



Guidance Document

G042 Asset Condition Reporting (ACR)

Document ID: G042-2015-01

Issue No. A4

Issue date: July 2015
Review date: July 2020

MAYOR OF LONDON

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1 Purpose

1.1 The purpose of this Guidance Document is to:

- a) Explain the principles of Asset Condition Reporting (ACR);
- b) Provide instructions and guidelines to support the accurate and timely production, submission and review of the annual Asset Condition Report and Asset Safety and Management Certificates in compliance with Category 1 ACR Standard S1042.

2 Scope

2.1 The Standard applies to engineering Assets listed in the Attachments to the ACR Standard, S1042.

2.2 The scope of reporting is limited to:

- a) Residual Life of the Asset base;
- b) Failures to meet Required Duty that result in Functional Condition Concerns:
 - Statutory non-compliance; and/or
 - Safety risks that may result in customer or staff fatalities and/or injuries, which require either control or mitigation to achieve risk levels of ALARP or better; and/or
 - Extraordinary maintenance and/or operational activities, outside of the maintenance regime, which are uneconomic and/or unsustainable; and/or
 - Performance Risks of £250k or more per year;
- c) Degradation Concerns.

2.3 The scope of reporting includes software and firmware, but excludes:

- a) Information and documentation used to support management of a physical Asset;
- b) Any aspect of failure to meet Required Duty that does not result in any of the business impacts covered by 2.2 above (i.e. transient defects).

Notes

Any exceptions to 2.3 are explicitly listed in the Attachments to the Standard.

For simplicity the term "engineering Asset" is shortened to "Asset" within the Standard and accompanying Guidance Document. Similarly the term "Asset" shall be interpreted to include "Asset systems", "Asset sub-systems" or "part of an Asset" as appropriate.

3 Guidance

3.1 Overview

3.1.1 Physical and Functional condition are assessed separately through ACR and categorised as follows:

- a) Residual Life is reported for 100% of the Asset base using Physical Condition Codes (A-D) and any specific Degradation Concerns are also recorded.
- b) Functional Condition Concerns (1-4) are used to report Assets with a residual risk that is a direct result of the physical condition of the Asset.

3.1.2 For ACR Reporting 100% of the total Relative Asset Value (RAV) for each Asset group must be allocated to Physical Condition Codes A-D.

3.1.3 The scope of ACR is limited to non-transient defects; i.e. it excludes defects rectified under the Asset's normal and budgeted maintenance regime or through maintenance deemed economic in comparison to renewal or replacement over the life of the Asset.

3.2 Physical Condition (Residual Life)

3.2.1 The Standard requires Physical Condition to be assessed using Residual Life (Nominal), Residual Life (Measured) or Time To Next Economic Intervention (TTNEI).

3.2.2 Nominal Lives

3.2.3 Nominal Lives have been specified for all Assets, where appropriate, in the Attachments to ACR Standard. These represent the Asset's design life, taking account of any duty or environmental considerations, and have been determined in the majority of Asset groups as either: manufacturer's design life; design life prescribed by Standards, good industry practice or engineering professional judgement.

3.2.4 Upon nominal life expiry the Asset must be replaced unless, a), there is justification to re-life it or, b), the business is prepared to accept the risk of the Asset being unable to fulfil its Required Duty ('run to fail'). An Asset can only be re-lived following a suitable assessment, and with the agreement of the Sponsor/Asset Manager (following consultation with the Head of Technical Discipline). A record must be retained of all instances where an Asset's life has been extended beyond its Nominal Life for audit purposes.

3.2.3 Residual Life (Nominal)

3.2.3.1 Residual Life (Nominal), RL(N), assumes straight line degradation. The nominal life may be stated to reflect the duty and environment that an Asset operates in. RL(N) is therefore calculated as:

$$RL(N) = (nominal\ life) - (time\ in\ service)$$

3.2.3.2 This method of measurement requires the date of installation of the Asset to be known and recorded, where this information is available. Where this date is not known, an assessment of its estimated installation date will be made, if possible. Any estimate should be supported by evidence and will only be accepted once approved by the Sponsor/Asset Manager.

