other (PM)	5	15	61	0.1	0.25	0.7	0	0.0005	0.01	0.2	0.2	0.2	10%	85%	5%	£1 192
20 kV Switch (GM)	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
20 kV RMU	10	50	150	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£1 486
6.6/11 kV Transformer (PM)	10	35	150	0	0	0	0	0.002	0.05	0	0.3	0.3	50%	30%	20%	£2 063
6.6/11 kV Transformer (GM)	20	100	300	0	0	0	0.0002	0.002	0.02	1	2	5	50%	40%	10%	£3 809
20 kV Transformer (PM)	10	35	150	0	0	0	0	0.002	0.05	0	0.3	0.3	50%	30%	20%	£2 063
20 kV Transformer (GM)	20	100	300	0	0	0	0.0002	0.002	0.02	1	2	5	50%	40%	10%	£3 809
Batteries at GM HV Substations	0	0	0	0	0	0	0.00	0.002	0.002	0.00	0.05	0.10	0%	70%	30%	£24
33 kV OHL (Pole Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
33 kV Pole	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90

Asset Register Category	Average volume of oil lost per failure (litres)			Average volume of SF6 lost per failure (kg)			Average probability that failure results in a fire			Average quantity of waste per failure (t)			Failures as % of all failures			Reference Environ-mental Consequence
66 kV OHL (Pole Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
66 kV Pole	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90
33 kV OHL (Tower Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96
33 kV Tower	0	0	0	0	0	0	0	0	0.001	0	0	1	0%	0%	100%	£186
33 kV Fittings	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96
66 kV OHL (Tower Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96
66 kV Tower	0	0	0	0	0	0	0	0	0.001	0	0	1	0%	0%	100%	£186
66 kV Fittings	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96
33 kV UG Cable (Non Pressurised)	0	0	0	0	0	0	0	0	0.001	0	0	4	0%	0%	100%	£726
33 kV UG Cable (Oil)	120	120	1200	0	0	0	0	0	0.001	0.8	0.8	40	45%	54%	1%	£5 885
33 kV UG Cable (Gas)	0	0	0	0	0	0	0	0	0.001	0.2	0.2	10	45%	54%	1%	£54
66 kV UG Cable (Non Pressurised)	0	0	0	0	0	0	0	0	0.001	0	0	4	0%	0%	100%	£726
66 kV UG Cable (Oil)	120	120	1200	0	0	0	0	0	0.001	0.8	0.8	40	45%	54%	1%	£5 885
66 kV UG Cable (Gas)	0	0	0	0	0	0	0	0	0.001	0.2	0.2	10	45%	54%	1%	£54
EHV Sub Cable	0	0	0	0	0	0	0	0	0	0	0	20	0%	0%	100%	£3 600
33 kV CB (Air Insulated Busbars)(ID) (GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
33 kV CB (Air Insulated Busbars)(OD) (GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
33 kV CB (Gas Insulated Busbars)(ID)(GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356

Asset Register Category	Average volume of oil lost per failure (litres)			Average volume of SF6 lost per failure (kg)			Average probability that failure results in a fire			Average quantity of waste per failure (t)			Failures as % of all failures			Reference Environ-mental Conseque nce
33kV CB (Gas Insulated Busbars)(OD)(GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
33 kV Switch (GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
33 kV Switchgear - Other	0	0	0	0	0	0	0	0	0	0.02	0.05	0.2	70%	20%	10%	£8
33 kV Switch (PM)	10	25	80	0.25	0.5	1.5	0	0.0005	0.01	0.2	0.2	0.2	5%	85%	10%	£2 346
33 kV RMU	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
66 kV CB (Air Insulated Busbars)(ID) (GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
66 kV CB (Air Insulated Busbars)(OD) (GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
66 kV CB (Gas Insulated Busbars)(ID)(GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
66 kV CB (Gas Insulated Busbars)(OD)(GM)	25	125	250	0.4	1	3	0	0.0005	0.01	0.2	0.5	2	70%	20%	10%	£4 356
66 kV Switchgear - Other	0	0	0	0	0	0	0	0	0	0.02	0.05	0.2	70%	20%	10%	£8
33 kV Transformer (PM)	15	75	250	0.1	0.1	0.4	0	0.0005	0.01	0.1	0.2	0.5	65%	30%	5%	£2 169
33 kV Transformer (GM)	50	250	2500	0	0	0	0.0002	0.002	0.02	0.2	3	30	50%	40%	10%	£17 048
66 kV Transformer (GM)	50	250	2500	0	0	0	0.0002	0.002	0.02	0.2	3	30	50%	40%	10%	£17 048
Batteries at 33 kV Substations	0	0	0	0	0	0	0.00	0.002	0.002	0.00	0.10	0.25	0%	70%	30%	£38
Batteries at 66k V Substations	0	0	0	0	0	0	0.00	0.002	0.002	0.00	0.10	0.25	0%	70%	30%	£38
132 kV OHL (Pole Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.1	0%	0%	100%	£24
132 kV Pole	0	0	0	0	0	0	0	0	0.0005	0.5	0.5	0.5	49%	49%	2%	£90
13 2kV OHL (Tower Line) Conductor	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96
132 kV Tower	0	0	0	0	0	0	0	0	0.001	0	0	1	0%	0%	100%	£186
132 kV Fittings	0	0	0	0	0	0	0	0	0.001	0	0	0.5	0%	0%	100%	£96

Asset Register Category	Average volume of oil lost per failure (litres)			Average volume of SF6 lost per failure (kg)			Average probability that failure results in a fire			Average quantity of waste per failure (t)			Failures as % of all failures			Reference Environ-mental Conseque nce
132 kV UG Cable (Non Pressurised)	0	0	0	0	0	0	0	0	0.001	0	0	6	0%	0%	100%	£1 086
132 kV UG Cable (Oil)	150	150	1500	0	0	0	0	0	0.001	1.2	1.2	60	45%	54%	1%	£7 410
132 kV UG Cable (Gas)	0	0	0	0	0	0	0	0	0.001	0.3	0.3	15	45%	54%	1%	£81
132 kV Sub Cable	0	0	0	0	0	0	0	0	0	0	0	20	0%	0%	100%	£3 600
132 kV CB (Air Insulated Busbars)(ID) (GM)	50	250	1000	4	10	30	0	0.0005	0.01	0.3	2	10	70%	20%	10%	£21 756
132 kV CB (Air Insulated Busbars)(OD) (GM)	50	250	1000	4	10	30	0	0.0005	0.01	0.3	2	10	70%	20%	10%	£21 756
132 kV CB (Gas Insulated Busbars)(ID) (GM)	50	250	1000	4	10	30	0	0.0005	0.01	0.3	2	10	70%	20%	10%	£21 756
132 kV CB (Gas Insulated Busbars)(OD) (GM)	50	250	1000	4	10	30	0	0.0005	0.01	0.3	2	10	70%	20%	10%	£21 756
132 kV Switchgear - Other	0	0	0	0	0	0	0	0	0	0.03	0.2	1	70%	20%	10%	£29
132 kV Transformer (GM)	100	500	5000	0	0	0	0.0002	0.002	0.02	0.5	10	100	50%	40%	10%	£35 095
Batteries at 132 kV Substations	0	0	0	0	0	0	0.00	0.002	0.002	0.00	0.10	0.25	0%	70%	30%	£38
NOTE: values rounded to nearest £ for presentation in this table																

D.3.2 Environmental Consequence Factors

As described in Section 8.5.3 the resulting Reference Environmental Cost of Failure can then be modified for individual assets within that type based on the application of a Type Environmental Factor, as shown in Table 279, and a Size Environmental Factor, as shown in Table 280 and/or a Location Environmental Factor to result in an Environmental CoF that reflects the characteristics of an individual asset of that type. These are shown in Table 281 by Asset Category Grouping.

The Type Environmental Factor for switchgear shall consider whether the individual asset contains oil or SF_6, either as an interruption medium or insulation medium,

Table 279 – Type Environmental Factor

Type Environment Factor	Oil	SF_6	Neither	Default
HV Switchgear (PM)	0.74	0.44	0.18	0.74
HV Switchgear (GM) - Distribution	0.98	0.04	0.02	0.98
HV Switchgear (GM) - Primary	0.97	0.05	0.02	0.97
EHV Switchgear (PM)	0.62	0.50	0.12	0.62
EHV Switchgear (GM)	0.93	0.10	0.03	0.93
132 kV Switchgear	0.79	0.24	0.03	0.79

All other Asset Categories are set to a default Type Environmental Factor of 1.

Table 280 – Size Environmental Factor

Asset Category	Size Environmental Factor Criteria	Size Environmental Factor
6.6/11 kV Transformer (GM)	≥2 MVA	1.5
	≥750kVA and <2MVA	1
	≥500kVA and <750kVA	1
	<500kVA	0.6
20 kV Transformer (GM)	≥2 MVA	1.5
	≥750kVA and <2MVA	1
	≥500kVA and <750kVA	1
	<500kVA	0.6
33 kV Transformer (GM)	33/20 kV, >20MVA CMR equivalent	1.6
	33/20 kV, >10MVA and ≤20MVA CMR equivalent	1
	33/20 kV, ≤10MVA CMR equivalent	0.7
	33/11 or 6.6kV, >20MVA CMR equivalent	1.6

Asset Category	Size Environmental Factor Criteria	Size Environmental Factor
	33/11 or 6.6kV, >10MVA and ≤20MVA CMR equivalent	1
	33/11 or 6.6kV, ≤10MVA CMR equivalent	0.7
66 kV Transformer (GM)	66/20 kV, >20MVA CMR equivalent	1.6
	66/20 kV, >10MVA and ≤20MVA CMR equivalent	1
	66/20 kV, ≤10MVA CMR equivalent	0.7
	66/33 kV	1.2
	66/11/11 kV	1.2
	66/11 or 6.6kV, >20MVA CMR equivalent	1.6
66 kV Transformer (GM)	66/11 or 6.6kV, >10MVA and ≤20MVA CMR equivalent	1
	66/11 or 6.6kV, ≤10MVA CMR equivalent	0.7
132 kV Transformer (GM)	132/66 kV, ≤60MVA	0.8
	132/66 kV, >60MVA	1
	132/33 kV, ≤60MVA	0.8
	132/33 kV, >60MVA	1
	132/11/11 kV	0.8
	132/11 kV	0.7
	132/20 kV	0.7
	132/20/20 kV	0.8
6.6/11 kV Transformer (PM)	< 50kVA,1P	0.4
	≥ 50kVA, 1P	0.7
	< 50kVA, 3P	0.4
	≥ 50kVA and < 200kVA, 3P	1
	≥ 200kVA, 3P	1.4
	Reactors & Regulators	1.5
20 kV Transformer (PM)	< 50kVA,1P	0.4
	≥ 50kVA, 1P	0.7

Asset Category	Size Environmental Factor Criteria	Size Environmental Factor
20 kV Transformer (PM)	< 50kVA, 3P	0.4
	≥ 50kVA and < 200kVA, 3P	1
	≥ 200kVA, 3P	1.4
	Reactors & Regulators	1.5
33 kV Transformer (PM)	< 50kVA,1P	0.4
	≥ 50kVA, 1P	0.7
	< 50kVA, 3P	0.4
	≥ 50kVA and < 200kVA, 3P	1
	≥ 200kVA, 3P	1.4
	Reactors & Regulators	1.5
132 kV Switchgear	132 kV CB (Air Insulated Busbars)(ID)(GM)	1
	132 kV CB (Air Insulated Busbars)(OD)(GM)	1
	132 kV CB (Gas Insulated Busbars)(ID)(GM)	2.5
	132 kV CB (Gas Insulated Busbars)(OD)(GM)	2.5

The default value for Size Environmental Factor is 1. The default value shall be applied to all those Asset Categories that are not shown in Table 280.

Table 281 – Location Environmental Factor

Asset Category	Proximity Factor					Bunding Factor		
	Not Close to Water Course (>120m) or No Oil	Moderately Close to Water Course (between 80m and 120m)	Close to Water Course (between 40m and 80m)	Very Close to Water Course (<40m)	Default	Bunded	Not bunded	Default
EHV UG Cable (Oil)	0.8	1	1.5	2.5	1	0.5	1	1
132 kV UG Cable (Oil)	0.8	1	1.5	2.5	1	0.5	1	1
HV Switchgear (PM)	0.8	1	1.5	2.5	1	0.5	1	1

Asset Category	Proximity Factor					Bunding Factor		
	Not Close to Water Course (>120m) or No Oil	Moderately Close to Water Course (between 80m and 120m)	Close to Water Course (between 40m and 80m)	Very Close to Water Course (<40m)	Default	Bunded	Not bunded	Default
HV Switchgear (GM) - Distribution	0.8	1	1.5	2.5	1	0.5	1	1
HV Switchgear (GM) - Primary	0.8	1	1.5	2.5	1	0.5	1	1
EHV Switchgear (PM)	0.8	1	1.5	2.5	1	0.5	1	1
EHV Switchgear (GM)	0.8	1	1.5	2.5	1	0.5	1	1
132 kV Switchgear	0.8	1	1.5	2.5	1	0.5	1	1
HV Transformer (PM)	0.8	1	1.5	2.5	1	N/A	1	1
HV Transformer (GM)	0.8	1	1.5	2.5	1	0.5	1	1
EHV Transformer (PM)	0.8	1	1.5	2.5	1	N/A	1	1
EHV Transformer (GM)	0.8	1	1.5	2.5	1	0.5	1	1
132 kV Transformer (GM)	0.8	1	1.5	2.5	1	0.5	1	1

The default value for Location Environmental Factor is 1. The default value shall be applied to all those Asset Categories that are not shown in Table 281.

D.4 Network Performance

D.4.1 Reference Network Performance Cost of Failure (LV & HV)

The Reference Network Performance Cost of Failure is based on an assessment of the typical network costs incurred by a failure of the asset as measured through its impact in relation to the number of customers interrupted and the duration of those interruptions. For regulatory purposes, this is captured via the IIS mechanism.

Table 282 – Costs Used in Derivation of Network Performance Reference Cost of Failure

Parameter	£ (at 2020/21 prices)
Cost of CML	£0.45
Cost of CI	£18.55
NOTE: source: Ofgem RIIO-ED2 CBA template	

For each Asset Category, an assessment is made of:

a) the typical number of customers interrupted by a failure; and
b) the typical duration of any loss of supply to customers.

This assessment considers two time periods that reflect the initial fault impact and response activity and the subsequent time to fully restore supplies and restore the asset to its pre-fault state, as illustrated in Figure 28.

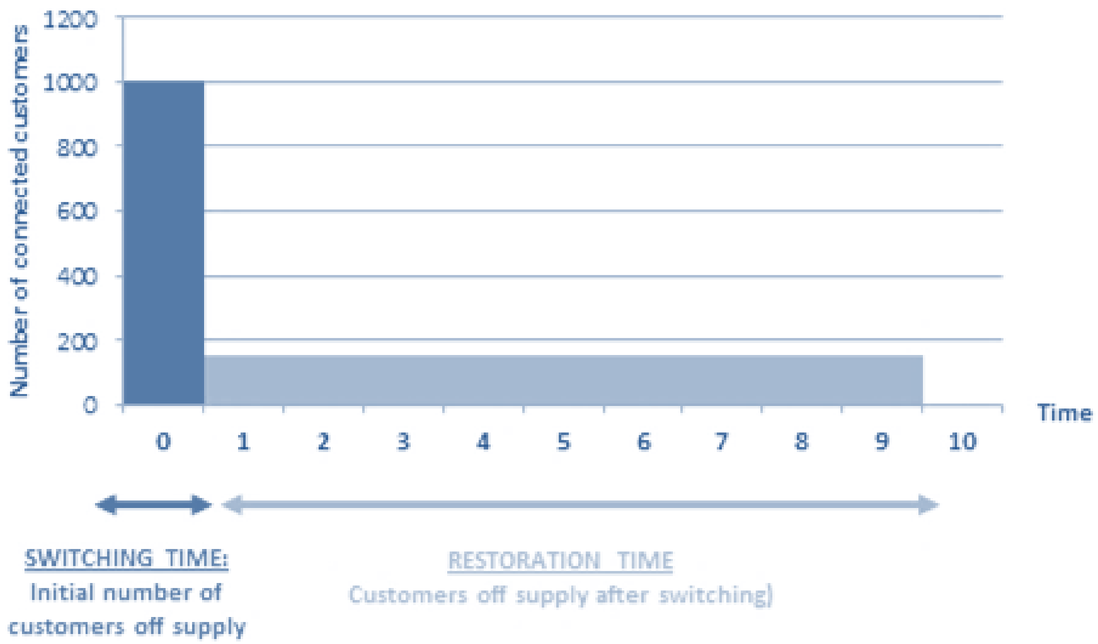

Figure 28 – Network Performance - LV & HV

This considers:

a) the proportion of failures that result in an interruption to supply. This is taken as being the proportion of total failures that are Degraded Failures or Catastrophic Failures. It is assumed that remedial works to address Incipient Failures can be undertaken as planned works and therefore that mitigation measures would be employed to avoid any Network Performance impact;

b) the typical number of customers connected to the section of distribution network that is affected by failure of the asset (the Reference Number of Connected Customers);

c) the typical number of customers whose supply is restored through immediate switching. This is expressed as a proportion of the Reference Number of Connected Customers. A customer's supply is only considered as being interrupted where supply is not restored immediately, which is consistent with the IIS mechanism;

d) the typical time to restore further supplies through manual switching;

e) the typical number of customers whose supplies are restored following completion of manual switching. This is expressed as a proportion of the Reference Number of connected Customers (and represents the total number of customers whose supplies are restored by immediate switching or manual switching); and

f) the typical time to repair the failure (and restore any remaining supplies that were not restored by manual switching).

In evaluating the Reference Network Performance Cost of Failure:

a) the number of customers interrupted per failure is multiplied by the relevant cost of a customer interruption (Cost of CI); and

b) the number of customer minutes without supply per failure is evaluated; and multiplied by the relevant cost of a customer minute lost (Cost of CML)

to produce a cost per failure for a given Reference Number of Connected Customers. This is shown in EQ. 36.

$$\begin{aligned}
&\textbf{Reference Network Performance Cost of Failure} = \\
&[(\textbf{Cost of CML} \times \textbf{60} \times \textbf{Reference Number of CC} \times \textbf{Switching Time} \times (\textbf{100\%} \\
&\qquad - \textbf{\% of CC restored through immediate switching})) \\
&+ (\textbf{Cost of CML} \times \textbf{60} \times \textbf{Reference Number of CC} \times \textbf{Restoration Time} \times \\
&(\textbf{100\%} - \textbf{\% of CC restored after manual switching})) \\
&+ (\textbf{Cost of CI} \times \textbf{Reference Number of CC} \times \\
&(\textbf{100\%} - \textbf{\% of CC restored through immediate switching}))] \times \text{\% of failures that result in}
\end{aligned}$$

EQ. 36

where:

- CC = Connected Customers;
- Switching Time and Restoration Time are durations (in hours)

Table 283 summarises the parameters used in evaluating the Reference Network Performance Cost of Failure for each HV and LV Asset Category.

