AMP 214 ELECTRICAL INSULATION OF ROTATING ELECTRICAL MACHINES AND ACTUATORS NOT SUBJECT TO ENVIRONMENTAL QUALIFICATION REQUIREMENTS (VERSION 2021)

**Programme Description**

The purpose of the AMP described herein is to provide reasonable assurance that the intended functions of insulation of rotating electrical machines components (motors, motor operated valves (MOV) actuators, and generators) are maintained consistent with the current licensing basis through the entire operational life time.

Insulation materials used in mentioned components may degrade due to temperature, radiation, moisture, oil mist, surface contamination (e.g. adhesion of dust), partial discharge and mechanical loading (e.g. loosening of coil-end bracing or winding slot wedges by vibration, abrasion of coil-end). These degradation mechanisms may lead to weakness in insulation that results in ageing effects of reduced insulation resistance and/or loss of dielectric strength that may be initiated from the inner or outer surface of insulation material. The rate of degradation depends on operating conditions (high availability ratio, frequent starts) and environmental factors (e.g. ambient temperature, moisture, radiation, dust, oil).

The programme described herein was written specifically to address accessible components of rotating electrical machines, which are inspected. If an unacceptable condition or situation is identified for an accessible component during inspection, a determination is made as to whether the same condition or situation is applicable to inaccessible components.

Bearing abrasion or degradation is not considered in this programme since it can be addressed by replacement as a consumable part. Scheduled replacement of rotating electrical machine components based on the result of condition monitoring described in this programme is considered an effective ageing management programme.

Degradation mechanisms and ageing effects related to mechanical parts of MOVs are described in AMP 143.

Degradation mechanisms and ageing effects related to Motors are described in AMP 224.

Evaluation and Technical Basis

1. Scope of the ageing management programme based on understanding ageing:

This AMP applies to rotating electrical machines and actuators within the scope according to national regulation.

1. Preventive actions to minimize and control ageing degradation:

This is a condition monitoring programme and no direct actions are taken as part of this programme to prevent ageing degradation. Nevertheless, keeping a low level of temperature and vibration prevents reduced insulation resistance in the winding.

1. Detection of ageing effects:

Insulation materials used in rotating electrical machine components may degrade due to the mechanisms mentioned above. These degradation mechanisms may lead to weakness in insulation that results in an ageing effect of reduced insulation resistance and/or loss of dielectric strength that may initiate from the inside (i.e. turn to turn insulation degradation) or outer surface of insulation material (i.e. ground wall insulation or degradation). Components are visually inspected for insulation material surface anomalies, such as discoloration, cracking, swelling or surface contamination, when insulation diagnosis for insulation anomalies or replacement of consumable parts such as bearings is performed. Insulation diagnosis for a component is carried out periodically, and this interval is shortened under severe environmental or operational conditions. The suitable method of insulation diagnosis should be selected according to voltage class of insulation system. For medium voltage components, insulation diagnosis is applied to confirm there is no significant change in insulating characteristics. Insulation diagnosis consists of electrical diagnosis and mechanical diagnosis (such as hammering test for wedge tightness). Electrical diagnosis may include insulation resistance, polarization index, dielectric strength, alternating current, tan delta and partial discharge testing. Performing insulation diagnosis periodically is an effective way for evaluating ageing degradation for individual components of rotating electrical machines and actuators.

1. Monitoring and trending of ageing effects:

Trending actions are included as part of this AMP. Test results are managed and trended so that they can be utilized for quantitative trend monitoring of insulating degradation.

1. Mitigating ageing effects:

This programme is a condition monitoring programme. This programme has no specific operations, maintenance, repair or replacement mitigation aspects.

1. Acceptance criteria:

Acceptance criteria for insulation diagnosis are defined by codes and standards according to voltage category [1-10]. The results of insulation diagnosis are compared with previous results to identify a possible degradation trend. The results of insulation diagnostics are evaluated in a comprehensive manner consistent with applicable test acceptance criteria for the specific component.

1. Corrective actions:

An engineering evaluation is performed, and related corrective actions are taken when significant change in insulating characteristics or unacceptable conditions are found in insulation material of rotating electrical machine components. The evaluation is to consider the age and operating environment of the components as well as the severity of the anomaly and whether such an anomaly has previously been correlated to insulation degradation of components. Corrective actions may include, but are not limited to, testing, repair, or replacement of the affected insulation material (possibility to use higher temperature class to improve heat resistance) or otherwise changing the environment. In certain applications, (i.e. in case of standby rotating machines) if the insulation resistance and polarization index values are below minimum expected values, heaters may be fitted or space heaters energized until readings are within acceptable values. The pre-heating and post-heating values should be recorded. When an unacceptable condition or situation is identified, a determination is made as to whether the same condition or situation is applicable to other components installed under similar environmental or operating conditions.

1. Operating experience feedback and feedback of research and development results:

This AMP addresses the industry-wide generic experience. Relevant plant-specific operating experience is considered in the development of the plant AMP to ensure the AMP is adequate for the plant. The plant implements a feedback process to periodically evaluate plant and industry-wide operating experience and research and development (R&D) results, and, as necessary, either modifies the plant AMP or takes additional actions (e.g. develop a new plant-specific AMP) to ensure the continued effectiveness of the ageing management.

Main generator operating experience including inspections and testing experience is provided in industry research [9].

1. Quality management:

Site quality assurance procedures, review and approval processes, and administrative controls are implemented in accordance with the different national regulatory requirements (e.g., 10 CFR 50, Appendix B [6]).

References

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