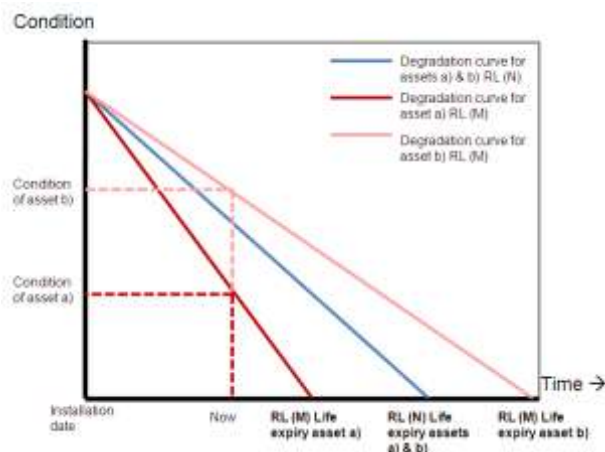
3.2.3.3 Example: Electrical Cabling

Nominal life is 35 yrs. If installed in 1978 then in 2010 service life of Asset is 32 yrs hence RL(N) is 35yrs - 32yrs = 3yrs (Code C)

3.2.4 Residual Life (Measured)

3.2.4.1 Where practical approaches to measuring Asset degradation have been developed, and the agreed methods detailed in the Attachments to the Standard, these shall be used to determine the Residual Life (Measured), RL(M).

- 3.2.4.2 The calculation of RL(M) will ideally be determined using a physical measure that can be correlated with residual life. RL(M) may also take into account other factors, which indicate the amount of remaining residual life. These may include, but are not limited to: obsolescence (see Appendix 1) and reliability.
- 3.2.4.3 Nominal Lives and installation dates (known or estimated) need to be recorded, where this information is available, alongside the RL(N) and RL(M) in the Detailed Report with the agreement of the Sponsor Asset Manager .
- 3.2.4.4 The diagram below illustrates the relationship between RL(N) and RL(M). Assets a) and b) both have the same RL(N), but Asset a) is experiencing quicker than expected degradation such that its RL(M) is less than its RL(N). Asset b) is shown to be degrading slower and if the degradation rates remained the same, intervention on Asset a) would be required first



3.2.4.5 Example: Sewage Pump

If Nominal Life 20yrs and installed in 1997, and reported in 2010, the life expired to date would be $2010 - 1997 = 13\text{yrs}$. Hence $RL(N) = 20\text{yrs} - 13\text{yrs} = 7\text{yrs}$ (Code B)
However, a more accurate approach, based upon actual usage, would be:
Nominal life is 15,000 hrs. Pump runs an average of 1.5 hrs per day, 550 hrs per yr.
Hence Nominal Life = $15,000/550 = 27\text{yrs}$. $RL(M) = 27\text{yrs} - 13\text{yrs} = 14\text{yrs}$ (Code A)

3.2.4.6 Time To Next Economic Intervention (TTNEI)

- 3.2.4.7 Time To Next Economic Intervention (TTNEI) is used for Assets which are managed to provide a nominally infinite life and for which Residual Life is therefore not meaningful. TTNEI is the interval between interventions required to manage the degradation of an Asset. For simplicity, the term Residual Life will include TTNEI within this Guidance Document, unless otherwise stated.

3.3 Physical Condition Coding

- 3.3.1 Once the Residual Life is calculated using either RL(M), RL(N) or TTNEI the Asset is assigned to one of four physical codes A, B, C & D:

Code A	- An expected residual life of at least 10 years; or - Where TTNEI is applicable an intervention is not required for at least 10 years.
Code B	- An expected residual life of between five and 10 years; or - Where TTNEI is applicable an intervention is required between five and 10 years.
Code C	- An expected residual life of less than five years; or - Where TTNEI is applicable an intervention in less than five years.
Code D	Beyond nominal life. Note: An Asset in this category can be reassessed to determine if it has further residual life if the relevant Asset group has an agreed method and approval process in place.

3.3.2 The physical condition codes for each Asset should be recorded at the level defined in the appropriate Attachment.

3.4 Degradation Concerns

3.4.1 Where Asset groups have no Residual Life methodology then Asset degradation will be reported in the Concerns Workbook.

3.4.2 A Degradation Concern should be formatted in the Concern Description of the Concerns Workbook as: <Asset><objective defect with measure and threshold><rationale for revised physical Condition code><source of concern>.