Table 283 – Reference Network Performance Cost of Failure for LV & HV Assets

Asset Category	Reference Number of Connected Customers	Proportion of connected customers restored through immediate (< 3min) switching	Proportion of customers restored after manual switching	Manual switching time (hours)	Typical repair time (hours)	Proportion of failures that result in interruption to supply	Reference Network Performance Cost (£)
LV Poles	30	0%	0%	1	5	10%	£542
LV Circuit Breaker	150	0%	85%	1	7	100%	£11,085
LV Pillar (ID)	150	25%	89%	1	7	100%	£8,243
LV Pillar (OD at Substation)	150	25%	89%	1	7	100%	£8,243
LV Pillar (OD not at a Substation)	50	25%	89%	1	7	100%	£2,748
LV Board (WM)	150	25%	89%	1	7	100%	£8,243
LV UGB	50	25%	89%	1	7	100%	£2,748
LV Board (X-type Network) (WM)	150	25%	89%	1	7	100%	£8,243
6.6/11 kV OHL (Conventional Conductor)	1000	60%	94%	0.5	3	100%	£17,680
6.6/11 kV OHL (BLX or similar Conductor)	1000	60%	94%	0.5	3	100%	£17,680
20 kV OHL (Conventional Conductor)	1500	60%	94%	0.5	3	100%	£26,520
20 kV OHL (BLX or similar Conductor)	1500	60%	94%	0.5	3	100%	£26,520
6.6/11 kV Poles	1000	60%	94%	0.5	4	10%	£1,930
20 kV Poles	1500	60%	94%	0.5	4	10%	£2,895
HV Sub Cable	800	40%	60%	2	18	100%	£190,344
6.6/11 kV CB (PM)	1000	80%	94%	0.5	2	50%	£4,825
6.6/11 kV CB (GM) Primary	3500	60%	94%	0.5	6	60%	£47,334
6.6/11 kV CB (GM) Secondary	1000	60%	94%	0.5	6	60%	£13,524

Asset Category	Reference Number of Connected Customers	Proportion of connected customers restored through immediate (< 3min) switching	Proportion of customers restored after manual switching	Manual switching time (hours)	Typical repair time (hours)	Proportion of failures that result in interruption to supply	Reference Network Performance Cost (£)
6.6/11 kV Switch (PM)	1000	80%	94%	0.5	2	50%	£4,825
6.6/11 kV Switchgear - Other (PM)	1000	80%	94%	0.5	2	50%	£4,825
6.6/11 kV Switch (GM)	1000	60%	94%	0.5	6	60%	£13,524
6.6/11 kV RMU	1000	60%	94%	0.5	6	60%	£13,524
6.6/11 kV X-type RMU	1000	60%	94%	0.5	6	60%	£13,524
20 kV CB (PM)	1500	80%	94%	50%	2	50%	£7,238
20 kV CB (GM) Primary	3500	60%	94%	0.5	6	60%	£47,334
20 kV CB (GM) Secondary	1500	60%	94%	0.5	6	60%	£20,286
20 kV Switch (PM)	1500	80%	94%	50%	2	50%	£7,238
20 kV Switchgear - Other (PM)	1500	80%	94%	0.5	2	50%	£7,238
20 kV Switch (GM)	1500	60%	94%	0.5	6	60%	£20,286
20 kV RMU	1500	60%	94%	0.5	6	60%	£20,286
6.6/11 kV Transformer (PM)	10	0	0	0.5	2	50%	£430
6.6/11 kV Transformer (GM)	150	0%	85%	0.5	6	60%	£5,072
20 kV Transformer (PM)	10	0	0	0.5	3	50%	£565
20 kV Transformer (GM)	150	0%	85%	0.5	6	60%	£5,072
Batteries at GM HV Substations	1000	60%	94%	0.5	2	0.10%	£16
33 kV Transformer (PM)	10	0	0	0.5	3	50%	£565
NOTE: values rounded to nearest £ for presentation in this table							

D.4.2 Network Performance Factors (LV & HV) and Transformer (PM) at HV & EHV)

As described in Section 8.6.2.1, the Reference Network Performance Cost of Failure can then be modified on an asset by asset basis as shown in EQ. 37.

$$\textbf{Network Performance Cost of Failure} \\ = \textbf{Reference Network Performance Cost of Failure} \\ \times \textbf{Network Performance Consequence Factor}$$

EQ. 37

Where:

$$\textbf{Network Performance Consequence Factor} \\ = \textbf{Customer Factor} \text{ x } \textbf{Customer Sensitivity Factor} \textbf{ x Network Protection Factor}$$

EQ. 38

Note: The Network Protection Factor is only applicable for Transformers (PM) at HV & EHV otherwise it is not applicable, see Table 285 for reference Network Protection Factors.

Customer Factor

This Factor is used to reflect the number of customers impacted by failure of an individual asset, relative to the reference number of customers used in the derivation of the Reference Network Performance Cost of Failure.

This is applied as a direct Factor, i.e. not via a lookup table. For example, if the number of customers used in the derivation of the Reference Network Performance Cost of Failure is 100, but for a specific example it is 80 (or 120), then a modifying factor of 0.8 (or 1.2) would be applied.

$$\textbf{Customer Factor} = \frac{\textbf{No. of Customers}}{\textbf{Reference No. of Customers}}$$

EQ. 39

Where a DNO identifies that the customers fed by an individual asset have an exceptionally high demand per customer, then the No. of Customers used in the derivation of EQ. 39 may be derived by applying an adjustment to the actual number of customers fed by the asset as shown in Table 284 which is a repeat of Table 20. This adjustment recognises that for high demand customers the cost of a customer interruption and a customer minute lost may not reflect the value of lost load to the customer. DNOs can elect whether or not to apply this adjustment within their implementation of the Methodology.

Table 284 (Table 20 Repeated) – Customer Number Adjustment for LV & HV Assets with High Demand Customers

Maximum Demand on Asset / Total Number of Customers fed by the Asset (kVA per Customer)	No. of Customers to be used in the derivation of Customer Factor
< 50	1 x actual number of customers fed by the asset
≥ 50 and < 100	25 x actual number of customers fed by the asset
≥ 100 and < 500	100 x actual number of customers fed by the asset
≥ 500 and < 1000	250 x actual number of customers fed by the asset
≥ 1000 and < 2000	500 x actual number of customers fed by the asset
≥ 2000	1000 x actual number of customers fed by the asset

The default value for the Customer Factor is 1.

Customer Sensitivity Factor

The Customer Sensitivity Factor is used to reflect circumstances where the customer impact is increased due to customer reliance on electricity (e.g. vulnerable customers). DNOs may use this factor at their discretion in order to modify the Network Performance Consequence Factor.

The default value for the Customer Sensitivity Factor is 1. Individual DNOs are provided with the freedom within the Methodology to apply a Customer Sensitivity Factor, other than the default, to the Network Performance Consequences (LV & HV) for any asset, provided that:

a) the individual DNO documents all instances where a Customer Sensitivity Factor different from the default is applied within their individual Network Asset Indices Methodology; and

b) The Customer Sensitivity Factor shall not be less than 1, nor greater than 2.

Network Protection Factor (Transformers (PM))

The reference Network Protection Factor assumes a transformer failure that is locally protected for HV & EHV networks only. However, this may not always be the case and therefore impacts on circuits network performance cost should a failure occur.

As a result, the Network Protection Factor enables the impact for each assets configuration to be reflected by way of an additional factor.

Table 285 – Network Protection Factor

Protection Zone	Protection Zone Description	Network Protection Factor
Locally	As this asset is directly protected (e.g. HV / EHV Fuses above HV / EHV pole mounted transformer), the failure of this asset will only effect downstream connected customers	1
Spur	As this asset is group protected by a spur, the failure of this asset will impact all customers connected downstream of the protection zone.	1.3
Sectionaliser/Reclosure	As this asset is group protected by a sectionaliser/reclosure, the failure of this asset will impact all customers connected downstream of the protection zone.	1.6
Source Circuit Breaker	As this asset is group protected by the source circuit breaker, the failure of this asset will impact all customers connected downstream of the protection zone.	2
Default	If the protection arrangement of the pole mounted transformer is unknown.	1

D.4.3 Reference Network Performance Cost of Failure (EHV & 132 kV)

For EHV and 132 kV assets the Reference Network Performance Cost of Failure is based on an assessment of the amount of Load at Risk during three stages of failure, and the typical duration of each stage:

a) During fault (T1): this is the time period between initial circuit protection trip operation and automatic switching to reconfigure the network;

b) During initial switching (T2): this is the time period during which further manual network switching is undertaken to reconfigure the network to minimise the risk associated with a further circuit outage; and

c) During repair time (T3).

These three stages are illustrated in Figure 29.

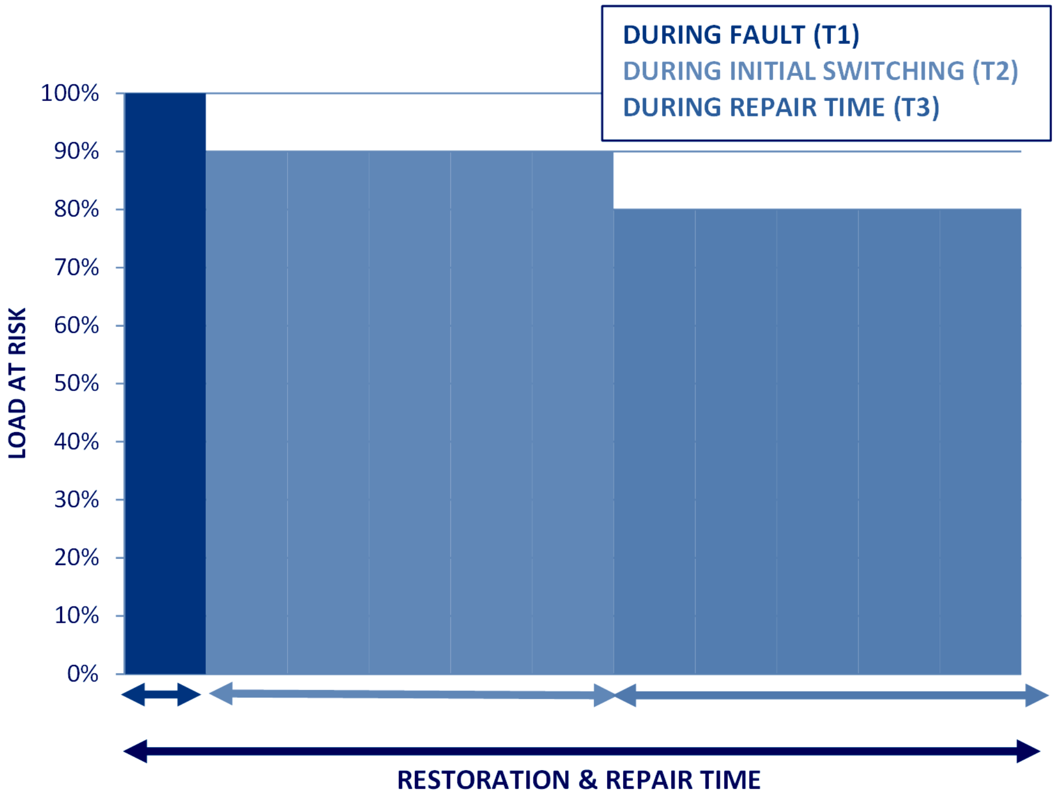

Figure 29 – Reference Network Performance Cost of Failure (EHV & 132 kV)

The Load at Risk during each stage represents the amount of load that would experience a loss of supply if a further circuit outage were to occur. The probability of the occurrence of such a further coincident outage is considered in the derivation of the Reference Network Performance Cost of Failure.

The proportion of failures that result in an unplanned outage is also considered. This is taken as being the proportion of total failures that are Degraded Failures or Catastrophic Failures. It is assumed that remedial works to address Incipient Failures can be undertaken as planned works and therefore can be scheduled, or mitigation measures employed, to avoid any Network Performance impact of a coincident outage.

The Load at risk, duration, probability of a further coincident outage and proportion of failures resulting in an unplanned outage are used to derive the probable amount of load lost (in MVAh) per failure. The relevant Value of Lost Load (VoLL) is then used to derive a typical Reference Network Performance Cost of Failure for these assets.

$$\textbf{Reference Network Performance Cost of Failure} =$$

$$\big((\textbf{Load at risk in T1} \times \textbf{Duration of T1}) + (\textbf{Load at risk in T2} \times \textbf{Duration of T2}) + (\textbf{Load at risk in T3} \times \textbf{Duration of T3})\big) \times \textbf{\% of failures that result in an unplanned outage} \times \textbf{Probability of further coincident outage} \times \textbf{VoLL}$$

EQ. 40

The value of VoLL adopted in this instance is £21 788 (Para 7.36 of Ofgem's document titled "RIIO-ED2 Methodology Decision: Annex 1 - Delivering value for money services for consumers" (17th December 2020) states a decision to set VoLL at £21 000 (at 2018/19 prices) for use in setting IIS incentive rates in RIIO-ED2. This has been inflated to 2020/21 prices).

Typical values of Load at Risk have been used, for each Asset Category in deriving the Reference Network Performance Cost of Failure. These are based on consideration of:

a) typical values for the maximum demand that would normally be supplied from the affected section of network; and

b) the proportion of the maximum demand that would be at risk of loss of supply, should a further coincident outage occur, during each stage (i.e. periods T1, T2 and T3)

such that:

$$\textbf{Load at risk in T1} = \textbf{Maximum Demand} * \textbf{\% of maximum demand at risk during T1};$$

$$\textbf{Load at risk in T2} = \textbf{Maximum Demand} * \textbf{\% of maximum demand at risk during T2};$$

$$\textbf{Load at risk in T3} = \textbf{Maximum Demand} * \textbf{\% of maximum demand at risk during T3}$$

EQ. 43

In this way, the Reference Network Performance Cost of Failure represents costs associated with a given level of maximum demand. This is representative of networks that are secure for a first circuit outage.

For linear assets (Cables and OHL), the maximum demand that is used to derive the reference costs is determined by applying a likely utilisation to a typical circuit rating for circuits of that voltage.

For discrete plant assets, the load at risk is more quantifiable and therefore the maximum demand that is used to derive the reference costs is based on the rating of the asset (in the case of transformers) or the board at the substation in the case of switchgear (it is assumed half of the switchboard would be out of commission for the catastrophic failure of a circuit breaker).

Table 286 shows the values of Reference Network Performance Cost of Failure that shall be used for EHV and 132 kV assets. This table also shows the maximum demand used to derive these reference costs. The Load Factor that is applied in the calculation of Network Performance Consequences shall be calculated using these maximum demand values.

Table 286 – Reference Network Performance Cost of Failure for EHV & 132 kV assets (Secure)

Asset Category	Maximum Demand Used to Derive Reference Cost (MVA)	Load at Risk (MVA) as % of Maximum Demand			Time (hours)			Probability of a coincident fault per hr	Proportion of failures that result in an unplanned outage	Reference Cost for Assets in Secure Networks (£)
		During T1 period	During T2 period	During T3 period	T1	T2	T3			
33 kV OHL (Pole Line) Conductor	12	100%	100%	80%	0	3	3	0.05%	100%	£706
33 kV Pole	12	100%	100%	80%	0	3	5	0.05%	10%	£92
66 kV OHL (Pole Line) Conductor	24	100%	100%	80%	0	3	5	0.05%	100%	£1 830
66 kV Pole	24	100%	100%	80%	0	3	7	0.05%	10%	£225
33 kV OHL (Tower Line) Conductor	12	100%	100%	80%	0	3	9	0.05%	100%	£1 333
33 kV Tower	12	100%	100%	80%	0	3	24	0.05%	20%	£580
33 kV Fittings	12	100%	100%	80%	0	3	9	0.05%	20%	£267
66 kV OHL Conductor	24	100%	100%	80%	0	3	9	0.05%	100%	£2 667
66 kV Tower	24	100%	100%	80%	0	3	36	0.05%	20%	£1 663
66 kV Fittings	24	100%	100%	80%	0	3	9	0.05%	20%	£533
33 kV UG Cable (Non Pressurised)	12	100%	100%	80%	0	3	30	0.05%	100%	£3 530
33 kV UG Cable (Oil)	12	100%	100%	80%	0	3	30	0.05%	0.10%	£4
33 kV UG Cable (Gas)	12	100%	100%	80%	0	3	30	0.05%	1%	£35
66 kV UG Cable (Non Pressurised)	24	100%	100%	80%	0	3	30	0.05%	100%	£7 059
66 kV UG Cable (Oil)	24	100%	100%	80%	0	3	30	0.05%	0.10%	£7
66 kV UG Cable (Gas)	24	100%	100%	80%	0	3	30	0.05%	1%	£71
EHV Sub Cable	12	100%	100%	80%	0	3	30	0.05%	100%	£3 530
33 kV CB (Air Insulated Busbars)(ID) (GM)	30	100%	100%	80%	0	2	200	0.05%	55%	£29 120
33 kV CB (Air Insulated Busbars)(OD) (GM)	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740

Asset Category	Maximum Demand Used to Derive Reference Cost (MVA)	Load at Risk (MVA) as % of Maximum Demand			Time (hours)			Probability of a coincident fault per hr	Proportion of failures that result in an unplanned outage	Reference Cost for Assets in Secure Networks (£)
		During T1 period	During T2 period	During T3 period	T1	T2	T3			
33 kV CB (Gas Insulated Busbars)(ID) (GM)	30	100%	100%	80%	0	2	200	0.05%	55%	£29 120
33 kV CB (Gas Insulated Busbars)(OD) (GM)	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740
33 kV Switch (GM)	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740
33 kV Switchgear - Other	30	100%	100%	80%	0	2	24	0.05%	55%	£3 811
33 kV Switch (PM)	30	100%	100%	80%	0	2	10	0.05%	55%	£1 798
33 kV RMU	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740
66 kV CB (Air Insulated Busbars)(ID) (GM)	30	100%	100%	80%	0	2	200	0.05%	55%	£29 120
66 kV CB (Air Insulated Busbars)(OD) (GM)	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740
66 kV CB (Gas Insulated Busbars)(ID) (GM)	30	100%	100%	80%	0	2	200	0.05%	55%	£29 120
66 kV CB (Gas Insulated Busbars)(OD) (GM)	30	100%	100%	80%	0	2	100	0.05%	55%	£14 740
66 kV Switchgear - Other	30	100%	100%	80%	0	2	24	0.05%	55%	£3 811
33 kV Transformer (GM)	15	100%	100%	80%	0	2	400	0.05%	55%	£28 940
66 kV Transformer	15	100%	100%	80%	0	2	400	0.05%	55%	£28 940
Batteries at 33 kV Substations	15	100%	100%	100%	1	1	1	0.05%	0.10%	£0
Batteries at 66 kV Substations	15	100%	100%	100%	1	1	1	0.05%	0.10%	£0
132 kV OHL (Pole Line) Conductor	60	100%	100%	70%	0	3	7	0.05%	100%	£5 164
132 kV Pole	60	100%	100%	70%	0	3	9	0.05%	10%	£608
132 kV OHL (Tower Line) Conductor	60	100%	100%	70%	0	3	9	0.05%	100%	£6 079

