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SAFETY RISK MANAGEMENT HAZARD ZONES ASSOCIATED WITH OVERDUE MAINTENANCE

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PURPOSE AND SCOPE

As part of the risk assessments for deferring maintenance or work not done, one of the mitigating actions may be to impose a Risk Management Hazard Zone (RMHZ).

The purpose of this document is to give guidance to staff on applying Risk Management Hazard Zones on plant and equipment. It seeks to give the size of the zone required; the reasoning for the zone and the amount of time staff can spend in the zone.

Maintenance is undertaken for many reasons and is normally undertaken to give appropriate balance of maintenance, cost and reliability. This document only focuses on the safety issue when maintenance is not undertaken at the appropriate time. It does not consider the other issues that occur due to not maintaining assets at the best time, for example, operational cost, environmental impact, and reliability etc.

This document considers safety only for equipment associated with outage maintenance and does not imply plant and equipment is reliable or satisfactory and guidance is dependant on completion of routines.

This document addresses the criteria, guidance and justification of imposing Risk Management Hazard Zones on substations. It is driven by the safety risk to persons that credibly could be attributed to overdue maintenance and or Work Not Done only. This document does not address any other aspect of risk and is not to override or undermine Operation Engineering & Safety Bulletins (OESB) etc.

As part of recording decisions and evidence in support of the application of generic Risk Management Hazard Zones, this paper has also looked at potential failure modes as a result of overdue maintenance for specific designs to assist in defining the appropriate size of the zone.

Generally the risk assessment includes minimum checks / tests that can be carried out to avoid a RMHZ, e.g. the full maintenance may not be achievable, but it may be possible to carry out work / testing to prove integrity of the equipment. In some cases, ensuring completion of the mitigations removes the need to establish a RMHZ. This will be communicated and controlled by the planning process.

Equipment considered:

- a) Air Blast Circuit Breakers – Conventional Air Blast (ABCB – CAB)
- b) Air Blast Circuit Breaker - Pressurised Head Air Blast (ABCB – PAB)
- c) Oil Circuit Breakers (OCB) & Barrier Bushings
- d) Gas Circuit Breakers (GCB) (SF6) – AIS
- e) Switch Disconnectors
- f) Disconnectors
- g) Cables
- h) Cable Sealing Ends (CSE)
- i) Instrument Transformers
- j) Supergrid Transformers, Bushings & Tapchangers
- k) GIS equipment
- l) Through Wall / Floor Bushings

Failure modes documented in the AHR (Asset Health Review) and OESBs imposing a RMHZ on switchgear were reviewed. The OESB investigations provided information on the distance travelled of porcelain and or other parts of the equipment that potentially could cause serious injury.

The approach outlined in this document is consistent with that detailed in UKBP TP139 (Management of the Safety Risks to People from Equipment Retained in Service with an Abnormal Condition). In cases where it is impractical to apply the generic guidance presented here, a more detailed, site specific assessment should be undertaken in accordance with UKBP TP139 by the relevant asset specialist within Electricity Network Investment (ENI) Asset Engineering.

PART 1 –PROCEDURAL

National Grid has recognised the need to critically review situations where equipment falls outside maintenance policy and has developed a maintenance deferral risk assessment process. Where this process identifies that overdue maintenance has safety implications e.g. where the overdue activities address known or potential failure modes of the equipment, the application of RMHZs must be considered to ensure ongoing personnel safety.

To date the application of RMHZs in such circumstances has been an ad-hoc process subject to local assessment and, as such, has lacked consistency at a national level. This document attempts to address this situation, and ensure an appropriate response in all cases, by providing:

- a) Summaries of the considered failure modes and related factors e.g. influence of prevailing weather conditions
- b) Appropriate dimensions for RMHZs by equipment category / family
- c) Guidance upon demarcation of, and access limitations to, RMHZs
- d) Mitigating actions to permit temporary or permanent alleviation of risk management restrictions prior to full completion of overdue activities

At the generic level of this document rigorous quantified risk assessment (QRA) of individual risk cannot be applied and a more qualitative approach has been taken. Nevertheless, the guidance pertaining to the need for demarcation of RMHZs is considered to be broadly consistent with that presented in UKBP TP139 for a "normal" substation environment e.g. demarcation is required for an individual risk level, without control of access, of worse than 1 in 100,000. However, since the calculation of individual risk is affected by personnel movements, equipment in heavily populated locations may require additional demarcation / controls to those outlined here. In cases of doubt a site specific risk assessment in accordance with UKBP TP139 should be carried out.

This guidance does not remove the need to comply with more specific safety related recommendations e.g. OESBs.

This guidance is based upon asset intelligence such as in service failures, ballistic testing, OESBs, asset health review and fault and defect data. As such it should be reviewed periodically and/or in the event of significant changes in available knowledge.

Where equipment is due maintenance, but planned for de-commissioning within twelve months and confirmed by construction the scheme will proceed, a site and equipment specific risk assessment should be undertaken to determine the scope of maintenance activities required for safe operation until removal from the system.

1 EQUIPMENT SPECIFIC RISK MANAGEMENT ZONE GUIDANCE

1.1 ABCB CAB (Conventional Air Blast)

1.1.1 Relevant Failure Mechanisms

The primary failure mode of CAB circuit-breakers is moisture ingress causing electrical flashover and a number of OESBs are in force to address known problems with specific designs. Nevertheless, overdue maintenance has the capacity to cause moisture related failure of all CAB designs. The risk of disruptive failure due to moisture ingress is of particular concern during, and shortly after, periods of inclement weather.

On some CAB circuit breaker designs conditioning air return pipework is fitted that allows dew point testing whilst on load. On these designs of circuit breaker moisture ingress can be monitored and, providing satisfactory dew point results are obtained, a RMHZ is not required. For other designs of CAB circuit breaker, where this cannot be achieved, e.g. Frame 'G' and Frame 'M' designs, a RMHZ is required. Pressure drop tests are also required on GA6 and GA10 circuit breakers, as per TDC 921, every 3 years and so RMHZ is required for these designs when any maintenance is overdue.

As the potential failure mechanism relates to moisture ingress a RMHZ is not required on indoor circuit breakers, providing roof integrity remains intact.

In addition, significantly overdue maintenance may result in mechanical problems (stiffness, poor lubrication) however this carries a significantly reduced risk of disruptive failure and is therefore not the primary focus of this assessment but is taken into account in a) below.

RMHZ requirement summary:

- a) Major maintenance is overdue – RMHZ required on all CAB design indoor and outdoor due to mechanical and lubrication issues.
- b) Basic / intermediate maintenance overdue – RMHZ required on '**outdoor**' circuit breaker designs that do not allow verification of satisfactory dew points whilst on load, RMHZ required for Frame 'G', Frame 'M' (no conditioning air return fitted) and GA6 / GA10 (TDC 921) circuit breakers.