3.5 Functional Condition Concerns

3.5.1 The Concerns Workbook

3.5.1.1 All Functional Condition Codes should be reported and the required details recorded, in the Concerns Workbook.

3.5.1.2 The Concerns Workbook is used to report issues arising as a result of the condition of an Asset. A guide to completing the Functional Condition Concerns worksheet is provided in Appendix 6.4.check reference

3.5.1.3 The Concerns Workbook should be populated by reviewing:

- The previous year's ACR Concerns;
- The risk registers prepared in accordance with the requirements of the Asset Risk Standard S5044 (to identify any condition related risks that may have arisen during the past year);
- Any other appropriate data sources.

3.5.1.4 Where a concern is common to multiple similar assets, in one or more locations, this should be reported on the ASMC as a single concern, with the number of instances stated.

3.5.1.5 Each Concern should be reported in the Concerns Workbook with, optionally, all the line(s) and location(s) with the affected Assets entered in the designated columns. It is preferable to have each location on a separate row so that archiving is made easier. This method will also remove some of the counting anomalies that have been found in the past which affect the calculations further across the row.



3.5.2 Reporting Concerns with two or more Functional Condition Codes

3.5.2.1 The Concerns Workbook allows all applicable Functional Condition Codes to be reported.

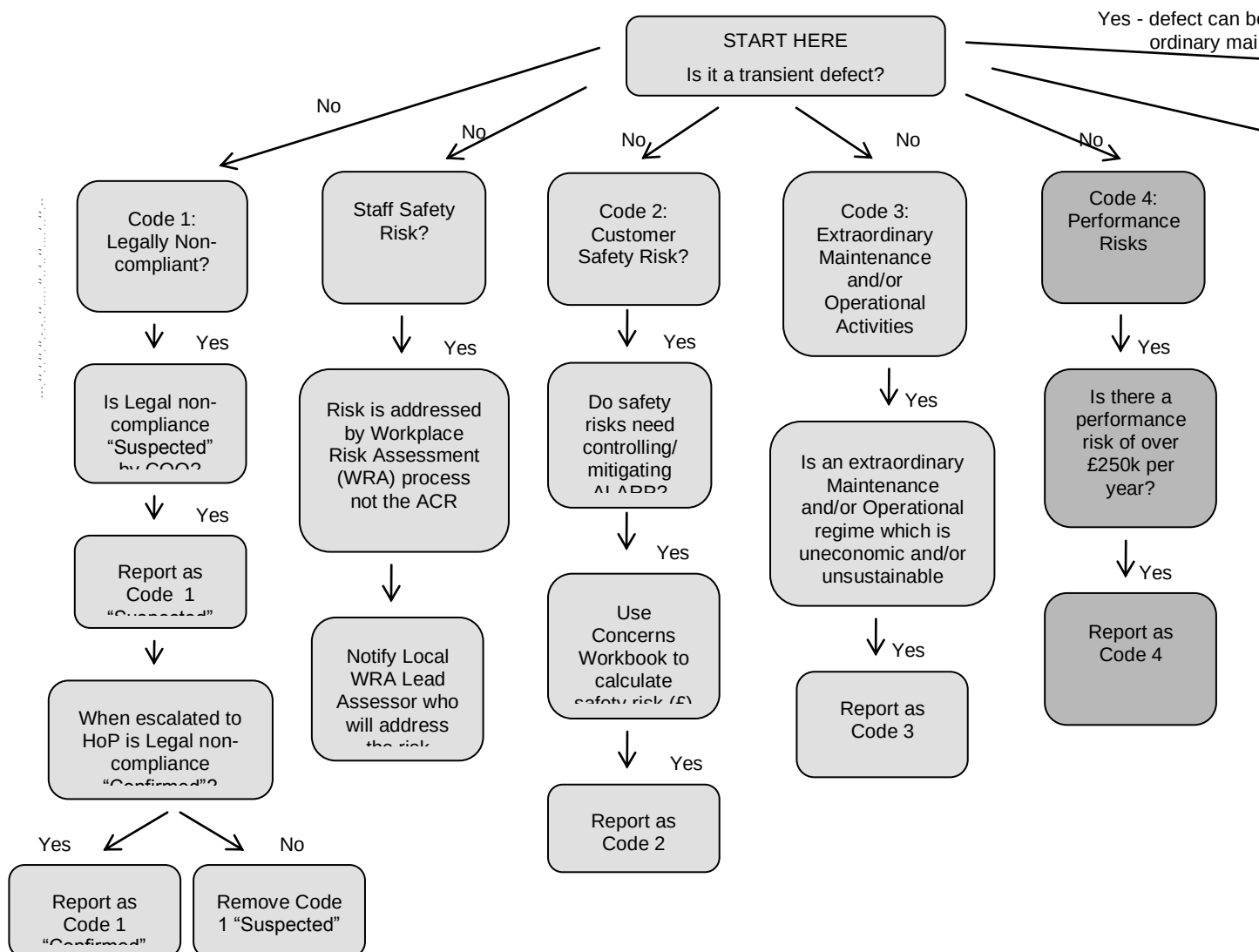
3.5.2.2 In the 'Concerns Description' cell all the information required for the applicable Functional Condition Codes must be entered in the required format which is set out in the section on each Functional Condition Code below.