Asset Category	Maximum Demand Used to Derive Reference Cost (MVA)	Load at Risk (MVA) as % of Maximum Demand			Time (hours)			Probability of a coincident fault per hr	Proportion of failures that result in an unplanned outage	Reference Cost for Assets in Secure Networks (£)
		During T1 period	During T2 period	During T3 period	T1	T2	T3			
132 kV Tower	60	100%	100%	70%	0	3	36	0.05%	20%	£3 687
132 kV Fittings	60	100%	100%	70%	0	3	9	0.05%	20%	£1 216
132 kV UG Cable (Non Pressurised)	60	100%	100%	70%	0	3	30	0.05%	100%	£15 687
132 kV UG Cable (Oil)	60	100%	100%	70%	0	3	30	0.05%	0.10%	£16
132 kV UG Cable (Gas)	60	100%	100%	70%	0	3	30	0.05%	1%	£157
132 kV Sub Cable	60	100%	100%	70%	0	3	30	0.05%	100%	£15 687
132 kV CB (Air Insulated Busbars)(ID) (GM)	80	100%	100%	70%	0	1	400	0.05%	55%	£134 693
132 kV CB (Air Insulated Busbars)(OD) (GM)	80	100%	100%	70%	0	1	100	0.05%	55%	£34 033
132 kV CB (Gas Insulated Busbars)(ID) (GM)	80	100%	100%	70%	0	1	400	0.05%	55%	£134 693
132 kV CB (Gas Insulated Busbars)(OD) (GM)	80	100%	100%	70%	0	1	100	0.05%	55%	£34 033
132 kV Switchgear - Other	80	100%	100%	70%	0	1	24	0.05%	55%	£8 532
132 kV Transformer	60	100%	100%	70%	0	1	800	0.05%	55%	£201 681
Batteries at 132 kV Substations	60	100%	100%	100%	1	1	1	0.05%	0.10%	£2
NOTE: values rounded to nearest £ for presentation in this table										

D.4.4 Network Performance Factors (EHV & 132 kV)

As described in Section 8.6.3.2 the Network Performance CoF is derived on an asset by asset basis as shown in EQ. 41.

$$\textbf{Network Performance Consequences of Failure} = \textbf{Reference Network Performance Cost of Failure} \times \textbf{Load Factor} \times \textbf{Network Type Factor}$$

EQ. 41

Load Factor

This Factor allows for the Network Performance CoF to reflect the actual load at risk associated with the failure of the asset under consideration, relative to the value of maximum demand used to create the reference value.

The Load Factor is determined as shown in EQ. 42 (i.e. not via a lookup table).

$$\textbf{Load Factor} = \frac{\textbf{Actual Load at Risk Associated with the Failure of the Asset Under Consideration}}{\textbf{Maximum Demand Used To Derive Reference Network Performance Cost of Failure}}$$

EQ. 42

For example, if the Reference Network Performance Cost of Failure has been derived using a reference maximum demand of 12MVA, but for a specific asset the actual load at risk was 6MVA then a Load Factor of 0.5 would be applied.

The values of maximum demand used in derivation of the Reference Network Performance Cost of Failure can be found in Table 286 in Annex D.

Where the actual load is not known, the default value for Load Factor is dependent on the security of supply of the associated network.

A default Load Factor of 0.5 shall be applied where an individual asset is located in a network that is not secure for a first circuit outage event that would result from failure of the asset (i.e. the network would be considered not secure if the load normally supplied by the asset would be interrupted and not restored automatically, in such an event).

A default Load Factor of 1 shall apply to assets in secure networks or where the security of the network is unknown.

Network Type Factor

This Network Performance CoF is derived on an asset by asset basis by the application of a Network Type Factor to take account of the security of supply afforded by the topology of the network in which the individual asset is located.

A Network Type Factor of 2.5 shall be applied where an individual asset is located in a network that is not secure for a first circuit outage event that would result from failure of the asset (i.e. the network would be considered not secure if the load normally supplied by the asset would be interrupted and not restored automatically, in such an event).

A Network Type Factor of 1 shall apply to assets in secure networks.

The default value for Network Type Factor is 1.

D.5 Network Performance – Network Type Factor

Table 287 – Reference Network Performance Cost of Failure for EHV & 132 KV Assets – Network Type

Network Type	Network Type Factor
Secure	2.5
Unsecure	1.0

Annex E
(informative)

Weighting Factors for application to risk matrices

E.1 Typical Weighting Factors for Criticality Index Bands

Table 288 – Typical CoF Weightings for Criticality Index Bands for use with Risk Matrices

Asset Register Category	Typical COF Weightings for Each Criticality Index Band (£ at 20/21 prices)			
	C1	C2	C3	C4
LV Main (OHL) Conductor	£22 928	£32 754	£49 131	£81 886
LV Poles	£1 799	£2 570	£3 855	£6 424
LV Circuit Breaker	£17 000	£24 285	£36 428	£60 713
LV Pillar (ID)	£16 129	£23 042	£34 563	£57 605
LV Pillar (OD at Substation)	£16 480	£23 543	£35 315	£58 858
LV Pillar (OD not at a Substation)	£11 074	£15 820	£23 731	£39 551
LV Board (WM)	£17 644	£25 206	£37 810	£63 016
LV UGB	£11 118	£15 884	£23 825	£39 709
LV Board (X-type Network) (WM)	£18 632	£26 617	£39 926	£66 543
6.6/11 kV OHL (Conventional Conductor)	£39 370	£56 243	£84 365	£140 608
6.6/11 kV OHL (BLX or similar Conductor)	£41 132	£58 760	£88 139	£146 899
20 kV OHL (Conventional Conductor)	£46 463	£66 375	£99 563	£165 938
2 0kV OHL (BLX or similar Conductor)	£48 622	£69 460	£104 190	£173 651
6.6/1 1kV Poles	£2 893	£4 133	£6 200	£10 333
20 kV Poles	£3 836	£5 480	£8 221	£13 701
HV Sub Cable	£263 159	£375 942	£563 913	£939 854
6.6/11 kV CB (PM)	£10 065	£14 379	£21 569	£35 948
6.6/11 kV CB (GM) Primary	£60 806	£86 865	£130 298	£217 163
6.6/11 kV CB (GM) Secondary	£20 540	£29 343	£44 014	£73 357
6.6/11 kV Switch (PM)	£9 287	£13 268	£19 902	£33 169

Asset Register Category	Typical COF Weightings for Each Criticality Index Band (£ at 20/21 prices)			
	C1	C2	C3	C4
6.6/11 kV Switchgear - Other (PM)	£10 783	£15 405	£23 107	£38 512
6.6/11 kV Switch (GM)	£20 405	£29 149	£43 724	£72 874
6.6/11 kV RMU	£20 770	£29 672	£44 508	£74 180
6.6/11 kV X-type RMU	£23 203	£33 147	£49 721	£82 868
20 kV CB (PM)	£13 455	£19 221	£28 832	£48 053
20 kV CB (GM) Primary	£63 369	£90 527	£135 790	£226 316
20 kV CB (GM) Secondary	£25 408	£36 297	£54 445	£90 742
20 kV Switch (PM)	£9 977	£14 253	£21 379	£35 632
20 kV Switchgear - Other (PM)	£9 977	£14 253	£21 379	£35 632
20 kV Switch (GM)	£25 319	£36 170	£54 255	£90 425
20 kV RMU	£25 633	£36 618	£54 928	£91 546
6.6/11 kV Transformer (PM)	£4 647	£6 639	£9 958	£16 597
6.6/11kV Transformer (GM)	£18 982	£27 117	£40 675	£67 792
20 kV Transformer (PM)	£5 369	£7 670	£11 505	£19 175
20 kV Transformer (GM)	£20 283	£28 976	£43 464	£72 440
Batteries at GM HV Substations	£659	£941	£1 411	£2 352
33 kV OHL (Pole Line) Conductor	£46 166	£65 951	£98 926	£164 877
33 kV Pole	£1 993	£2 847	£4 271	£7 118
66 kV OHL (Pole Line) Conductor	£47 945	£68 493	£102 740	£171 233
66 kV Pole	£2 963	£4 233	£6 349	£10 582
33 kV OHL (Tower Line) Conductor	£54 850	£78 357	£117 536	£195 893
33 kV Tower	£5 525	£7 893	£11 839	£19 732
33 kV Fittings	£1 469	£2 098	£3 148	£5 246
66 kV OHL (Tower Line) Conductor	£67 928	£97 040	£145 559	£242 599
66 kV Tower	£10 411	£14 873	£22 309	£37 181

Asset Register Category	**Typical COF Weightings for Each Criticality Index Band (£ at 20/21 prices)**			
	C1	**C2**	**C3**	**C4**
66 kV Fittings	£1 701	£2 429	£3 644	£6 074
33 kV UG Cable (Non Pressurised)	£25 131	£35 901	£53 852	£89 754
33 kV UG Cable (Oil)	£4 214	£6 020	£9 030	£15 051
33 kV UG Cable (Gas)	£285	£407	£611	£1 018
66 kV UG Cable (Non Pressurised)	£50 266	£71 808	£107 712	£179 520
66 kV UG Cable (Oil)	£4 224	£6 034	£9 051	£15 086
66 kV UG Cable (Gas)	£452	£645	£968	£1 613
EHV Sub Cable	£204 717	£292 453	£438 680	£731 133
33 kV CB (Air Insulated Busbars)(ID) (GM)	£59 279	£84 685	£127 027	£211 711
33 kV CB (Air Insulated Busbars)(OD) (GM)	£42 327	£60 467	£90 700	£151 167
33 kV CB (Gas Insulated Busbars)(ID)(GM)	£69 262	£98 946	£148 418	£247 364
33 kV CB (Gas Insulated Busbars)(OD)(GM)	£45 206	£64 581	£96 871	£161 452
33 kV Switch (GM)	£36 998	£52 854	£79 281	£132 135
33 kV Switchgear - Other	£6 027	£8 610	£12 915	£21 524
33 kV Switch (PM)	£6 572	£9 389	£14 083	£23 472
33 kV RMU	£47 561	£67 944	£101 916	£169 861
66 kV CB (Air Insulated Busbars)(ID) (GM)	£78 545	£112 207	£168 310	£280 517
66 kV CB (Air Insulated Busbars)(OD) (GM)	£62 195	£88 849	£133 274	£222 123
66 kV CB (Gas Insulated Busbars)(ID)(GM)	£109 610	£156 586	£234 878	£391 464

Asset Register Category	**Typical COF Weightings for Each Criticality Index Band (£ at 20/21 prices)**			
	C1	**C2**	**C3**	**C4**
66 kV CB (Gas Insulated Busbars)(OD)(GM)	£66 341	£94 773	£142 159	£236 932
33 kV Transformer (GM)	£110 031	£157 188	£235 781	£392 969
66 kV Switchgear - Other	£6 328	£9 041	£13 561	£22 601
66 kV Transformer (GM)	£143 000	£204 285	£306 428	£510 713
33 kV Transformer (PM)	£4 495	£6 421	£9 632	£16 053
Batteries at 33 kV Substations	£2 666	£3 808	£5 712	£9 521
Batteries at 66 kV Substations	£2 666	£3 808	£5 712	£9 521
132 kV OHL (Pole Line) Conductor	£85 527	£122 182	£183 273	£305 455
132 kV Pole	£3 841	£5 487	£8 230	£13 717
132 kV OHL (Tower Line) Conductor	£68 082	£97 259	£145 889	£243 149
132 kV Tower	£13 211	£18 873	£28 309	£47 182
132 kV Fittings	£2 314	£3 306	£4 958	£8 264
132 kV UG Cable (Non Pressurised)	£88 213	£126 019	£189 029	£315 048
132 kV UG Cable (Oil)	£5 308	£7 582	£11 374	£18 956
132 kV UG Cable (Gas)	£728	£1 041	£1 561	£2 602
132 kV Sub Cable	£349 882	£499 831	£749 747	£1 249 578
132 kV CB (Air Insulated Busbars)(ID) (GM)	£243 203	£347 432	£521 149	£868 581
132 kV CB (Air Insulated Busbars)(OD) (GM)	£91 098	£130 140	£195 211	£325 351
132 kV CB (Gas Insulated Busbars)(ID) (GM)	£360 535	£515 050	£772 576	£1 287 626
132 kV CB (Gas Insulated	£182 596	£260 852	£391 278	£652 129

Asset Register Category	Typical COF Weightings for Each Criticality Index Band (£ at 20/21 prices)			
	C1	C2	C3	C4
Busbars)(OD)(GM)				
132 kV Transformer (GM)	£375 173	£535 961	£803 942	£1 339 903
132 kV Switchgear - Other	£13 406	£19 151	£28 727	£47 879
Batteries at 132 kV Substations	£2 759	£3 941	£5 912	£9 853

E.2 Weighting Factors for Determination of In-Year Risk

Table 289 – Typical PoF Weightings for Health Indices Bands for use in the calculation of In-Year Risk from Risk Matrices

Asset Register Category	Typical In-Year POF Weightings for Each Health Index Band				
	H1	H2	H3	H4	H5
Batteries at GM HV Substations	0.014250	0.016362	0.037514	0.060754	0.107343
Batteries at 33 kV Substations	0.014250	0.016362	0.037514	0.060754	0.107343
Batteries at 66 kV Substations	0.014250	0.016362	0.037514	0.060754	0.107343
Batteries at 132 kV Substations	0.014250	0.016362	0.037514	0.060754	0.107343
LV Main (OHL) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
LV Poles	0.008123	0.009326	0.021383	0.03463	0.061186
LV Circuit Breaker	0.001169	0.001342	0.003076	0.004982	0.008802
LV Pillar (ID)	0.001311	0.001505	0.003451	0.005589	0.009876
LV Pillar (OD at Substation)	0.001311	0.001505	0.003451	0.005589	0.009876
LV Pillar (OD not at a Substation)	0.001311	0.001505	0.003451	0.005589	0.009876
LV Board (WM)	0.001967	0.002258	0.005177	0.008384	0.014813
LV UGB	0.002195	0.00252	0.005777	0.009356	0.016531
LV Board (X-type Network) (WM)	0.001967	0.002258	0.005177	0.008384	0.014813
6.6/11 kV Poles	0.008123	0.009326	0.021383	0.03463	0.061186
6.6/11 kV OHL (Conventional Conductor)	0.002280	0.002618	0.006002	0.009721	0.017175
6.6/11 kV OHL (BLX or similar Conductor)	0.002280	0.002618	0.006002	0.009721	0.017175
20 kV Poles	0.008123	0.009326	0.021383	0.03463	0.061186
20 kV OHL (Conventional Conductor)	0.002280	0.002618	0.006002	0.009721	0.017175
20 kV OHL (BLX or similar Conductor)	0.002280	0.002618	0.006002	0.009721	0.017175
HV Sub Cable	0.005757	0.00661	0.015156	0.024545	0.043367
6.6/11 kV CB (PM)	0.001910	0.002192	0.005027	0.008141	0.014384

Asset Register Category	Typical In-Year POF Weightings for Each Health Index Band				
	H1	H2	H3	H4	H5
6.6/11 kV CB (GM) Secondary	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV CB (GM) Primary	0.001482	0.001702	0.003901	0.006318	0.011164
6.6/11 kV Switch (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV Switch (GM)	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV Switchgear - Other (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV RMU	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV X-type RMU	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV CB (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV CB (GM) Secondary	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV CB (GM) Primary	0.001482	0.001702	0.003901	0.006318	0.011164
20 kV Switch (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV Switch (GM)	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV Switchgear - Other (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
20 kV RMU	0.001910	0.002192	0.005027	0.008141	0.014384
6.6/11 kV Transformer (PM)	0.002223	0.002552	0.005852	0.009478	0.016746
6.6/11 kV Transformer (GM)	0.002223	0.002552	0.005852	0.009478	0.016746
20 kV Transformer (PM)	0.002223	0.002552	0.005852	0.009478	0.016746
20 kV Transformer (GM)	0.002223	0.002552	0.005852	0.009478	0.016746
33 kV OHL (Pole Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
33 kV Pole	0.008123	0.009326	0.021383	0.03463	0.061186
66 kV OHL (Pole Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
66 kV Pole	0.008123	0.009326	0.021383	0.03463	0.061186
33 kV OHL (Tower Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
33 kV Tower	0.015533	0.017834	0.04089	0.066222	0.117004
33 kV Fittings	0.002736	0.003141	0.007203	0.011665	0.02061
66 kV OHL (Tower Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
66 kV Tower	0.015533	0.017834	0.04089	0.066222	0.117004
66 kV Fittings	0.002736	0.003141	0.007203	0.011665	0.02061
33 kV UG Cable (Non Pressurised)	0.018753	0.021532	0.049368	0.079952	0.141264
33 kV UG Cable (Oil)	0.596913	0.685357	1.571374	2.544859	4.496404
33 kV UG Cable (Gas)	1.283546	1.473727	3.378934	5.472225	9.668642
66 kV UG Cable (Non Pressurised)	0.018753	0.021532	0.049368	0.079952	0.141264
66 kV UG Cable (Oil)	0.596913	0.685357	1.571374	2.544859	4.496404
66 kV UG Cable (Gas)	1.283546	1.473727	3.378934	5.472225	9.668642
EHV Sub Cable	0.005757	0.00661	0.015156	0.024545	0.043367

Asset Register Category	Typical In-Year POF Weightings for Each Health Index Band				
	H1	H2	H3	H4	H5
33 kV CB (Air Insulated Busbars)(ID)(GM)	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV CB (Air Insulated Busbars)(OD)(GM)	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV CB (Gas Insulated Busbars)(ID)(GM)	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV CB (Gas Insulated Busbars)(OD)(GM)	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV Switchgear - Other	0.004767	0.005473	0.012548	0.020322	0.035906
33 kV Switch (GM)	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV RMU	0.006356	0.007297	0.016731	0.027096	0.047875
33 kV Switch (PM)	0.001910	0.002192	0.005027	0.008141	0.014384
66 kV CB (Air Insulated Busbars)(ID)(GM)	0.014592	0.016754	0.038414	0.062212	0.10992
66 kV CB (Air Insulated Busbars)(OD)(GM)	0.014592	0.016754	0.038414	0.062212	0.10992
66 kV CB (Gas Insulated Busbars)(ID)(GM)	0.014592	0.016754	0.038414	0.062212	0.10992
66 kV CB (Gas Insulated Busbars)(OD)(GM)	0.014592	0.016754	0.038414	0.062212	0.10992
66 kV Switchgear - Other	0.004767	0.005473	0.012548	0.020322	0.035906
33 kV Transformer (PM)	0.002223	0.002552	0.005852	0.009478	0.016746
33 kV Transformer (GM)	0.012939	0.014856	0.034062	0.055165	0.097468
66 kV Transformer (GM)	0.012939	0.014856	0.034062	0.055165	0.097468
132 kV OHL (Pole Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
132 kV Pole	0.004061	0.004663	0.010691	0.017315	0.030593
132 kV OHL (Tower Line) Conductor	0.002280	0.002618	0.006002	0.009721	0.017175
132 kV Tower	0.015533	0.017834	0.04089	0.066222	0.117004
132 kV Fittings	0.002736	0.003141	0.007203	0.011665	0.02061
132 kV UG Cable (Non Pressurised)	0.018753	0.021532	0.049368	0.079952	0.141264
132 kV UG Cable (Oil)	0.596913	0.685357	1.571374	2.544859	4.496404
132 kV UG Cable (Gas)	1.283546	1.473727	3.378934	5.472225	9.668642
132 kV Sub Cable	0.005757	0.00661	0.015156	0.024545	0.043367
132 kV CB (Air Insulated Busbars)(ID)(GM)	0.012284	0.014104	0.032337	0.05237	0.09253
132 kV CB (Air Insulated Busbars)(OD)(GM)	0.012284	0.014104	0.032337	0.05237	0.09253
132 kV CB (Gas Insulated Busbars)(ID)(GM)	0.012284	0.014104	0.032337	0.05237	0.09253

Asset Register Category	Typical In-Year POF Weightings for Each Health Index Band				
	H1	H2	H3	H4	H5
132 kV CB (Gas Insulated Busbars)(OD)(GM)	0.012284	0.014104	0.032337	0.052370	0.092530
132 kV Switchgear - Other	0.004767	0.005473	0.012548	0.020322	0.035906
132 kV Transformer (GM)	0.012939	0.014856	0.034062	0.055165	0.097468

Table 290 – Risk Matrix Weightings - Monetised In-Year Risk

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
LV Main (OHL) Conductor	C1	52	60	138	223	394
	C2	75	86	197	318	563
	C3	112	129	295	478	844
	C4	187	214	491	796	1 406
LV OHL Supports/ Poles	C1	4	5	12	19	33
	C2	6	7	16	27	47
	C3	9	11	25	40	71
	C4	16	18	41	67	118
LV Circuit Breaker	C1	20	23	52	85	150
	C2	28	33	75	121	214
	C3	43	49	112	181	321
	C4	71	81	187	302	534
LV Pillar (ID)	C1	21	24	56	90	159
	C2	30	35	80	129	228
	C3	45	52	119	193	341
	C4	76	87	199	322	569
LV Pillar (OD at Substation)	C1	22	25	57	92	163
	C2	31	35	81	132	233
	C3	46	53	122	197	349
	C4	77	89	203	329	581

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
LV Pillar (OD not at a Substation)	C1	15	17	38	62	109
	C2	21	24	55	88	156
	C3	31	36	82	133	234
	C4	52	60	136	221	391
LV Board (WM)	C1	35	40	91	148	261
	C2	50	57	130	211	373
	C3	74	85	196	317	560
	C4	124	142	326	528	933
LV UGB	C1	24	28	64	104	184
	C2	35	40	92	149	263
	C3	52	60	138	223	394
	C4	87	100	229	372	656
LV Board (X-type Network) (WM)	C1	37	42	96	156	276
	C2	52	60	138	223	394
	C3	79	90	207	335	591
	C4	131	150	344	558	986
6.6/11 kV OHL (Conventional Conductor)	C1	90	103	236	383	676
	C2	128	147	338	547	966
	C3	192	221	506	820	1 449
	C4	321	368	844	1 367	2 415
6.6/11 kV OHL (BLX or similar Conductor)	C1	94	108	247	400	706
	C2	134	154	353	571	1 009
	C3	201	231	529	857	1 514
	C4	335	385	882	1 428	2 523
20 kV OHL (Conventional Conductor)	C1	106	122	279	452	798
	C2	151	174	398	645	1 140
	C3	227	261	598	968	1 710
	C4	378	434	996	1 613	2 850

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
20 kV OHL (BLX or similar Conductor)	C1	111	127	292	473	835
	C2	158	182	417	675	1 193
	C3	238	273	625	1 013	1 789
	C4	396	455	1 042	1 688	2 982
6.6/11 kV Poles	C1	7	8	19	30	53
	C2	10	12	27	43	76
	C3	15	17	40	64	114
	C4	25	29	66	107	190
20 kV Poles	C1	9	11	25	40	70
	C2	13	15	35	57	101
	C3	20	23	53	85	151
	C4	33	38	88	142	251
HV Sub Cable	C1	1 515	1 739	3 988	6 459	11 412
	C2	2 164	2 485	5 698	9 227	16 303
	C3	3 246	3 727	8 547	13 841	24 455
	C4	5 411	6 212	14 244	23 069	40 759
6.6/11 kV CB (PM)	C1	19	22	51	82	145
	C2	27	32	72	117	207
	C3	41	47	108	176	310
	C4	69	79	181	293	517
6.6/11 kV CB (GM) Primary	C1	90	103	237	384	679
	C2	129	148	339	549	970
	C3	193	222	508	823	1 455
	C4	322	370	847	1 372	2 424
6.6/11 kV CB (GM) Secondary	C1	39	45	103	167	295
	C2	56	64	148	239	422
	C3	84	96	221	358	633
	C4	140	161	369	597	1 055

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
6.6/11 kV Switch (PM)	C1	18	20	47	76	134
	C2	25	29	67	108	191
	C3	38	44	100	162	286
	C4	63	73	167	270	477
6.6/11 kV Switchgear - Other (PM)	C1	21	24	54	88	155
	C2	29	34	77	125	222
	C3	44	51	116	188	332
	C4	74	84	194	314	554
6.6/11 kV Switch (GM)	C1	39	45	103	166	293
	C2	56	64	147	237	419
	C3	84	96	220	356	629
	C4	139	160	366	593	1 048
6.6/11 kV RMU	C1	40	46	104	169	299
	C2	57	65	149	242	427
	C3	85	98	224	362	640
	C4	142	163	373	604	1 067
6.6/11 kV X-type RMU	C1	44	51	117	189	334
	C2	63	73	167	270	477
	C3	95	109	250	405	715
	C4	158	182	417	675	1 192
20 kV CB (PM)	C1	26	29	68	110	194
	C2	37	42	97	156	276
	C3	55	63	145	235	415
	C4	92	105	242	391	691
20 kV CB (GM) Primary	C1	94	108	247	400	707
	C2	134	154	353	572	1 011
	C3	201	231	530	858	1 516
	C4	335	385	883	1 430	2 527

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
20 kV CB (GM) Secondary	C1	49	56	128	207	365
	C2	69	80	182	295	522
	C3	104	119	274	443	783
	C4	173	199	456	739	1 305
20 kV Switch (PM)	C1	19	22	50	81	144
	C2	27	31	72	116	205
	C3	41	47	107	174	308
	C4	68	78	179	290	513
20 kV Switchgear - Other (PM)	C1	19	22	50	81	144
	C2	27	31	72	116	205
	C3	41	47	107	174	308
	C4	68	78	179	290	513
20 kV Switch (GM)	C1	48	55	127	206	364
	C2	69	79	182	294	520
	C3	104	119	273	442	780
	C4	173	198	455	736	1 301
20 kV RMU	C1	49	56	129	209	369
	C2	70	80	184	298	527
	C3	105	120	276	447	790
	C4	175	201	460	745	1 317
6.6/11 kV Transformer (PM)	C1	10	12	27	44	78
	C2	15	17	39	63	111
	C3	22	25	58	94	167
	C4	37	42	97	157	278
6.6/11 kV Transformer (GM)	C1	42	48	111	180	318
	C2	60	69	159	257	454
	C3	90	104	238	386	681
	C4	151	173	397	643	1 135

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
20 kV Transformer (PM)	C1	12	14	31	51	90
	C2	17	20	45	73	128
	C3	26	29	67	109	193
	C4	43	49	112	182	321
20 kV Transformer (GM)	C1	45	52	119	192	340
	C2	64	74	170	275	485
	C3	97	111	254	412	728
	C4	161	185	424	687	1 213
Batteries at GM HV Substations	C1	9	11	25	40	71
	C2	13	15	35	57	101
	C3	20	23	53	86	151
	C4	34	38	88	143	252
33 kV OHL (Pole Line) Conductor	C1	105	121	277	449	793
	C2	150	173	396	641	1 133
	C3	226	259	594	962	1 699
	C4	376	432	990	1 603	2 832
33 kV Pole	C1	8	9	21	35	61
	C2	12	13	30	49	87
	C3	17	20	46	74	131
	C4	29	33	76	123	218
66 kV OHL (Pole Line) Conductor	C1	109	126	288	466	823
	C2	156	179	411	666	1 176
	C3	234	269	617	999	1 765
	C4	390	448	1 028	1 665	2 941
66 kV Pole	C1	12	14	32	51	91
	C2	17	20	45	73	129
	C3	26	30	68	110	194
	C4	43	49	113	183	324

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
33 kV OHL (Tower Line) Conductor	C1	125	144	329	533	942
	C2	179	205	470	762	1 346
	C3	268	308	705	1 143	2 019
	C4	447	513	1 176	1 904	3 364
33 kV Tower	C1	86	99	226	366	646
	C2	123	141	323	523	924
	C3	184	211	484	784	1 385
	C4	307	352	807	1 307	2 309
33 kV Fittings	C1	4	5	11	17	30
	C2	6	7	15	24	43
	C3	9	10	23	37	65
	C4	14	16	38	61	108
66 kV OHL (Tower Line) Conductor	C1	155	178	408	660	1 167
	C2	221	254	582	943	1 667
	C3	332	381	874	1 415	2 500
	C4	553	635	1 456	2 358	4 167
66 kV Tower	C1	162	186	426	689	1 218
	C2	231	265	608	985	1 740
	C3	347	398	912	1 477	2 610
	C4	578	663	1 520	2 462	4 350
66 kV Fittings	C1	5	5	12	20	35
	C2	7	8	17	28	50
	C3	10	11	26	43	75
	C4	17	19	44	71	125
33 kV UG Cable (Non Pressurised)	C1	471	541	1 241	2 009	3 550
	C2	673	773	1 772	2 870	5 072
	C3	1 010	1 160	2 659	4 306	7 607
	C4	1 683	1 933	4 431	7 176	12 679

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
33 kV UG Cable (Oil)	C1	2 515	2 888	6 622	10 724	18 949
	C2	3 594	4 126	9 460	15 321	27 069
	C3	5 390	6 189	14 190	22 981	40 604
	C4	8 984	10 315	23 650	38 302	67 674
33 kV UG Cable (Gas)	C1	366	420	963	1 560	2 757
	C2	523	600	1 376	2 229	3 938
	C3	784	900	2 064	3 343	5 907
	C4	1 307	1 501	3 441	5 572	9 845
66 kV UG Cable (Non Pressurised)	C1	943	1 082	2 482	4 019	7 101
	C2	1 347	1 546	3 545	5 741	10 144
	C3	2 020	2 319	5 318	8 612	15 216
	C4	3 367	3 865	8 863	14 353	25 360
66 kV UG Cable (Oil)	C1	2 521	2 895	6 637	10 749	18 993
	C2	3 602	4 136	9 482	15 356	27 133
	C3	5 403	6 203	14 223	23 035	40 699
	C4	9 005	10 339	23 705	38 391	67 831
66 kV UG Cable (Gas)	C1	580	665	1 526	2 471	4 366
	C2	828	951	2 180	3 530	6 237
	C3	1 242	1 426	3 270	5 295	9 356
	C4	2 070	2 377	5 449	8 825	15 593
EHV SubCable	C1	1 179	1 353	3 103	5 025	8 878
	C2	1 684	1 933	4 432	7 178	12 683
	C3	2 525	2 900	6 649	10 767	19 024
	C4	4 209	4 833	11 081	17 946	31 707
33 kV CB (Air Insulated Busbars)(ID) (GM)	C1	377	433	992	1 606	2 838
	C2	538	618	1 417	2 295	4 054
	C3	807	927	2 125	3 442	6 081
	C4	1 346	1 545	3 542	5 737	10 136

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
33 kV CB (Air Insulated Busbars)(OD) (GM)	C1	269	309	708	1 147	2 026
	C2	384	441	1 012	1 638	2 895
	C3	576	662	1 518	2 458	4 342
	C4	961	1 103	2 529	4 096	7 237
33 kV CB (Gas Insulated Busbars)(ID)(GM)	C1	440	505	1 159	1 877	3 316
	C2	629	722	1 655	2 681	4 737
	C3	943	1 083	2 483	4 022	7 106
	C4	1 572	1 805	4 139	6 703	11 843
33 kV CB (Gas Insulated Busbars)(OD)(GM)	C1	287	330	756	1 225	2 164
	C2	410	471	1 080	1 750	3 092
	C3	616	707	1 621	2 625	4 638
	C4	1 026	1 178	2 701	4 375	7 730
33 kV Switch (GM)	C1	235	270	619	1 002	1 771
	C2	336	386	884	1 432	2 530
	C3	504	579	1 326	2 148	3 796
	C4	840	964	2 211	3 580	6 326
33 kV Switchgear - Other	C1	29	33	76	122	216
	C2	41	47	108	175	309
	C3	62	71	162	262	464
	C4	103	118	270	437	773
33 kV Switch (PM)	C1	13	14	33	54	95
	C2	18	21	47	76	135
	C3	27	31	71	115	203
	C4	45	51	118	191	338
33 kV RMU	C1	302	347	796	1 289	2 277
	C2	432	496	1 137	1 841	3 253
	C3	648	744	1 705	2 762	4 879
	C4	1 080	1 239	2 842	4 603	8 132

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
66 kV CB (Air Insulated Busbars)(ID) (GM)	C1	1 146	1 316	3 017	4 886	8 634
	C2	1 637	1 880	4 310	6 981	12 334
	C3	2 456	2 820	6 465	10 471	18 501
	C4	4 093	4 700	10 776	17 452	30 834
66 kV CB (Air Insulated Busbars)(OD) (GM)	C1	908	1 042	2 389	3 869	6 836
	C2	1 296	1 489	3 413	5 527	9 766
	C3	1 945	2 233	5 120	8 291	14 649
	C4	3 241	3 721	8 533	13 819	24 416
66 kV CB (Gas Insulated Busbars)(ID)(GM)	C1	1 599	1 836	4 211	6 819	12 048
	C2	2 285	2 623	6 015	9 742	17 212
	C3	3 427	3 935	9 023	14 612	25 818
	C4	5 712	6 559	15 038	24 354	43 030
66 kV CB (Gas Insulated Busbars)(OD)(GM)	C1	968	1 111	2 548	4 127	7 292
	C2	1 383	1 588	3 641	5 896	10 417
	C3	2 074	2 382	5 461	8 844	15 626
	C4	3 457	3 970	9 102	14 740	26 044
66 kV Switchgear - Other	C1	30	35	79	129	227
	C2	43	49	113	184	325
	C3	65	74	170	276	487
	C4	108	124	284	459	812
33 kV Transformer (PM)	C1	10	11	26	43	75
	C2	14	16	38	61	108
	C3	21	25	56	91	161
	C4	36	41	94	152	269
33 kV Transformer (GM)	C1	1 424	1 635	3 748	6 070	10 725
	C2	2 034	2 335	5 354	8 671	15 321
	C3	3 051	3 503	8 031	13 007	22 981
	C4	5 085	5 838	13 385	21 678	38 302

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
66 kV Transformer (GM)	C1	1 850	2 124	4 871	7 889	13 938
	C2	2 643	3 035	6 958	11 269	19 911
	C3	3 965	4 552	10 438	16 904	29 867
	C4	6 608	7 587	17 396	28 173	49 778
Batteries at 33 kV Substations	C1	38	44	100	162	286
	C2	54	62	143	231	409
	C3	81	93	214	347	613
	C4	136	156	357	578	1 022
Batteries at 66 kV Substations	C1	38	44	100	162	286
	C2	54	62	143	231	409
	C3	81	93	214	347	613
	C4	136	156	357	578	1 022
132 kV OHL (Pole Line) Conductor	C1	195	224	513	831	1 469
	C2	279	320	733	1 188	2 098
	C3	418	480	1 100	1 782	3 148
	C4	696	800	1 833	2 969	5 246
132 kV Pole	C1	16	18	41	67	118
	C2	22	26	59	95	168
	C3	33	38	88	143	252
	C4	56	64	147	238	420
132 kV OHL (Tower Line) Conductor	C1	155	178	409	662	1 169
	C2	222	255	584	945	1 670
	C3	333	382	876	1 418	2 506
	C4	554	637	1 459	2 364	4 176
132 kV Tower	C1	205	236	540	875	1 546
	C2	293	337	772	1 250	2 208
	C3	440	505	1 158	1 875	3 312
	C4	733	841	1 929	3 124	5 520

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
132 kV Fittings	C1	6	7	17	27	48
	C2	9	10	24	39	68
	C3	14	16	36	58	102
	C4	23	26	60	96	170
132 kV UG Cable (Non Pressurised)	C1	1 654	1 899	4 355	7 053	12 461
	C2	2 363	2 713	6 221	10 075	17 802
	C3	3 545	4 070	9 332	15 113	26 703
	C4	5 908	6 784	15 553	25 189	44 505
132 kV UG Cable (Oil)	C1	3 168	3 638	8 340	13 507	23 866
	C2	4 526	5 197	11 915	19 296	34 094
	C3	6 789	7 795	17 872	28 944	51 141
	C4	11 315	12 992	29 787	48 241	85 234
132 kV UG Cable (Gas)	C1	935	1 074	2 462	3 986	7 044
	C2	1 336	1 534	3 516	5 695	10 062
	C3	2 004	2 301	5 275	8 542	15 093
	C4	3 339	3 834	8 791	14 237	25 155
132 kV Sub Cable	C1	2 014	2 313	5 303	8 588	15 173
	C2	2 878	3 304	7 575	12 268	21 676
	C3	4 316	4 956	11 363	18 403	32 514
	C4	7 194	8 260	18 939	30 671	54 190
132 kV CB (Air Insulated Busbars)(ID) (GM)	C1	2 988	3 430	7 864	12 737	22 504
	C2	4 268	4 900	11 235	18 195	32 148
	C3	6 402	7 350	16 852	27 293	48 222
	C4	10 670	12 250	28 087	45 488	80 370
132 kV CB (Air Insulated Busbars)(OD) (GM)	C1	1 119	1 285	2 946	4 771	8 429
	C2	1 599	1 835	4 208	6 815	12 042
	C3	2 398	2 753	6 313	10 223	18 063
	C4	3 997	4 589	10 521	17 039	30 105