3.5.2.3 Information required for all Functional Condition Concerns - <Asset><objective defect with measure and threshold>...<source of concern> - needs to only be entered once.

3.5.3 Flow Chart: Functional Condition Concerns and Physical Condition Concerns.

Notes

- 1) All of the Functional Codes and the Degradation Concerns need to be considered separately and all that are reported in the Concerns Workbook or the ACR Detailed Report.
- 2) If you cannot answer "Yes" move onto the next Concern type.
- 3) COO/TLL Equivalent are responsible for identifying & reporting Codes 1, 2 & 3 and Degradation Concerns.
- 4) Client Sponsors/TLL equivalent are responsible for identifying & reporting Code 4 Concerns.



3.5.4 Code 1: Statutory Non-Compliance

3.5.4.1 Code 1 - Condition Concern that states an Asset is statutorily non-compliant.

3.5.4.2 In the Concerns Description cell in the Concerns Workbook a Code 1 Concern should be formatted as: <Asset><objective defect with measure and threshold><how Asset breaches specific part(s) of legislation><reference to action plan proposed / agreed with the enforcing authority><source of concern>

3.5.4.3 The purpose of the Concern description for this Functional Condition Code is to clearly and concisely detail the issue and how it is in breach of particular legislation.

3.5.4.4 Example Code 1: Concern for Rolling Stock

Concern: <Colour of floor in the vestibule (area around the doors) on xxx Stock> has <inadequate contrast with the colour of the floor in the saloon.><Breach of Rail Vehicle Accessibility Regulations 1998; clause 4(i).><Identified by Accessibility Working Group when reviewing Assets against legislation>

3.5.4.5 In the Concerns Workbook the assessor records a 'Suspected' Code 1 and then updates this to "Confirmed" or removes the entry depending upon the decision taken by the Head of Technical Discipline.

3.5.4.6 For any confirmed Code 1 Concerns the Head of Technical Discipline shall, act as the principle point of contact for the regulatory authority, lead engagement and notify HSE. If not the principle point of contact then the Head of Technical Discipline shall notify the appropriate team in HSE and work with them to agree a plan for engaging the relevant regulatory authority.

3.5.4.7 If the Concern has customer and/or staff safety implications it also needs to be reported as a Code 2.

3.5.5 Code 2: Safety Risks to Customers and Staff

3.5.5.1 Condition Concern that may cause an event with a potential safety consequence, fatalities and/or injuries, for customers and staff, that requires either control or mitigation to achieve a risk level of ALARP or better by either: Withdrawal of the Asset from full duty; or Risk reduction by either control or mitigation measures not required by the original design of the Asset.

3.5.5.2 In the Concerns Workbook a Code 2 Concern should be formatted as: <Asset><objective defect with measure and threshold><most probable failure mode/behaviour> and the potential <outcome/consequence – Note: number of fatalities and/or injuries will be calculated by the Concerns Workbook using data from the LUQRA models. If the relevant Top Event or Base Event is not quantified in LUQRA then no estimate of the number of potential fatalities and/or injuries should be made><source of concern>

3.5.5.3 The purpose of the Concern description is to clearly and concisely detail the issue with the Asset, the safety related hazard and the potential consequence. Risk described should be the situation post mitigation or post control measures having been implemented.