Asset Register Category	Criticality Index Band	In Year Monetised Risk Weighting (£ at 2020/21 prices) For Each Health Index Band				
		H1	H2	H3	H4	H5
132 kV CB (Gas Insulated Busbars)(ID) (GM)	C1	4 429	5 085	11 659	18 881	33 360
	C2	6 327	7 264	16 655	26 973	47 658
	C3	9 490	10 896	24 983	40 460	71 486
	C4	15 817	18 161	41 638	67 433	119 144
132 kV CB (Gas Insulated Busbars)(OD) (GM)	C1	2 243	2 575	5 905	9 563	16 896
	C2	3 204	3 679	8 435	13 661	24 137
	C3	4 806	5 519	12 653	20 491	36 205
	C4	8 011	9 198	21 088	34 152	60 342
132 kV Switchgear - Other	C1	64	73	168	272	481
	C2	91	105	240	389	688
	C3	137	157	360	584	1 031
	C4	228	262	601	973	1 719
132 kV Transformer (GM)	C1	4 854	5 574	12 779	20 696	36 567
	C2	6 935	7 962	18 256	29 566	52 239
	C3	10 402	11 943	27 384	44 349	78 359
	C4	17 337	19 906	45 640	73 916	130 598
Batteries at 132 kV Substations	C1	39	45	103	168	296
	C2	56	64	148	239	423
	C3	84	97	222	359	635
	C4	140	161	370	599	1 058

E.3 Weighting Factors for Determination of Long Term Risk

Table 291 – Typical Forecast Ageing Rates for use in Determination of Cumulative Discounted PoF Weightings for Risk Matrices

Asset Register Category	Forecast Ageing Rate	Comments
LV Main (OHL) Conductor	0.03996492	
LV Poles	0.04359810	From Normal Expected Life for Wood Pole subdivision
LV Circuit Breaker	0.03996492	
LV Pillar (ID)	0.03996492	
LV Pillar (OD at Substation)	0.03996492	

Asset Register Category	Forecast Ageing Rate	Comments
LV Pillar (OD not at a Substation) LV Board (WM)	0.03996492 0.03996492	
LV UGB	0.04359810	
LV Board (X-type Network) (WM)	0.03996492	
6.6/11 kV OHL (Conventional Conductor)	0.03996492	From Normal Expected Life for AAAC
6.6/11 kV OHL (BLX or similar Conductor)	0.03996492	From Normal Expected Life for AAAC
20 kV OHL (Conventional Conductor)	0.03996492	From Normal Expected Life for AAAC
20 kV OHL (BLX or similar Conductor)	0.03996492	From Normal Expected Life for AAAC
6.6/11 kV Poles	0.04359810	From Normal Expected Life for Wood Pole subdivision
20 kV Poles	0.04359810	From Normal Expected Life for Wood Pole subdivision
HV Sub Cable	0.03996492	
6.6/11 kV CB (PM)	0.05994738	
6.6/11 kV CB (GM) Secondary	0.04359810	
6.6/11 kV CB (GM) Primary	0.04359810	
6.6/11kV Switch (PM)	0.05994738	
6.6/11kV Switchgear - Other (PM)	0.05994738	
6.6/11 kV Switch (GM)	0.04359810	
6.6/11 kV RMU	0.04359810	
6.6/11 kV X-type RMU	0.04359810	
20kV CB (PM)	0.05994738	
20 kV CB (GM) Secondary	0.04359810	
20 kV CB (GM) Primary	0.04359810	
20 kV Switch (PM)	0.05994738	
20 kV Switchgear - Other (PM)	0.05994738	
20 kV Switch (GM)	0.04359810	
20 kV RMU	0.04359810	
6.6/11 kV Transformer (PM)	0.04359810	
6.6/11 kV Transformer (GM)	0.03996492	
20 kV Transformer (PM)	0.04359810	
20 kV Transformer (GM)	0.03996492	
Batteries at GM HV Substations	0.14105266	
33 kV OHL (Pole Line) Conductor	0.03996492	From Normal Expected Life for AAAC

Asset Register Category	Forecast Ageing Rate	Comments
33 kV Pole	0.04359810	From Normal Expected Life for Wood Pole subdivision
66 kV OHL (Pole Line) Conductor	0.03996492	From Normal Expected Life for AAAC
66 kV Pole	0.04359810	From Normal Expected Life for Wood Pole subdivision
33 kV OHL (Tower Line) Conductor	0.04359810	From Normal Expected Life for ACSR - greased subdivision
33 kV Tower	0.02997369	From Normal Expected Life for Steelwork subcomponent
33 kV Fittings	0.05994738	
66 kV OHL (Tower Line) Conductor	0.04359810	From Normal Expected Life for ACSR - greased subdivision
66 kV Tower	0.02997369	From Normal Expected Life for Steelwork subcomponent
66 kV Fittings	0.05994738	
33 kV UG Cable (Non Pressurised)	0.02397895	
33 kV UG Cable (Oil)	0.03197194	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
33 kV UG Cable (Gas)	0.03425565	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
66 kV UG Cable (Non Pressurised)	0.02397895	
66 kV UG Cable (Oil)	0.03197194	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
66 kV UG Cable (Gas)	0.03425565	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
EHV Sub Cable	0.03996492	
33 kV CB (Air Insulated Busbars)(ID)(GM)	0.03996492	
33 kV CB (Air Insulated Busbars)(OD)(GM)	0.04795791	
33 kV CB (Gas Insulated Busbars)(ID)(GM)	0.03996492	
33 kV CB (Gas Insulated Busbars)(OD)(GM)	0.04795791	
33 kV Switch (GM)	0.04359810	
33 kV RMU	0.04359810	
33 kV Switchgear - Other	0.04795791	
33 kV Switch (PM)	0.05994738	
66 kV CB (Air Insulated Busbars)(ID)(GM)	0.04795791	
66 kV CB (Air Insulated Busbars)(OD)(GM)	0.04359810	

Asset Register Category	Forecast Ageing Rate	Comments
66 kV CB (Gas Insulated Busbars)(ID)(GM)	0.04359810	
66 kV CB (Gas Insulated Busbars)(OD)(GM)	0.04795791	
66 kV Switchgear - Other	0.04795791	
33 kV Transformer (PM)	0.04359809	
33 kV Transformer (GM)	0.03996492	From Normal Expected Life for Transformer - Pre 1980 subcomponent and subdivision
33 kV Transformer (PM)	0.04359810	
66 kV Transformer (GM)	0.03996492	From Normal Expected Life for Transformer - Pre 1980 subcomponent and subdivision
Batteries at 33 kV Substations	0.14105266	
Batteries at 66 kV Substations	0.14105266	
132 kV OHL (Pole Line) Conductor	0.03996492	From Normal Expected Life for AAAC
132 kV Pole	0.04359810	From Normal Expected Life for Wood Pole subdivision
132 kV OHL (Tower Line) Conductor	0.04359810	From Normal Expected Life for ACSR - greased subdivision
132 kV Tower	0.02997369	From Normal Expected Life for Steelwork subcomponent
132 kV Fittings	0.05994738	
132 kV UG Cable (Non Pressurised)	0.02397895	
132 kV UG Cable (Oil)	0.03197194	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
132 kV UG Cable (Gas)	0.03425565	From Normal Expected Life for Aluminium Sheath - Copper Conductor subdivision
132 kV Sub Cable	0.03996492	
132 kV CB (Air Insulated Busbars)(ID)(GM)	0.03996492	
132 kV CB (Air Insulated Busbars)(OD)(GM)	0.04795791	
132 kV CB (Gas Insulated Busbars)(ID)(GM)	0.03996492	
132 kV CB (Gas Insulated Busbars)(OD)(GM)	0.04359810	
132 kV Switchgear - Other	0.04795791	
132 kV Transformer (GM)	0.03996492	From Normal Expected Life for Transformer - Pre 1980 subcomponent and subdivision
Batteries at 132 kV Substations	0.14105266	

Table 292 – Typical Cumulative Discounted PoF Weightings for Health Indices Bands for use in the Calculation of Long Term Risk from Risk Matrices

Asset Register Category	Typical Cumulative Discounted POF Weightings for Each Health Index Band				
	HI1	HI2	HI3	HI4	HI5
LV Main (OHL) Conductor	0.0443	0.1599	0.3333	0.5466	0.833
LV Poles	0.0478	0.1958	0.4017	0.6338	0.9251
LV Circuit Breaker	0.0227	0.082	0.1708	0.2801	0.4269
LV Pillar (ID)	0.0254	0.0919	0.1916	0.3143	0.479
LV Pillar (OD at Substation)	0.0254	0.0919	0.1916	0.3143	0.479
LV Pillar (OD not at a Substation)	0.0254	0.0919	0.1916	0.3143	0.479
LV Board (WM)	0.0382	0.1379	0.2875	0.4715	0.7184
LV UGB	0.0431	0.1763	0.3617	0.5708	0.8332
LV Board (X-type Network) (WM)	0.0382	0.1379	0.2875	0.4715	0.7184
6.6/11 kV OHL (Conventional Conductor)	0.0443	0.1599	0.3333	0.5466	0.833
6.6/11 kV OHL (BLX or similar Conductor)	0.0443	0.1599	0.3333	0.5466	0.833
20 kV OHL (Conventional Conductor)	0.0443	0.1599	0.3333	0.5466	0.833
20 kV OHL (BLX or similar Conductor)	0.0443	0.1599	0.3333	0.5466	0.833
6.6/11 kV Poles	0.0478	0.1958	0.4017	0.6338	0.9251
20 kV Poles	0.0478	0.1958	0.4017	0.6338	0.9251
HV Sub Cable	0.1117	0.4038	0.8416	1.3802	2.1032
6.6/11 kV CB (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
6.6/11 kV CB (GM) Primary	0.0291	0.1191	0.2443	0.3855	0.5627
6.6/11 kV CB (GM) Secondary	0.0375	0.1534	0.3148	0.4966	0.725
6.6/11 kV Switch (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
6.6/11 kV Switchgear - Other (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
6.6/11 kV Switch (GM)	0.0375	0.1534	0.3148	0.4966	0.725
6.6/11 kV RMU	0.0375	0.1534	0.3148	0.4966	0.725
6.6/11 kV X-type RMU	0.0375	0.1534	0.3148	0.4966	0.725
20 kV CB (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
20 kV CB (GM) Primary	0.0291	0.1191	0.2443	0.3855	0.5627
20 kV CB (GM) Secondary	0.0375	0.1534	0.3148	0.4966	0.725
20 kV Switch (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
20 kV Switchgear - Other (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
20 kV Switch (GM)	0.0375	0.1534	0.3148	0.4966	0.725
20 kV RMU	0.0375	0.1534	0.3148	0.4966	0.725

Asset Register Category	Typical Cumulative Discounted POF Weightings for Each Health Index Band				
	HI1	HI2	HI3	HI4	HI5
6.6/11 kV Transformer (PM)	0.0436	0.1786	0.3664	0.5782	0.8440
6.6/11 kV Transformer (GM)	0.0431	0.1559	0.3250	0.5330	0.8121
20 kV Transformer (PM)	0.0436	0.1786	0.3664	0.5782	0.8440
20kV Transformer (GM)	0.0431	0.1559	0.3250	0.5330	0.8121
Batteries at GM HV Substations	3.2123	5.0930	5.8839	6.5337	7.2597
33 kV OHL (Pole Line) Conductor	0.0443	0.1599	0.3333	0.5466	0.8330
33kV Pole	0.0797	0.3263	0.6694	1.0563	1.5419
66 kV OHL (Pole Line) Conductor	0.0443	0.1599	0.3333	0.5466	0.8330
66 kV Pole	0.0797	0.3263	0.6694	1.0563	1.5419
33 kV OHL (Tower Line) Conductor	0.0448	0.1832	0.3758	0.593	0.8656
33 kV Tower	0.3012	0.7709	1.6673	2.7647	4.8615
33 kV Fittings	0.0694	0.4162	0.6737	0.8979	1.1667
66 kV OHL (Tower Line) Conductor	0.0448	0.1832	0.3758	0.593	0.8656
66 kV Tower	0.3012	0.7709	1.6673	2.7647	4.8615
66 kV Fittings	0.0694	0.4162	0.6737	0.8979	1.1667
33 kV UG Cable (Non Pressurised)	0.3637	0.7714	1.6978	2.8015	5.0373
33 kV UG Cable (Oil)	11.5754	31.6439	67.9831	112.9162	194.2315
33 kV UG Cable (Gas)	24.8906	73.5116	156.6694	260.7076	433.9966
66 kV UG Cable (Non Pressurised)	0.3637	0.7714	1.6978	2.8015	5.0373
66 kV UG Cable (Oil)	11.5754	31.6439	67.9831	112.9162	194.2315
66 kV UG Cable (Gas)	24.8906	73.5116	156.6694	260.7076	433.9966
EHV Sub Cable	0.1117	0.4038	0.8416	1.3802	2.1032
33 kV CB (Air Insulated Busbars)(ID) (GM)	0.1234	0.4457	0.9291	1.5237	2.3219
33 kV CB (Air Insulated Busbars)(OD) (GM)	0.1291	0.6052	1.2054	1.7886	2.5091
33 kV CB (Gas Insulated Busbars)(ID)(GM)	0.1234	0.4457	0.9291	1.5237	2.3219
33 kV CB (Gas Insulated Busbars)(OD)(GM)	0.1291	0.6052	1.2054	1.7886	2.5091
33 kV Switch (GM)	0.1248	0.5106	1.0476	1.653	2.4129
33 kV Switchgear - Other	0.0968	0.4539	0.9041	1.3415	1.8819
33 kV Switch (PM)	0.0484	0.2905	0.4702	0.6267	0.8143
33 kV RMU	0.1248	0.5106	1.0476	1.653	2.4129
66 kV CB (Air Insulated Busbars)(ID) (GM)	0.2865	1.1723	2.4053	3.7953	5.5400

Asset Register Category	Typical Cumulative Discounted POF Weightings for Each Health Index Band				
	HI1	HI2	HI3	HI4	HI5
66 kV CB (Air Insulated Busbars)(OD)(GM)	0.2963	1.3896	2.7676	4.1066	5.7609
66 kV CB (Gas Insulated Busbars)(ID)(GM)	0.2865	1.1723	2.4053	3.7953	5.5400
66 kV CB (Gas Insulated Busbars)(OD)(GM)	0.2963	1.3896	2.7676	4.1066	5.7609
66 kV Switchgear - Other	0.0968	0.4539	0.9041	1.3415	1.8819
33 kV Transformer (PM)	0.0436	0.1786	0.3664	0.5782	0.844
33 kV Transformer (GM)	0.2511	0.9075	1.8915	3.1021	4.7271
66 kV Transformer (GM)	0.2511	0.9075	1.8915	3.1021	4.7271
Batteries at 33 kV Substations	3.2123	5.093	5.8839	6.5337	7.2597
Batteries at 66 kV Substations	3.2123	5.093	5.8839	6.5337	7.2597
132 kV OHL (Pole Line) Conductor	0.0443	0.1599	0.3333	0.5466	0.833
132 kV Pole	0.0797	0.3263	0.6694	1.0563	1.5419
132 kV OHL (Tower Line) Conductor	0.0448	0.1832	0.3758	0.593	0.8656
132 kV Tower	0.3012	0.7709	1.6673	2.7647	4.8615
132 kV Fittings	0.0694	0.4162	0.6737	0.8979	1.1667
132 kV UG Cable (Non Pressurised)	0.3637	0.7714	1.6978	2.8015	5.0373
132 kV UG Cable (Oil)	11.5754	31.6439	67.9831	112.9162	194.2315
132 kV UG Cable (Gas)	24.8906	73.5116	156.6694	260.7076	433.9966
132 kV Sub Cable	0.1117	0.4038	0.8416	1.3802	2.1032
132 kV CB (Air Insulated Busbars)(ID)(GM)	0.2384	0.8615	1.7957	2.945	4.4876
132 kV CB (Air Insulated Busbars)(OD) (GM)	0.2495	1.1697	2.3297	3.4569	4.8495
132 kV CB (Gas Insulated Busbars)(ID) (GM)	0.2384	0.8615	1.7957	2.945	4.4876
132 kV CB (Gas Insulated Busbars)(OD) (GM)	0.2412	0.9869	2.0248	3.1948	4.6636
132 kV Switchgear - Other	0.0968	0.4539	0.9041	1.3415	1.8819
132 kV Transformer (GM)	0.2511	0.9075	1.8915	3.1021	4.7271
Batteries at 132 kV Substations	3.2123	5.093	5.8839	6.5337	7.2597

Table 293 – Risk Matrix Weightings - Risk Index (Long Term Risk)

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
LV Main (OHL) Conductor	C1	1 016	3 666	7 642	12 532	19 099
	C2	1 451	5 237	10 917	17 903	27 284
	C3	2 177	7 856	16 375	26 855	40 926
	C4	3 628	13 093	27 292	44 759	68 211
LV OHL Supports/ Poles	C1	86	352	723	1 140	1 664
	C2	123	503	1 032	1 629	2 377
	C3	184	755	1 548	2 443	3 566
	C4	307	1 258	2 581	4 072	5 943
LV Circuit Breaker	C1	386	1 394	2 904	4 762	7 257
	C2	551	1 991	4 148	6 802	10 367
	C3	827	2 987	6 222	10 203	15 551
	C4	1 378	4 978	10 370	17 006	25 918
LV Pillar (ID)	C1	410	1 482	3 090	5 069	7 726
	C2	585	2 118	4 415	7 242	11 037
	C3	878	3 176	6 622	10 863	16 556
	C4	1 463	5 294	11 037	18 105	27 593
LV Pillar (OD at Substation)	C1	419	1 515	3 158	5 180	7 894
	C2	598	2 164	4 511	7 400	11 277
	C3	897	3 245	6 766	11 100	16 916
	C4	1 495	5 409	11 277	18 499	28 193
LV Pillar (OD not at a Substation)	C1	281	1 018	2 122	3 481	5 305
	C2	402	1 454	3 031	4 972	7 578
	C3	603	2 181	4 547	7 459	11 367
	C4	1 005	3 635	7 578	12 431	18 945
LV Board (WM)	C1	674	2 433	5 073	8 319	12 676
	C2	963	3 476	7 247	11 885	18 108
	C3	1 444	5 214	10 870	17 827	27 162
	C4	2 407	8 690	18 117	29 712	45 271