3.5.5.4 Example Code 2: Concern for Rolling Stock

<Primary load bearing components responsible for whole vehicle support, braking or guidance><suffering fatigue cracks within the critical crack length>. <Structural failure> leading to <derailment/trackside structure strike/uncoupled vehicles with consequential risk of injury or loss of life><Asset Risk Register Reference>

3.5.5.5 The risk is quantified in financial terms in the Concerns Workbook using data from the LUQRA models.

3.5.6 Quantifying Safety Risks for Code 2

3.5.6.1 Assessors are required to quantify the annual risk in financial terms for Code 2 concerns reported in the ACR.

3.5.6.2 To enable assessors to complete this task the Concerns Workbook was developed to include safety consequence and probability data from the LUQRA models managed by HSE. Details on completing the Concerns Workbook, including this section, are available in Appendix 4, and descriptions of each Top Event are in Appendix 2.

3.5.6.3 The LUQRA estimates the number of Fatalities & Weighted Injuries (FWIs) –a fatality equates to 1, Major Injury to 0.10 and minor injury to 0.005.

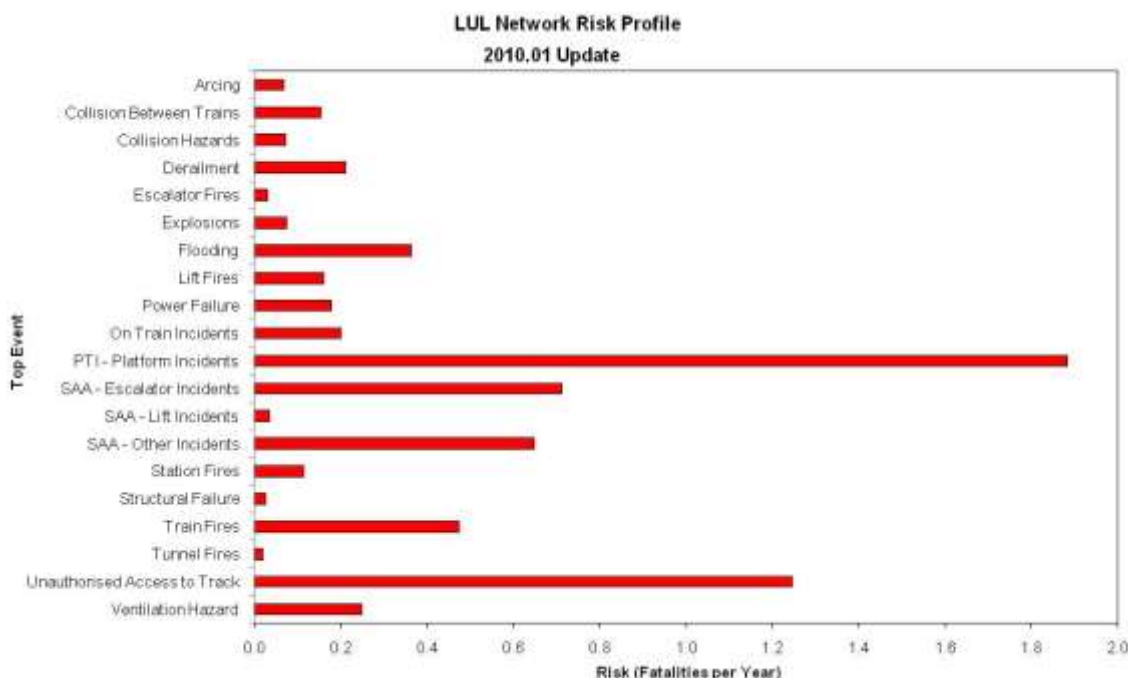
3.5.6.4 The current value for Preventing a Fatality (VPF) is defined by Cat 1 standard 'Safety Decision Making' S1521.

3.5.6.5 If it is not possible to calculate the Safety Risk (£) using the Concerns Workbook no estimate of the number of potential fatalities and/or injuries should be made. Heads of Technical Discipline will continue to review all concerns (including those which are not quantified) to ensure the railway is safe to operate and Sponsors/Asset Managers will consider them all when developing and prioritising the investment plan.

3.5.6.6 HSE will note any Code 2 concerns that cannot be quantified and take these into account when the model for the relevant Top Event/Asset group is reviewed.