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
LV UGB	C1	479	1 960	4 022	6 346	9 264
	C2	685	2 800	5 745	9 066	13 234
	C3	1 027	4 200	8 618	13 599	19 851
	C4	1 711	7 001	14 363	22 666	33 085
LV Board (X-type Network) (WM)	C1	712	2 569	5 357	8 785	13 385
	C2	1 017	3 671	7 652	12 550	19 122
	C3	1 525	5 506	11 479	18 825	28 683
	C4	2 542	9 176	19 131	31 375	47 804
6.6/11 kV OHL (Conventional Conductor)	C1	1 744	6 295	13 122	21 520	32 795
	C2	2 492	8 993	18 746	30 743	46 851
	C3	3 737	13 490	28 119	46 114	70 276
	C4	6 229	22 483	46 865	76 856	117 126
6.6/11 kV OHL (BLX or similar Conductor)	C1	1 822	6 577	13 709	22 483	34 263
	C2	2 603	9 396	19 585	32 118	48 947
	C3	3 905	14 093	29 377	48 177	73 420
	C4	6 508	23 489	48 961	80 295	122 367
20 kV OHL (Conventional Conductor)	C1	2 058	7 429	15 486	25 396	38 703
	C2	2 940	10 613	22 123	36 281	55 290
	C3	4 411	15 920	33 184	54 421	82 936
	C4	7 351	26 533	55 307	90 702	138 226
20 kV OHL (BLX or similar Conductor)	C1	2 154	7 775	16 206	26 577	40 502
	C2	3 077	11 107	23 151	37 967	57 860
	C3	4 616	16 660	34 727	56 950	86 791
	C4	7 693	27 767	57 878	94 917	144 651
6.6/11 kV Poles	C1	138	567	1 162	1 834	2 677
	C2	198	809	1 660	2 620	3 824
	C3	296	1 214	2 490	3 929	5 736
	C4	494	2 023	4 151	6 549	9 559

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
20 kV Poles	C1	183	751	1 541	2 431	3 549
	C2	262	1 073	2 201	3 474	5 070
	C3	393	1 610	3 302	5 210	7 605
	C4	655	2 683	5 504	8 684	12 675
HV Sub Cable	C1	29 395	106 264	221 475	363 212	553 476
	C2	41 993	151 805	316 393	518 875	790 681
	C3	62 989	227 708	474 589	778 312	1 186 021
	C4	104 982	379 513	790 981	1 297 187	1 976 702
6.6/11 kV CB (PM)	C1	487	2 924	4 733	6 308	8 196
	C2	696	4 177	6 761	9 011	11 709
	C3	1 044	6 266	10 142	13 517	17 564
	C4	1 740	10 443	16 903	22 529	29 273
6.6/11 kV CB (GM) Primary	C1	1 769	7 242	14 855	23 441	34 215
	C2	2 528	10 346	21 221	33 487	48 879
	C3	3 792	15 519	31 832	50 230	73 319
	C4	6 319	25 864	53 053	83 717	122 198
6.6/11 kV CB (GM) Secondary	C1	770	3 151	6 466	10 200	14 891
	C2	1 100	4 501	9 237	14 572	21 273
	C3	1 651	6 752	13 856	21 857	31 910
	C4	2 751	11 253	23 093	36 429	53 184
6.6/11 kV Switch (PM)	C1	450	2 698	4 367	5 820	7 563
	C2	642	3 854	6 238	8 315	10 804
	C3	963	5 781	9 358	12 472	16 206
	C4	1 605	9 636	15 596	20 787	27 010
6.6/11 kV Switchgear - Other (PM)	C1	522	3 133	5 070	6 758	8 781
	C2	746	4 475	7 243	9 654	12 544
	C3	1 118	6 713	10 865	14 481	18 816
	C4	1 864	11 188	18 108	24 135	31 360

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
6.6/11 kV Switch (GM)	C1	765	3 130	6 423	10 133	14 793
	C2	1 093	4 472	9 176	14 476	21 133
	C3	1 640	6 707	13 764	21 713	31 700
	C4	2 733	11 179	22 941	36 189	52 833
6.6/11 kV RMU	C1	779	3 186	6 539	10 315	15 059
	C2	1 113	4 552	9 341	14 735	21 512
	C3	1 669	6 828	14 011	22 103	32 268
	C4	2 782	11 379	23 352	36 838	53 780
6.6/11 kV X-type RMU	C1	870	3 559	7 304	11 523	16 822
	C2	1 243	5 085	10 435	16 461	24 032
	C3	1 865	7 627	15 652	24 691	36 048
	C4	3 108	12 712	26 087	41 152	60 079
20 kV CB (PM)	C1	651	3 909	6 326	8 432	10 956
	C2	930	5 584	9 038	12 046	15 652
	C3	1 395	8 376	13 557	18 069	23 477
	C4	2 326	13 959	22 594	30 115	39 129
20 kV CB (GM) Primary	C1	1 844	7 547	15 481	24 429	35 658
	C2	2 634	10 782	22 116	34 898	50 939
	C3	3 951	16 173	33 173	52 347	76 409
	C4	6 586	26 954	55 289	87 245	127 348
20 kV CB (GM) Secondary	C1	953	3 898	7 998	12 617	18 421
	C2	1 361	5 568	11 426	18 025	26 315
	C3	2 042	8 352	17 139	27 037	39 473
	C4	3 403	13 920	28 565	45 062	65 788
20 kV Switch (PM)	C1	483	2 898	4 691	6 252	8 124
	C2	690	4 140	6 702	8 932	11 606
	C3	1 035	6 211	10 052	13 398	17 409
	C4	1 725	10 351	16 754	22 330	29 015

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
20 kV Switchgear - Other (PM)	C1	483	2 898	4 691	6 252	8 124
	C2	690	4 140	6 702	8 932	11 606
	C3	1 035	6 211	10 052	13 398	17 409
	C4	1 725	10 351	16 754	22 330	29 015
20 kV Switch (GM)	C1	949	3 884	7 970	12 573	18 356
	C2	1 356	5 548	11 386	17 962	26 223
	C3	2 035	8 323	17 079	26 943	39 335
	C4	3 391	13 871	28 466	44 905	65 558
20 kV RMU	C1	961	3 932	8 069	12 729	18 584
	C2	1 373	5 617	11 527	18 185	26 548
	C3	2 060	8 426	17 291	27 277	39 823
	C4	3 433	14 043	28 819	45 462	66 371
6.6/11 kV Transformer (PM)	C1	203	830	1 703	2 687	3 922
	C2	289	1 186	2 432	3 839	5 603
	C3	434	1 779	3 649	5 758	8 405
	C4	724	2 964	6 081	9 596	14 008
6.6/11 kV Transformer (GM)	C1	818	2 959	6 169	10 117	15 415
	C2	1 169	4 228	8 813	14 453	22 022
	C3	1 753	6 341	13 220	21 680	33 033
	C4	2 922	10 569	22 033	36 133	55 054
20 kV Transformer (PM)	C1	234	959	1 967	3 104	4 532
	C2	334	1 370	2 810	4 435	6 474
	C3	502	2 055	4 216	6 652	9 710
	C4	836	3 425	7 026	11 087	16 184
20 kV Transformer (GM)	C1	874	3 162	6 592	10 811	16 472
	C2	1 249	4 517	9 417	15 444	23 531
	C3	1 873	6 776	14 126	23 166	35 297
	C4	3 122	11 293	23 543	38 610	58 828

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
Batteries at GM HV Substations	C1	2 116	3 354	3 875	4 303	4 781
	C2	3 022	4 792	5 536	6 147	6 830
	C3	4 533	7 188	8 304	9 221	10 245
	C4	7 556	11 979	13 840	15 368	17 076
33 kV OHL (Pole Line) Conductor	C1	2 045	7 382	15 387	25 234	38 456
	C2	2 922	10 546	21 981	36 049	54 937
	C3	4 382	15 818	32 972	54 073	82 405
	C4	7 304	26 364	54 953	90 122	137 343
33 kV Pole	C1	159	650	1 334	2 105	3 073
	C2	227	929	1 906	3 008	4 390
	C3	340	1 394	2 859	4 511	6 586
	C4	567	2 323	4 765	7 519	10 976
66 kV OHL (Pole Line) Conductor	C1	2 124	7 666	15 980	26 207	39 938
	C2	3 034	10 952	22 829	37 438	57 055
	C3	4 551	16 428	34 243	56 158	85 582
	C4	7 586	27 380	57 072	93 596	142 637
66 kV Pole	C1	236	967	1 983	3 130	4 569
	C2	337	1 381	2 834	4 471	6 527
	C3	506	2 072	4 250	6 707	9 790
	C4	843	3 453	7 084	11 178	16 317
33 kV OHL (Tower Line) Conductor	C1	2 457	10 049	20 613	32 526	47 478
	C2	3 510	14 355	29 447	46 466	67 826
	C3	5 266	21 533	44 170	69 699	101 739
	C4	8 776	35 888	73 616	116 164	169 565
33 kV Tower	C1	1 664	4 259	9 212	15 275	26 860
	C2	2 377	6 085	13 160	21 822	38 372
	C3	3 566	9 127	19 740	32 732	57 557
	C4	5 943	15 212	32 900	54 554	95 929

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
33 kV Fittings	C1	102	611	990	1 319	1 714
	C2	146	873	1 414	1 884	2 448
	C3	218	1 310	2 121	2 826	3 672
	C4	364	2 183	3 534	4 710	6 121
66 kV OHL (Tower Line) Conductor	C1	3 043	12 444	25 527	40 281	58 798
	C2	4 347	17 778	36 467	57 544	83 997
	C3	6 521	26 666	54 701	86 317	125 996
	C4	10 868	44 444	91 169	143 861	209 994
66 kV Tower	C1	3 136	8 026	17 358	28 783	50 612
	C2	4 480	11 465	24 797	41 118	72 303
	C3	6 719	17 198	37 195	61 677	108 454
	C4	11 199	28 663	61 992	102 795	180 757
66 kV Fittings	C1	118	708	1 146	1 527	1 984
	C2	169	1 011	1 637	2 181	2 834
	C3	253	1 517	2 455	3 272	4 252
	C4	422	2 528	4 092	5 454	7 086
33 kV UG Cable (Non Pressurised)	C1	9 140	19 386	42 667	70 404	126 592
	C2	13 057	27 694	60 953	100 578	180 846
	C3	19 586	41 542	91 430	150 867	271 269
	C4	32 643	69 236	152 384	251 444	452 115
33 kV UG Cable (Oil)	C1	48 781	133 352	286 492	475 847	818 523
	C2	69 687	190 504	409 274	679 781	1 169 318
	C3	104 530	285 755	613 911	1 019 673	1 753 978
	C4	174 217	476 259	1 023 186	1 699 455	2 923 299
33 kV UG Cable (Gas)	C1	7 097	20 960	44 670	74 333	123 741
	C2	10 138	29 942	63 813	106 189	176 771
	C3	15 207	44 913	95 720	159 285	265 159
	C4	25 346	74 855	159 533	265 473	441 930

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
66 kV UG Cable (Non Pressurised)	C1	18 282	38 775	85 341	140 819	253 203
	C2	26 117	55 393	121 916	201 170	361 719
	C3	39 175	83 089	182 874	301 755	542 578
	C4	65 291	138 482	304 789	502 926	904 297
66 kV UG Cable (Oil)	C1	48 894	133 664	287 161	476 958	820 434
	C2	69 849	190 948	410 230	681 369	1 172 049
	C3	104 774	286 423	615 344	1 022 053	1 758 073
	C4	174 623	477 371	1 025 574	1 703 422	2 930 122
66 kV UG Cable (Gas)	C1	11 240	33 195	70 746	117 725	195 976
	C2	16 057	47 422	101 066	168 180	279 967
	C3	24 085	71 132	151 598	252 268	419 948
	C4	40 142	118 554	252 664	420 448	699 915
EHV Sub Cable	C1	22 867	82 665	172 290	282 551	430 562
	C2	32 667	118 093	246 129	403 644	615 088
	C3	49 001	177 139	369 193	605 466	922 632
	C4	81 668	295 232	615 322	1 009 110	1 537 720
33 kV CB (Air Insulated Busbars)(ID) (GM)	C1	7 315	26 421	55 076	90 324	137 640
	C2	10 450	37 744	78 680	129 034	196 629
	C3	15 675	56 616	118 021	193 551	294 944
	C4	26 125	94 360	196 701	322 585	491 573
33 kV CB (Air Insulated Busbars)(OD) (GM)	C1	5 464	25 616	51 021	75 706	106 202
	C2	7 806	36 594	72 887	108 151	151 717
	C3	11 709	54 892	109 330	162 226	227 576
	C4	19 516	91 486	182 217	270 377	379 293
33 kV CB (Gas Insulated Busbars)(ID)(GM)	C1	8 547	30 870	64 351	105 534	160 819
	C2	12 210	44 100	91 930	150 763	229 742
	C3	18 315	66 150	137 895	226 145	344 613
	C4	30 525	110 250	229 826	376 908	574 354

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
33 kV CB (Gas Insulated Busbars)(OD)(GM)	C1	5 836	27 359	54 492	80 856	113 428
	C2	8 337	39 084	77 846	115 509	162 039
	C3	12 506	58 626	116 768	173 264	243 059
	C4	20 843	97 711	194 614	288 773	405 098
33 kV Switch (GM)	C1	4 617	18 891	38 759	61 157	89 272
	C2	6 596	26 987	55 370	87 368	127 532
	C3	9 894	40 481	83 055	131 052	191 297
	C4	16 490	67 468	138 425	218 420	318 829
33 kV Switchgear - Other	C1	583	2 736	5 449	8 085	11 342
	C2	833	3 908	7 784	11 550	16 203
	C3	1 250	5 862	11 676	17 325	24 304
	C4	2 084	9 770	19 460	28 875	40 507
33 kV Switch (PM)	C1	318	1 909	3 090	4 119	5 352
	C2	454	2 727	4 415	5 884	7 645
	C3	682	4 091	6 622	8 826	11 468
	C4	1 136	6 819	11 037	14 710	19 113
33 kV RMU	C1	5 936	24 285	49 825	78 618	114 760
	C2	8 479	34 692	71 178	112 312	163 943
	C3	12 719	52 039	106 768	168 468	245 914
	C4	21 199	86 731	177 946	280 780	409 857
66 kV CB (Air Insulated Busbars)(ID) (GM)	C1	22 503	92 078	188 924	298 101	435 138
	C2	32 147	131 540	269 891	425 859	621 626
	C3	48 221	197 310	404 837	638 788	932 439
	C4	80 368	328 850	674 728	1 064 646	1 554 065
66 kV CB (Air Insulated Busbars)(OD) (GM)	C1	18 428	86 425	172 129	255 408	358 296
	C2	26 326	123 465	245 899	364 868	511 852
	C3	39 489	185 197	368 849	547 303	767 778
	C4	65 815	308 662	614 748	912 171	1 279 630

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
66 kV CB (Gas Insulated Busbars)(ID)(GM)	C1	31 403	128 496	263 645	416 003	607 239
	C2	44 862	183 565	376 635	594 290	867 485
	C3	67 293	275 348	564 953	891 434	1 301 227
	C4	112 154	458 913	941 589	1 485 724	2 168 711
66 kV CB (Gas Insulated Busbars)(OD)(GM)	C1	19 657	92 188	183 606	272 436	382 184
	C2	28 081	131 697	262 294	389 195	545 978
	C3	42 122	197 545	393 441	583 792	818 967
	C4	70 203	329 241	655 734	972 987	1 364 944
66 kV Switchgear - Other	C1	613	2 872	5 721	8 489	11 909
	C2	875	4 103	8 174	12 128	17 013
	C3	1 313	6 155	12 260	18 192	25 520
	C4	2 188	10 259	20 434	30 320	42 533
33 kV Transformer (PM)	C1	196	803	1 647	2 599	3 794
	C2	280	1 147	2 353	3 713	5 420
	C3	420	1 720	3 529	5 569	8 129
	C4	700	2 867	5 882	9 282	13 549
33 kV Transformer (GM)	C1	27 629	99 853	208 124	341 328	520 129
	C2	39 470	142 648	297 320	487 612	743 041
	C3	59 205	213 972	445 980	731 417	1 114 562
	C4	98 674	356 619	743 301	1 219 029	1 857 603
66 kV Transformer (GM)	C1	35 907	129 772	270 484	443 599	675 974
	C2	51 296	185 389	386 405	633 713	965 677
	C3	76 944	278 083	579 608	950 570	1 448 515
	C4	128 240	463 472	966 014	1 584 283	2 414 192
Batteries at 33 kV Substations	C1	8 563	13 577	15 685	17 417	19 353
	C2	12 233	19 395	22 407	24 882	27 647
	C3	18 350	29 093	33 611	37 323	41 470
	C4	30 583	48 488	56 018	62 204	69 116

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
Batteries at 66 kV Substations	C1	8 563	13 577	15 685	17 417	19 353
	C2	12 233	19 395	22 407	24 882	27 647
	C3	18 350	29 093	33 611	37 323	41 470
	C4	30 583	48 488	56 018	62 204	69 116
132 kV OHL (Pole Line) Conductor	C1	3 789	13 676	28 506	46 749	71 244
	C2	5 413	19 537	40 723	66 785	101 778
	C3	8 119	29 305	61 085	100 177	152 666
	C4	13 532	48 842	101 808	166 962	254 444
132 kV Pole	C1	306	1 253	2 571	4 057	5 922
	C2	437	1 790	3 673	5 796	8 460
	C3	656	2 686	5 509	8 694	12 690
	C4	1 093	4 476	9 182	14 490	21 151
132 kV OHL (Tower Line) Conductor	C1	3 050	12 473	25 585	40 372	58 931
	C2	4 357	17 818	36 550	57 675	84 188
	C3	6 536	26 727	54 825	86 512	126 282
	C4	10 893	44 545	91 375	144 187	210 470
132 kV Tower	C1	3 979	10 184	22 027	36 524	64 225
	C2	5 684	14 549	31 466	52 177	91 750
	C3	8 527	21 823	47 200	78 266	137 624
	C4	14 211	36 372	78 666	130 443	229 374
132 kV Fittings	C1	161	963	1 559	2 078	2 700
	C2	229	1 376	2 227	2 968	3 857
	C3	344	2 064	3 340	4 452	5 785
	C4	574	3 439	5 567	7 420	9 642
132 kV UG Cable (Non Pressurised)	C1	32 083	68 048	149 769	247 130	444 357
	C2	45 833	97 211	213 955	353 043	634 796
	C3	68 750	145 817	320 933	529 564	952 194
	C4	114 583	243 028	534 888	882 606	1 586 990

Asset Register Category	Criticality Index Band	Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band				
		HI1	HI2	HI3	HI4	HI5
132 kV UG Cable (Oil)	C1	61 439	167 957	360 835	599 326	1 030 924
	C2	87 770	239 938	515 478	856 180	1 472 749
	C3	131 655	359 907	773 216	1 284 269	2 209 121
	C4	219 424	599 845	1 288 694	2 140 450	3 681 870
132 kV UG Cable (Gas)	C1	18 133	53 552	114 132	189 923	316 162
	C2	25 904	76 504	163 046	271 318	451 660
	C3	38 856	114 756	244 570	406 980	677 495
	C4	64 759	191 260	407 616	678 299	1 129 155
132 kV Sub Cable	C1	39 082	141 282	294 460	482 907	735 871
	C2	55 831	201 832	420 658	689 867	1 051 245
	C3	83 747	302 748	630 987	1 034 800	1 576 867
	C4	139 578	504 579	1 051 645	1 724 667	2 628 112
132 kV CB (Air Insulated Busbars)(ID) (GM)	C1	57 980	209 519	436 719	716 232	1 091 396
	C2	82 828	299 313	623 884	1 023 189	1 559 138
	C3	124 242	448 970	935 827	1 534 783	2 338 707
	C4	207 070	748 283	1 559 711	2 557 971	3 897 844
132 kV CB (Air Insulated Busbars)(OD) (GM)	C1	22 729	106 558	212 232	314 918	441 781
	C2	32 470	152 225	303 188	449 882	631 116
	C3	48 705	228 338	454 782	674 823	946 674
	C4	81 175	380 563	757 970	1 124 706	1 577 789
132 kV CB (Gas Insulated Busbars)(ID) (GM)	C1	85 952	310 601	647 413	1 061 777	1 617 938
	C2	122 788	443 716	924 876	1 516 824	2 311 340
	C3	184 182	665 574	1 387 314	2 275 235	3 467 011
	C4	306 970	1 109 290	2 312 190	3 792 059	5 778 351
132 kV CB (Gas Insulated Busbars)(OD) (GM)	C1	44 042	180 204	369 721	583 358	851 556
	C2	62 917	257 435	528 173	833 369	1 216 508
	C3	94 376	386 152	792 259	1 250 054	1 824 763
	C4	157 294	643 587	1 320 432	2 083 423	3 041 271

Asset Register Category	**Criticality Index Band**	**Risk Index or Monetised Long Term Risk Weighting (£ at 20/21 prices) For Each Health Index Band**				
		HI1	**HI2**	**HI3**	**HI4**	**HI5**
132 kV Switchgear - Other	**C1**	1 298	6 085	12 120	17 984	25 229
	C2	1 854	8 693	17 315	25 692	36 041
	C3	2 781	13 039	25 972	38 538	54 062
	C4	4 635	21 732	43 287	64 229	90 103
132 kV Transformer (GM)	**C1**	94 206	340 469	709 640	1 163 824	1 773 480
	C2	134 580	486 385	1 013 771	1 662 606	2 533 543
	C3	201 870	729 577	1 520 656	2 493 908	3 800 314
	C4	336 450	1 215 962	2 534 427	4 156 514	6 333 857
Batteries at 132 kV Substations	**C1**	8 862	14 050	16 232	18 025	20 027
	C2	12 660	20 072	23 189	25 749	28 611
	C3	18 990	30 107	34 783	38 624	42 916
	C4	31 649	50 179	57 971	64 374	71 526

Annex F
(informative)

Worked examples

F.1 Probability of Failure (PoF)

The described methodology is capable of representing a very wide range of asset conditions and situations. In order to provide the reader with some clarity, this section works through a selection of typical scenarios with references to the relevant section of the methodology. The examples begin with the simplest scenario first. In order to avoid repetition, each subsequent example will focus on the key differences with the previous examples. The scenarios presented here are not exhaustive but provide an illustration of how the methodology works.