3.5.6.7 The chart below breaks down the 2010.01 LU Network Risk Profile of seven FWIs per year by Top Event and shows that the risk of fatalities and injuries from customer or operational incidents is far greater than that from Asset failures.

3.5.7 LUL Network Risk Profile (2010.01 Update)



Note; The most up-to-date version of this chart can be found on the LU Intranet.

3.5.8 Code 3: Extraordinary Maintenance and/or Operational Activities

- 3.5.8.1 A Condition Concern that requires extraordinary maintenance and/or operational activities, which are outside the maintenance regime and considered to be uneconomic and/or unsustainable. Unsustainable can be applied to Assets where it is economic to provide additional maintenance for a planned period before total or part replacement.
- 3.5.8.2 In the Concerns Workbook a Code 3 Concern should be formatted as: <Asset><objective defect with measure and threshold><uneconomic because...> and/or <unsustainable because...> and <quantified description of the extraordinary maintenance and/or operation regime that has been adopted><source of concern>
- 3.5.8.3 The purpose of the Concern description is to clearly and concisely detail the issue with the Asset, the activity additional to the normal regime and the consequence to the business.
- 3.5.8.4 The annual additional cost recorded in the Concerns Workbook for Code 3 Concerns, which will either be: the actual costs where these are recorded or an estimate of the additional cost, including, but not limited, to plant, labour, materials for the total population of Assets described in the Concerns Workbook. The cost of routine maintenance undertaken on the Asset population will not be included.
- 3.5.8.5 As part of the joint working process the ACR assessor will review with the Sponsor/Asset Manager the issues proposed as Code 3 to determine whether the activity is uneconomic or unsustainable. Where this cannot be determined prior to submission of the ACR report, then the issue will be included within the Concerns Workbook and reviewed with the Sponsor/Asset Manager post submission. Where the activity is agreed to be economic or

sustainable these are no longer Code 3 Concerns and should be removed from the Concerns Workbook

3.5.8.6 Example Code 3: Concern Track Drains

Maintenance Regime:

The condition of a track drain is measured in terms of structural strength and serviceability (i.e. the ability to pass its designed flow), both of which are measured using WRc objective criteria and grading systems.

Structural defects are an ACR issue as their rectification is outside the maintenance regime.

Serviceability defects are usually rectified as part of the maintenance regime and so will not normally be covered by ACR.

However if the drain suffers exceptional serviceability problems – typically tree root ingress at joints – then the level of cleaning required is likely to move from “normal” to “extraordinary”. Permanent rectification would usually mean the introduction of a polypropylene liner.

It is anticipated that the Track Drainage Strategy will address this issue and will have set a threshold at which the whole-life cost of extraordinary cleaning will exceed the whole-life cost of rectification. The cost estimates should allow for the fact that excessive cleaning accelerates physical degradation, therefore, assume that more than two tree root cuttings/cleanings per year are uneconomic.

Generic Concern: <Track drain> that <suffers tree root ingress producing WRc serviceability scores in excess of 3>. <Uneconomic because it requires a cleaning frequency greater than twice per year><Asset Risk Register Reference>

The total number of instances of this defect will be reported in the Concerns Workbook, together with the annual extra-over cost.

3.5.9 Code 4: Performance Risks

3.5.9.1 A Condition Concern that presents a Lost Customer Hours (LCH) performance risk on the Underground Network of £250k or more per year.

3.5.9.2 In the Concerns Workbook a Code 4 Concern should be formatted as: <Asset><objective defect with measure and threshold><most probable failure mode/behaviour> and the ongoing/potential <outcome/consequence of><source of concern>

3.5.9.3 The Sponsor/Asset Manager is responsible for identifying and quantifying Code 4 concerns, based upon their analysis of CuPID and other data sources, and sharing these with the Assessor, for inclusion in the Concerns Workbook, at least three weeks prior to submission of the final draft ACR to the Asset Development Manager.

3.5.9.4 The Sponsor/Asset Manager should also review any Code 1, 2 & 3 Concerns reported in the Concerns Workbook for their Asset group and quantify any that are likely to have a performance risk of £250k or more per year.

3.5.9.5 The consequence of future performance risks can be estimated using the Nominally Accumulated Customer Hours (NACHs) calculator if sufficient data is available. See Appendix 3 for a guide to using the NACHs calculator.

3.5.9.6 To ensure consistency, the value of a Lost Customer Hour (LCH) given in the latest version of the Business Case Development Manual (BCDM) should be used.