Example 1: A new LV pole with no associated condition information

The asset used in this example is a one-year-old steel LV pole, 5km from the coast, at an altitude of 100m, in corrosion zone 3. No condition information is available for this asset. For this asset, the following calculation steps enable the PoF (and associated Heath Index Band) to be determined:

Normal Expected Life (see Section 7.1.3)

1. The Normal Expected Life of a steel pole is given by Table 22 “Normal Expected Life” as **50** years

Expected Life (see Section 7.1.4)

2. The Distance from Coast Factor is given by Table 24 “Distance from Coast Factor Lookup Table” as **1.2**

3. The Altitude Factor is given by Table 25 “Altitude Factor Lookup Table” as **1**

4. The Corrosion Category Factor is given by Table 26 “Corrosion Category Factor Lookup Table” as **1**

$$\mathbf{Location\ Factor} = \mathbf{MAX(Distance\ From\ Coast\ Factor, Altitude\ Factor, Corrosion\ Factor)} + \left(\left((\mathbf{COUNT\ of\ factors\ greater\ than\ 1}) - \mathbf{1}\right) \times \mathbf{INC}\right)$$

5. The Location Factor is determined in accordance with EQ. 13 as

   giving **MAX (1.2, 1, 1) + 0 = 1.2**

6. The Duty Factor is given by Table 10 “Duty Factor Methodology” as **1**

7. The Expected Life is given by EQ. 4 as

$$\textbf{Expected Life} = \frac{\textbf{Normal Expected Life}}{(\textbf{Duty Factor} \times \textbf{Location Factor})}$$

giving **50 / (1.2 x 1) = 41.66667** years

β1 Initial Ageing Rate (see Section 7.1.5)

8. The Initial Ageing Rate is given by EQ. 5 as

$$\boldsymbol{\beta_1} = \frac{\ln\left(\frac{H_{\text{expected life}}}{H_{\text{new}}}\right)}{\textbf{Expected Life}}$$

giving **ln(5.5 / 0.5) / 41.66667 = 0.05755**

Initial Health Score (see Section 7.1.6)

9. The Initial Health Score is given by EQ. 6 as

$$\textbf{Initial Health Score} = H_{\text{new}} \times e^{(\beta_1 \times \text{age})}$$

giving **0.5 x e^(0.05755 x 1) = 0.52962**

Current Health Score (see Section 7.1.7)

10. The Observed Condition Modifiers are given by Table 130 to Table 134. As no condition information is available, the default values apply, namely Condition Input Factor = **1**, Condition Input Cap = **10**, Condition Input Collar = **0.5**

11. The Measured Condition Modifier is given by Table 238 “Measured Condition Input - LV Pole: Pole Decay / Deterioration”. As no condition information is available, the default values apply, namely Condition Input Factor = **1**, Condition Input Cap = **10**, Condition Input Collar = **0.5**

12. The Health Score Modifier is calculated using the MMI technique described in Section 7.8.2. In this case, all input factors are the same, resulting in a Health Score Modifier that consists of Health Score Factor = **1**, Health Score Cap = **10**, Health Score Collar = **0.5**

13. The Current Health Score is given by EQ. 7 as

$$\textbf{Current Health Score} = \textbf{Initial Health Score} \times \textbf{Health Score Factor} \times \textbf{Reliability Factor}$$

giving **0.52962 x 1 x 1 = 0.52962**. The test conditions in EQ. 8 and EQ. 9 confirm that this value is within the cap and collar range (0.5 to 10), so the Current Health Score is confirmed as **0.52962**

14. The corresponding Health Index Band is given by Table 5 “Health Index Banding Criteria” as **HI1**

<u>β2 Forecast Ageing Rate (see Section 7.1.8)</u>

15. The Forecast Ageing Rate is given by EQ. 10 as

$$\boldsymbol{\beta_2 = \frac{\ln\left(\frac{\text{Current Health Score}}{H_{new}}\right)}{\text{Age}}}$$

giving **ln(0.52962/ 0.5) / 1 = 0.05755**

16. The test condition in EQ. 11 confirms that this result for β2 is within the cap of 2 x β1

<u>Ageing Reduction Factor (see Section 7.1.9)</u>

17. The Current Health Score is less than 2, so Table 265 “Ageing Reduction Factor” confirms that the Ageing Reduction Factor is **1**

<u>Future Health Score – Deterioration (see Section 7.1.10)</u>

18. The Future Health Score is given by EQ. 12

$$\boldsymbol{\text{Future Health Score} = \text{Current Health Score} \times e^{((\beta_2/r)\times t)}}$$

For a five-year forecast period, t is equal to **5**, so the Future Health Score is therefore **0.52962 x e^((0.05755 / 1) x 5)) = 0.70620**

19. The future Health Index Band is given by Table 5 “Health Index Banding Criteria” as **HI1**

20. The value of K is given by Table 23 “PoF Curve Parameters” as **0.00029**

21. The Current Health Score is <=4, so the PoF if given by setting H=4 in EQ. 3

$$\boldsymbol{\text{PoF} = K \times \left[1 + (C \times H) + \frac{(C \times H)^2}{2!} + \frac{(C \times H)^3}{3!}\right]}$$

This gives a PoF value of **0.00029 x (1 + (1.087 x 4) + (1.087 x 4)^2 / 2 + (1.087 x 4)^3 / 6) = 0.00827**

22. The Future Health Score is <=4, so the future PoF is again given by EQ. 3 as **0.00029 x (1 + (1.087 x 4) + (1.087 x 4)^2 / 2 + (1.087 x 4)^3 / 6) = 0.00827**

In summary, this asset would be banded into the most reliable Health Index Band (HI1) and would remain there for the 5-year period under review.

Example 2: An ageing LV pole

The asset used in this example is a 50-year-old steel LV pole in the same location as the previous example i.e. located outdoors, 5km from the coast, at an altitude of 100m, in corrosion zone 3. No condition information is available for this asset.

Steps 1 to 8 are exactly the same as in the previous example.

Initial Health Score (see Section 7.1.6)

9. The Initial Health Score is given by EQ. 6 as

$$\textbf{Initial Health Score} = \mathbf{H_{new}} \times \mathbf{e}^{(\beta_1 \times \text{age})}$$

giving **0.5 x e^(0.05755 x 50) = 8.88490.** However, the result is capped to the maximum permissible value of **5.5**

Current Health Score (see Section 7.1.7)

Steps 10 to 12 are exactly the same as in the previous example.

13. The Current Health Score is given by EQ. 7 as

$$\textbf{Current Health Score} = \textbf{Initial Health Score} \times \textbf{Health Score Factor} \times \textbf{Reliability Factor}$$

giving **5.5 x 1 x 1 = 5.5**. The test conditions in EQ. 8 and EQ. 9 confirm that this value is within the cap and collar range (0.5 to 10), so the Current Health Score is confirmed as **5.5**

14. The corresponding Health Index Band is given by Table 5 “Health Index Banding Criteria” as **HI3**

β2 Forecast Ageing Rate (see Section 7.1.8)

15. The Forecast Ageing Rate is given by EQ. 10 as

$$\boldsymbol{\beta_2} = \frac{\ln\left(\frac{\textbf{Current Health Score}}{\mathbf{H_{new}}}\right)}{\textbf{Age}}$$

giving **ln(5.5 / 0.5) / 50 = 0.04796**

16. The test condition in EQ. 11confirms that this result for β2 is within the cap of 2 x β1

Ageing Reduction Factor (see Section 7.1.9)

17. The Current Health Score is 5.5, so Table 265 “Ageing Reduction Factor” increases the Ageing Reduction Factor to **1.5**

Future Health Score – Deterioration (see Section 7.1.10)

The Future Health Score is given by EQ. 12

$$\mathbf{Future\ Health\ Score} = \mathbf{Current\ Health\ Score} \times \mathbf{e}^{((\beta_2/r)\times t)}$$

For a five-year forecast period, t is equal to 5, so the Future Health Score is therefore 5.5 x e^((0.04796 / 1.5) x 5)) = 6.45340

The future Health Index Band is given by Table 5 “Health Index Banding Criteria” as HI3

The value of K is given by Table 23 “PoF Curve Parameters” as 0.00029

The Current Health Score is >4, so the current PoF from EQ. 3 where H = Health Score

$$\mathbf{PoF} = \mathbf{K} \times \left[\mathbf{1} + (\mathbf{C} \times \mathbf{H}) + \frac{(\mathbf{C} \times \mathbf{H})^2}{\mathbf{2}!} + \frac{(\mathbf{C} \times \mathbf{H})^3}{\mathbf{3}!}\right]$$

is 0.00029 x (1 + (1.087 x 5.5) + (1.087 x 5.5)^2 / 2 + (1.087 x 5.5)^3 / 6) = 0.01753 – approximately twice that of the new pole in the first example

Future Health Score is >4, so the future PoF is similarly given by EQ. 3 as 0.00029 x (1 + (1.087 x 6.45340) + (1.087 x 6.45340)^2 / 2 + (1.087 x 6.45340)^3 / 6) = 0.02614 – approximately three times that of the new pole in the first example

In summary, this asset would be banded into the middle Health Index Band (HI3) and would still be in the same band (HI3) by the end of the 5-year period under review, when it would be approximately three times more likely to fail than a new pole.

Example 3: A mid-life LV pole with evidence of degraded condition

The asset used in this example is a 25-year-old steel LV pole in the same location as the previous example i.e. located outdoors, 5km from the coast, at an altitude of 100m, in corrosion zone 3. The pole has been inspected and was found to have significant loss of residual strength, although within an acceptable level.

Steps 1 to 8 are exactly the same as in the previous example.

Initial Health Score (see Section 7.1.6)

9. The Initial Health Score is given by EQ. 6 as

$$\textbf{Initial Health Score} = \mathbf{H_{new}} \times \mathbf{e^{(\beta_1 \times age)}}$$

giving **0.5 x e^(0.05755 x 25) = 2.10768**

Current Health Score (see Section 7.1.7)

Step 10 is the same as in the previous example.

11. The Measured Condition Modifier is given by Table 238 “Measured Condition Input - LV Pole: Pole Decay / Deterioration”. The pole has significant loss of residual strength, although within an acceptable level and so would be classified as having “High” deterioration. Therefore, Condition Input Factor =**1.4**, Condition Input Cap = **10**, Condition Input Collar = **5.5**

12. The Health Score Modifier is calculated using the MMI technique described in Section 7.8.2. In this case, the result is driven by the highest Condition Input Factor, resulting in a Health Score Modifier that consists of Health Score Factor = **1.4**, Health Score Cap = **10**, Health Score Collar = **5.5**

13. The Current Health Score is given by EQ. 7 as

$$\textbf{Current Health Score} = \textbf{Initial Health Score} \times \textbf{Health Score Factor} \times \textbf{Reliability Factor}$$

giving **2.10768 x 1.4 x 1 = 2.95076**. However, the test conditions in EQ. 8 and EQ. 9 show that this is outside the cap and collar range (5.5 to 10), so the Current Health Score is collared to **5.5**

14. The corresponding Health Index Band is given by Table 5 “Health Index Banding Criteria” as **HI3**

β2 Forecast Ageing Rate (see Section 7.1.8)

15. The Forecast Ageing Rate is given by EQ. 10 as

$$\boldsymbol{\beta_2} = \frac{\ln\left(\frac{\textbf{Current Health Score}}{\mathbf{H_{new}}}\right)}{\textbf{Age}}$$

giving **ln(5.5 / 0.5) / 25 = 0.09592**.

16. The test condition in EQ. 11confirms that this result for β2 is within the cap of 2 x β1

Ageing Reduction Factor (see Section 7.1.9)

17. The Current Health Score is 5.5, so Table 265 “Ageing Reduction Factor” increases the Ageing Reduction Factor to **1.5**

Future Health Score – Deterioration (see Section 7.1.10)

18. The Future Health Score is given by EQ. 12

$$\mathbf{Future\ Health\ Score} = \mathbf{Current\ Health\ Score} \times \mathbf{e}^{((\boldsymbol{\beta}_2/\mathbf{r}) \times \mathbf{t})}$$

For a five-year forecast period, t is equal to **5**, so the Future Health Score is therefore **5.5 x e^((0.09592 / 1.5) x 5)) = 7.57208**

19. The future Health Index Band is given by Table 5 “Health Index Banding Criteria” as **HI4**

20. The value of K is given by Table 23 “PoF Curve Parameters” as **0.00029**

21. The Current Health Score is >4, so the current PoF from EQ. 3 where H = Health Score

$$\mathbf{PoF} = \mathbf{K} \times \left[\mathbf{1} + (\mathbf{C} \times \mathbf{H}) + \frac{(\mathbf{C} \times \mathbf{H})^{2}}{\mathbf{2}!} + \frac{(\mathbf{C} \times \mathbf{H})^{3}}{\mathbf{3}!}\right]$$

is **0.00029 x (1 + (1.087 x 5.5) + (1.087 x 5.5)^2 / 2 + (1.087 x 5.5)^3 / 6) = 0.01753** - approximately twice that of the new pole in the first example

22. Future Health Score is >4, so the future PoF is similarly given by EQ. 3 as **0.00029 x (1 + (1.087 x 7.57208) + (1.087 x 7.57208)^2 / 2 + (1.087 x 7.57208)^3 / 6) = 0.03945** – approximately five times that of the new pole in the first example

In summary, this asset would be banded into the middle Health Index Band (HI3) and would progress to HI4 by the end of the 5-year period under review, when it would be approximately five times more likely to fail than a new pole.

Example 4: An EHV transformer in good condition

The asset used in this example is a 40 year old 33 kV transformer, located outdoors, 5km from the coast, at an altitude of 100m, in corrosion zone 3. It is 50% loaded and averages 5 taps per day. Condition information is available, showing that the main transformer tank has low levels of DGA.

This example illustrates how the health scores of two asset sub-components are combined to give an overall health score.

Normal Expected Life (see Section 7.1.3)

1. The Normal Expected Life of a pre-1980 33 kV transformer and tapchanger is given by Table 22 "Normal Expected Life" as **60** years

Expected Life (see Section 7.1.4)

2. The Distance from Coast Factor is given by Table 24 "Distance from Coast Factor Lookup Table" as **1.1**

3. The Altitude Factor is given by Table 25 "Altitude Factor Lookup Table" as **0.9**

4. The Corrosion Category Factor is given by Table 26 "Corrosion Category Factor Lookup Table" as **1**

5. The Location Factor is determined in accordance with EQ. 13 as

$$\begin{aligned}&\textbf{Location Factor}\\&= \textbf{MAX}(\textbf{Distance From Coast Factor}, \textbf{Altitude Factor}, \textbf{Corrosion Factor})\\&+ \Big(\big((\textbf{COUNT of factors greater than 1}) - \textbf{1}\big) \times \textbf{INC}\Big)\end{aligned}$$

giving **MAX (1.1, 0.9, 1) + 0 = 1.1**

6. The Transformer Duty Factor is given by

7. Table 36 "Duty Factor Lookup Tables - Grid & Primary Transformers" as **1**

The Tapchanger Duty Factor is given by

$$\textbf{Expected Life} = \frac{\textbf{Normal Expected Life}}{(\textbf{Duty Factor} \times \textbf{Location Factor})}$$

Table 36 "Duty Factor Lookup Tables - Grid & Primary Transformers" as **0.9**

8. The Transformer Expected Life is given by EQ. 4 as

giving **60 / (1.1 x 1) = 54.54545** years

9. The Tapchanger Expected Life is given similarly by EQ. 4 as **60 / (1.1 x 0.9) = 60.60606** years

β1 Initial Ageing Rate (see Section 7.1.5)

10. The Transformer Initial Ageing Rate is given by EQ. 5 as

$$\beta_1 = \frac{\ln\left(\frac{H_{\text{expected life}}}{H_{\text{new}}}\right)}{\text{Expected Life}}$$

giving **ln(5.5 / 0.5) / 54.55 = 0.04396**

11. The Tapchanger Initial Ageing Rate is given similarly by EQ. 5 as **ln(5.5 / 0.5) / 60.61 = 0.03957**

Initial Health Score (see Section 7.1.6)

12. The Transformer Initial Health Score is given by EQ. 6 as

$$\text{Initial Health Score} = H_{\text{new}} \times e^{(\beta_1 \times \text{age})}$$

giving **0.5 x e^(0.04396 x 40) = 2.90174**

13. The Tapchanger Initial Health Score is given similarly by EQ. 6 as **0.5 x e^(0.03957 x 40) = 2.43382**

Current Health Score (see Section 7.1.7)

14. The Health Score Modifier is calculated using the MMI technique described in Section 7.8.2. In this case, all input factors are neutral, resulting in a Health Score Modifier that consists of Health Score Factor = **1**, Health Score Cap = **10**, Health Score Collar = **0.5** for both the Transformer and the Tapchanger

15. The Transformer Current Health Score is given by EQ. 7 as

$$\text{Current Health Score} = \text{Initial Health Score} \times \text{Health Score Factor} \times \text{Reliability Factor}$$

giving **2.90174 x 1 = 2.90174**. The test conditions in EQ. 8 and EQ. 9 confirm that this value is within the cap and collar range (0.5 to 10), so the Transformer Current Health Score is confirmed as **2.90174**

16. The Tapchanger Current Health Score is similarly given by EQ. 7 as **2.43382 x 1 = 2.43382** EQ. 8 and EQ. 9 confirm that this value is within the cap and collar range (0.5 to 10), so the Tapchanger Current Health Score is confirmed as **2.43382**

17. The combined Current Health Score is derived according to Section 7.2 as **MAX(2.90174, 2.43382) = 2.90174**

18. The corresponding Health Index Band is given by Table 5 as **HI1**

The derivation of the PoF and Future Health Score then follows the same pattern as described in Steps 15 to 22 in the first example. In this case, the transformer will remain in Health Index Band HI1 through to the end of the 5-year period under review.

Example 5: An EHV transformer with rising DGA levels

The asset used in this example is the same 40 year old 33 kV transformer from example 4, which is located outdoors, 5km from the coast, at an altitude of 100m, in corrosion zone 3. It is 50% loaded and averages 5 taps per day. Additional condition information is available, showing that the DGA in the main transformer has risen from 10ppm (Hydrogen, Methane, Ethylene, Ethane) and 5ppm (Acetylene) to 50ppm (Hydrogen), 25ppm (Methane, Ethylene, Ethane) and 10ppm (Acetylene). In addition, Oil Moisture is measured at 15ppm, Acidity at 0.2 mg KOH/g and oil breakdown at 25kV. This is indicative of degradation and accelerated ageing, placing the transformer at increased risk of failure.

This example illustrates how the poor condition of a sub-component affects the overall health score.

Initial Health Scores are derived using Steps 1 to 13 from the previous example:

- The Transformer Initial Health Score is **2.90174**
- The Tapchanger Initial Health Score is **2.43382**

<u>Health Score Modifier (see Section 7.8)</u>

The Health Score Modifier for a 33 kV transformer is derived in the same generic way as described in Section 7.8 except for the following differences:

- There are three additional Condition Modifiers to the model: The Oil Test Modifier, the DGA Test Modifier and the FFA Test Modifier.
- The parameters used to combine the Factors associated with these Condition Modifiers in order to derive the Health Score Factor are as shown in Table 12.

14. The Oil Test Modifier is determined from EQ. 22

$$\begin{aligned}\textbf{Oil Condition Score} \\ &= \mathbf{80 \times Moisture\ Score + 125 \times Acidity\ Score} \\ &\quad \mathbf{+ 80 \times Breakdown\ Strength\ Score}\end{aligned}$$

Using the inputs determined from Table 251 - Table 255 as follows

Oil Condition Score = (80 x 2) + (125 x 4) + (80 x 10) = 1,460 giving an Oil Test Factor of **1.2** and an Oil Test Collar of **5.5** in accordance with Table 254 and Table 255 respectively.

15. The DGA Test Modifier is determined from EQ. 23, EQ. 24 and EQ. 25

$$\mathbf{DGA\ Score} = \mathbf{50 \times Hydrogen\ Score + 30 \times Methane\ Score}$$
$$\mathbf{+\ 30 \times Ethylene\ Score + 30 \times Ethane\ Score + 120 \times Acetylene\ Score}$$

$$\mathbf{DGA\ Test\ Collar = DGA\ Score \div 220}$$

$$\%\ \mathbf{Change} = \frac{\mathbf{DGA\ Score_{latest} - DGA\ Score_{previous}}}{\mathbf{DGA\ Score_{previous}}} \times \mathbf{100\%}$$

Using the inputs determined from Table 256 - Table 260:

- Current DGA Condition Score = (50 x 4) + (30 x 4) + (30 x 4) + (30 x 4) + (120 x 4) = 1,040
- Previous DGA Condition Score = (50 x 0) + (30 x 0) + (30 x 0) + (30 x 0) + (120 x 2) = 240
- % change = ((1,040 – 240) / 240 x 100) = 333% giving a DGA Test Factor of 1.50 in accordance with Table 261 and Table 262.
- The DGA Test Collar = 1,040 / 220 = 4.727273

19. The FFA Test Modifier is determined from to give an FFA Test Factor of 1.0

16. The Health Score Factor (pre collar) can therefore be determined using the MMI technique as follows: 1.5 + ((1.2-1.0) / 1.5) = 1.6333

<u>Current Health Score (see Section 7.1.7)</u>

17. The Health Score Modifier is calculated using the MMI technique described in Section 7.8.2.

18. The Transformer Current Health Score is given by EQ. 7 as

$$\mathbf{Current\ Health\ Score = Initial\ Health\ Score \times Health\ Score\ Factor \times Reliability\ Factor}$$

giving **2.90 x 1.633 = 4.73950**

19. The test conditions in EQ. 8 and EQ. 9 confirm that this value is outside the cap and collar range (5.5 to 10) due to the DGA Test Collar and so the Transformer Current Health Score becomes **5.5.**

20. The Tapchanger Current Health Score is similarly given by EQ. 7 as **2.43 x 1 = 2.43**. EQ. 8 and EQ. 9 confirm that this value is within the cap and collar range (0.5 to 10), so the Tapchanger Current Health Score is confirmed as **2.43**

21. The combined Current Health Score is derived according to Section 7.2 as **MAX(5.5, 2.43) = 5.5**

22. The corresponding Health Index Band is given by Table 5 as **HI3**

The derivation of the PoF and Future Health Score then follows the same pattern as described in Steps 15-22 in the first example

F.2 Consequences of Failure

The described methodology is capable of representing a very wide range of asset criticalities. In order to provide the reader with some clarity, this section works through a selection of typical scenarios. The scenarios presented here are not exhaustive but provide an illustration of how the methodology works.

Example 1: A distribution RMU with a typical number of connected customers

The asset used in this example is an 11 kV oil-filled RMU supplying 800 customers with normal access arrangements. The safety location and type risks have been assessed as “Medium” in accordance with ESQCR. It is moderately close to a water course. For this asset, the following calculation steps enable the Consequences of Failure to be determined:

Financial Consequences (see Section 8.3)

1. Table 18 “Reference Costs of Failure” gives the Reference Financial Cost of Failure as **£9,839**Table 271 “Access Factor: Battery System, Switchgear & Transformer Assets” gives the Access Factor as **1**

2. Applying EQ. 28 and EQ. 29

$$\textbf{Financial Consequences of Failure} = \textbf{Reference Financial Cost of Failure} \times \textbf{Financial Consequences Factor}$$

$$\textbf{Financial Consequences Factor} = \textbf{Type Financial Factor} \times \textbf{Access Financial Factor}$$

gives the Financial Consequences of Failure as **£9,839 x 1 = £9,839**

Safety Consequences (see Section 8.4)

3. Table 18 “Reference Costs of Failure” gives the Reference Safety Cost of Failure as **£4,823**

4. Table 275 “Safety Consequence Factor – Switchgear, Transformers & Overhead Lines” gives the Safety Consequence Factor as **1**

5. Applying EQ. 31

$$\textbf{Safety Consequences of Failure} = \textbf{Reference Safety Cost of Failure} \times \textbf{Safety Consequences Factor} \times \textbf{Safety Risk Reduction Factor}$$

gives the Safety Consequences of Failure as **£4,823 x 1 = £4,823**

Environmental Consequences (see Section 8.5)

6. Table 18 “Reference Costs of Failure” gives the Reference Environmental Cost of Failure as **£1,486**

7. Table 279 “Type Environmental Factor” gives the Type Environmental Factor as **0.98**

8. Table 281 “Location Environmental Factor” gives a Proximity Factor of **1** and a Bunding Factor of **1**. The Location Environmental Factor is therefore equal to **1**

9. Applying EQ. 33 and EQ. 34

$$\textbf{Environmental Consequences of Failure} = \textbf{Reference Environmental Cost of Failure} \times \textbf{Environmental Consequences Factor}$$

$$\textbf{Environmental Consequences Factor} = \textbf{Type Environmental Factor} \times \textbf{Size Environmental Factor} \times \textbf{Location Environmental Factor}$$

gives the Environmental Consequences of Failure as **£1,486 x 0.98 = £1,456**

Network Performance Consequences (see Section 8.6)

10. Table 18 “Reference Costs of Failure” gives the Reference Network Performance Cost of Failure as **£11,580**

11. Applying EQ. 39 and EQ. 38

$$\textbf{Customer Factor} = \frac{\textbf{No. of Customers}}{\textbf{Reference No. of Customers}}$$

$$\textbf{Network Performance Consequence Factor} = \textbf{Customer Factor} \times \textbf{Customer Sensitivity Factor}$$

gives the Network Performance Consequence Factor as **800 / 1,000 x 1 = 0.8.**

12. Applying EQ. 37

$$\textbf{Network Performance Cost of Failure} = \textbf{Reference Network Performance Cost of Failure} \times \textbf{Network Performance Consequence Factor}$$

gives the Network Performance Cost of Failure as **£11,580 x 0.8 = £9,264**

Consequences of Failure (see Section 8.1)

13. Figure 20 “Consequences of Failure” shows that the total Consequences of Failure is the sum of the above, giving **£9,839 + £4,823 + £1,456 + £9,264 = £25,382**

As described in Section 6.3 the classification of this total CoF into Criticality Bands C1, C2, C3 and C4 is a based on the relative magnitude of the total CoF of the asset (in this instance £25,382) compared to the Reference Costs of Failure shown in Table 18(in this instance £27,728) and the Criticality Index banding criteria shown in Table 6. Therefore, in this example, **£25,382 / 27,728 = 92%** giving a Criticality Index band of C2.

Example 2: A distribution RMU with a single commercial customer

The asset used in this example is an 11 kV oil-filled RMU supplying a single commercial customer 600kVA of load and normal access arrangements. The safety location and type risks have been assessed as “Medium” in accordance with ESQCR. It is not close to a water course. For this asset, the following calculation steps enable the Consequences of Failure to be determined:

Steps 1 to 10 are exactly the same as in the previous example.

Network Performance Consequences (See Section 8.6)

11. Applying Table 20 “Customer Number Adjustment for LV & HV Assets with High Demand Customers” gives the multiplier on the number of customers as **250**

12. Applying EQ. 39 and EQ. 38

$$\textbf{Network Performance Consequence Factor} = \textbf{Customer Factor} \times \textbf{Customer Sensitivity Factor}$$

$$\textbf{Customer Factor} = \frac{\textbf{No. of Customers}}{\textbf{Reference No. of Customers}}$$

gives the Network Performance Consequence Factor as **250 / 1,000 x 1 = 0.25**

13. Applying EQ. 37

$$\textbf{Network Performance Cost of Failure} = \textbf{Reference Network Performance Cost of Failure} \times \textbf{Network Performance Consequence Factor}$$

gives the Network Performance Cost of Failure as **£11,580 x 0.25 = £2,895**

<u>Consequences of Failure (see Section 8.1)</u>

14. Figure 20 "Consequences of Failure" shows that the total Consequences of Failure is the sum of the above, giving **£9,839 + £4,823 + £1,456 + £2,895 = £19,013**

As described in Section 6.3 the classification of this total CoF into Criticality Bands C1, C2, C3 and C4 is a based on the relative magnitude of the total CoF of the asset (in this instance £19,013) compared to the Reference Costs of Failure shown in Table 18 (in this instance £27,728) and the Criticality Index banding criteria shown in Table 6. Therefore, in this example, **£19,013 / 27,728 = 69%** giving a Criticality Index band of C1.

Example 3: An EHV transformer with typical loading

The asset used in this example is a 33/11 kV, 24MVA-rated transformer with normal access arrangements. The safety location has not been assessed. It is bunded and moderately close to a water course. It has a maximum demand of 10MVA and is in an "n-1" (or Secure) configuration. For this asset, the following calculation steps enable the Consequences of Failure to be determined:

<u>Financial Consequences (see Section 8.3)</u>

1. Table 18 "Reference Costs of Failure" gives the Reference Financial Cost of Failure as **£87,698**

2. Table 269 "Type Financial Factors" gives the Type Financial Factor as **1.1**

3. Table 271 "Access Factor: Battery System, Switchgear & Transformer Assets" gives the Access Factor as **1**

4. Applying EQ. 28 and EQ. 29

$$\textbf{Financial Consequences of Failure} = \textbf{Reference Financial Cost of Failure} \times \textbf{Financial Consequences Factor}$$

$$\textbf{Financial Consequences Factor} = \textbf{Type Financial Factor} \times \textbf{Access Financial Factor}$$

gives the Financial Consequences of Failure as **£87,698 x 1.1 x 1 = £96,468**

Safety Consequences (see Section 8.4)

5. Table 18 “Reference Costs of Failure” gives the Reference Safety Cost of Failure as **£23,502**

6. Table 275 “Safety Consequence Factor – Switchgear, Transformers & Overhead Lines” gives the Safety Consequence Factor as **1**

7. Applying EQ. 31

$$\textbf{Safety Consequences of Failure} = \textbf{Reference Safety Cost of Failure} \times \textbf{Safety Consequences Factor} \times \textbf{Safety Risk Reduction Factor}$$

gives the Safety Consequences of Failure as **£23,502x 1 = £23,502**

Environmental Consequences (see Section 8.5)

8. Table 18 “Reference Costs of Failure” gives the Reference Environmental Cost of Failure as **£17,048**

9. Table 279 “Type Environmental Factor” gives the Type Environmental Factor as **1**

10. Table 280 “Size Environmental Factor” gives the Size Environmental Factor as **1.6**

11. Table 281 “Location Environmental Factor” gives a Proximity Factor of **1** and a Bunding Factor as **0.5**. The Location Environmental Factor is therefore equal to **1**

12. Applying EQ. 33, EQ. 34 and EQ. 35

$$\textbf{Environmental Consequences of Failure} = \textbf{Reference Environmental Cost of Failure} \times \textbf{Environmental Consequences Factor}$$

$$\textbf{Environmental Consequences Factor} = \textbf{Type Environmental Factor} \times \textbf{Size Environmental Factor} \times \textbf{Location Environmental Factor}$$

$$\textbf{Location Environment Factor} = \textbf{Proximity Factor} \times \textbf{Bunding Factor}$$

gives the Environmental Consequences of Failure as **£17,048 x 1 x 1.6 x 0.5 = £13,638**

Network Performance Consequences (see Section 8.6)

13. Table 18 “Reference Costs of Failure” gives the Reference Network Performance Cost of Failure as **£28,940**

14. Applying EQ. 42

$$\textbf{Load Factor} = \frac{\textbf{Actual Load Supplied By Asset}}{\textbf{Maximum Demand Used To Derive Reference Network Performance Cost of Failure}}$$

gives the Load Factor as **10 / 15 = 0.66**

15. Applying EQ. 41

$$\textbf{Network Performance Consequences of Failure} = \textbf{Reference Network Performance Cost of Failure} \times \textbf{Load Factor} \times \textbf{Network Type Factor}$$

gives the Network Performance Consequence of Failure as **£28,940 x 0.66 x 1 = £19,100**

Consequences of Failure (see Section 8.1)

16. Figure 20 “Consequences of Failure” shows that the total Consequences of Failure is the sum of the above, giving **£96,468 + £23,502 + £13,638 + £19,100 = £152,708**

As described in Section 6.3 the classification of this total CoF into Criticality Bands C1, C2, C3 and C4 is a based on the relative magnitude of the total CoF of the asset (in this instance £152,708) compared to the Reference Costs of Failure shown in Table 18 (in this instance £157,188) and the Criticality Index banding criteria shown in Table 6. Therefore, in this example, **£152,708 / 157,188 = 97%** giving a Criticality Index band of C2.

Acronyms

Acronym	Description
AAAC	All Aluminium Alloy Conductors
ACB	Air Circuit Breaker
ACSR	Aluminium Conductor Steel Reinforced
Cad Cu	Cadmium Copper
CCA	Chromated Copper Arsenate
CI	Customer Interruption
CML	Customer Minutes Lost
CMR	Continuous Maximum Rating
CoF	Consequence of Failure
CRC	Charge Restriction Condition
DGA	Dissolved Gas Analysis
DIN	Dangerous Incident Notification
DNO	Distribution Network Operator
DP	Degree of Polymerisation
DPCR5	Distribution Price Control Review for five years from 1 April 2010 to 31 March 2015
DSI	Death or Serious Injury
EHV	Extra High Voltage
ENA	Energy Networks Association
EQ	Equation

Acronym	Description
ESQCR	Electricity, Safety, Quality and Continuity Regulations 2002
FFA	Furfuraldehyde
FFC	Fluid Filled Cable
GB	Great Britain
GM	Ground Mounted
HI	Health Index
HSE	Health and Safety Executive or Health, Safety and Environment
HM	Her Majesty or His Majesty
HV	High Voltage
ID	Indoor
IIS	Interruption Incentive Scheme
IR	Insulation Resistance
kV	Kilovolt
LV	Low Voltage
LV UGB	Low Voltage Underground Board (Link Box)
LTA	Lost Time Accident
MMI	Maximum and Multiple Increment
MVA	Megavolt Ampere
NaFIRS	National Fault and Interruption Reporting Scheme
NARM	Network Asset Risk Metric
NAW	Network Assets Workbook

Acronym	Description
NEDeRs	National Equipment Defect Reporting Scheme
OD	Outdoor
Ofgem	Office of Gas and Electricity Markets
OHL	Overhead Line
PM	Pole Mounted
PoF	Probability of Failure
RIG	Regulatory Instructions and Guidance
RIIO	Ofgem's price control framework first implemented in 2013
RIIO-ED1	First price control for Electricity Distribution companies under the RIIO framework from 1 April 2015 to 31 March 2023
RIIO-ED2	Second price control for Electricity Distribution companies under the RIIO framework from 1 April 2023 to 31 March 2028
RMU	Ring Main Unit
SDI	Secondary Deliverable Intervention
SF_6	Sulphur Hexafluoride
SLC	Standard Licence Condition
SOP	Suspension of Operational Practice
VoLL	Value of Lost Load
VSL	Value of Statistical Life
WM	Wall Mounted