- 3.5.9.7 This data will be used to provide a profile of the risk to service, based upon the underlying condition of the Assets.

3.6 Relative Asset Values (RAVs)

- 3.6.1 Relative Asset Values (RAVs) for each Asset group, except Signalling, C&I and Premises are Modern Equivalent Asset Values (MEAVs) from the 1997 re-pricing exercise minus the pound sign. For ACR reporting 100% of the total RAV for an Asset group must be allocated to the A, B, C and D classifications.
- 3.6.2 Any RAVs required for new Assets, or amendments to existing values, must be agreed by the Sponsor/Asset Manager and submitted to the Asset Development Manager. To ensure consistency RAVs for new Assets should be calculated by deflating the cost of the Asset to 1997 values and removing the pound sign (£).
- 3.6.3 No MEAVs were available for Signalling and C&I since these Assets were not repriced as part of the 1997 exercise. In the absence of MEAVs Signalling and C&I engineers have used the impact of Asset failure to derive RAVs for their Asset group.

3.7 The Summary Report

- 3.7.1 Each Asset group will provide a Summary Report representing the Physical Condition (A-D) and Functional Concerns (1-4), the report will compare the previous year's ACR figures; see the template in Appendix 5.
- 3.7.2 Additionally the report will identify and explain all changes/variations that have a significant business impact in the commentary section.

3.8 The Reporting Process

- 3.8.1 All proposed amendments to improve or update the Standard, Attachments to the Standard and the Guidance Document, including updated LUQRA data, must be submitted to the Asset Development Manager on or before 1st October.
- 3.8.2 Any revision to the Standard and associated Attachments shall be published via the Management System by the Asset Development Manager no later than 1st February.
- 3.8.3 The Asset Condition Report shall describe the condition of the Asset base at the reporting date of the reporting year. All Asset condition data shall be fully evidenced by auditable information.
- 3.8.4 The Asset Condition Report (ACR), Asset Safety and Management Certificate (ASMC) and ACR Summary Report will be prepared by Assessors working jointly with the relevant Heads of Technical Discipline and Sponsors / Asset Managers. Regular meetings should take place to ensure all parties are aware of the Physical Condition (A-D) of the Asset base and any Functional Condition and Degradation Concerns.
- 3.8.7 A draft version of the documents will be submitted to the Asset Development Manager on or before the 23rd of June of the reporting year. The Asset Development Manager then has two weeks to return any observations to the relevant Asset Manager via the ACR Manager.
- 3.8.5 Heads of Technical Discipline and Sponsors / Asset Managers, will determine if the ASMC for their Asset Group is:
- a) Accepted; or
 - b) Accepted with caveats.

- 3.8.6 The completed ACR and signed off ASMC shall be submitted by the Assessors to their relevant ACR Managers for logging and onward transmission to the Asset Development Manager on or before 31st July in the reporting year.
- 3.8.7 After reviewing these documents the Asset Development Manager shall submit a report to the LU Executive summarising the findings of the ACR and highlighting any critical risks to the business.

4 Responsibilities

- 4.1 The responsibilities for Sponsors/Asset Managers and Heads Technical Discipline are set out in Section 4 of the ACR Standard, S1042

5 References

5.1 Abbreviations

The following abbreviations are created:

- within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
- from published sources that are clearly identified.

Abbreviation	Definition	Source
ACR	Asset Condition Reporting	
AGS	Asset Group Strategy	
ALARP	As Low As Reasonably Practicable	
ASMC	Asset Safety and Management Certificate	
BCDM	Business Case Development Manual	
COO	Chief Operating Office	
CPD	See Document History 1	
FWI	Fatalities & Weighted Injuries	
HSE	Health, Safety and Environment	
LU	London Underground	
LUQRA	London Underground Quantified Risk Assessment	
RAV	Relative Asset Value	
S&C	See Document History 1	
TTNEI	Time To Next Economic Intervention	
WRA	Workplace Risk Assessment	

5.2 Definitions

The following topic specific definitions are created:

- within London Underground's Glossary of Terms (S1622) (a Category 1 Standard);
- from published sources that are clearly identified.

Term	Definition	Source
Asset group	Set of assets that interact and/or are inter-related so as to deliver a required business function or service.	a