## AMP 136 LUBRICATING OIL ANALYSIS (VERSION 2020)

### Programme Description

All substances in power stations are subject to ageing during storage and exploitation by thermal, mechanical or chemical loads. In nuclear power stations radiation is an additional load but the impact of radiation on lubricating oils at NPPs is not high enough for significant influence to ageing.

The purpose of the Lubricating Oil Analysis programme is to ensure that the oil environment in the mechanical systems is maintained to the required quality to prevent or mitigate age-related degradation of components within the scope of this programme. To assure the required quality, specific plant procedures are in place, based on international guides as such DIN 51562-1, DIN 51365, DIN EN ISO 2592:2017, ISO 3733:1999, ISO 3771:2011, DIN 51592 [1-6] This programme maintains oil systems contaminants (primarily water and particulates) within acceptable limits, thereby preserving an environment that is not conducive to loss of material or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for detrimental contaminants. The presence of water or particulates may also be indicative of in-leakage and corrosion product buildup.

Although primarily a sampling programme, the lubricating oil analysis programme is generally effective in monitoring and controlling impurities. Verification of the effectiveness of the programme is undertaken to ensure that significant degradation is not occurring and that the component’s intended function is maintained during the intended period of operation. For these specific cases, an acceptable verification programme is a one-time inspection of selected components at susceptible locations in the system such as AMP 119.

### Evaluation and Technical Basis

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

The programme manages the ageing effects of loss of material due to corrosion or reduction of heat transfer due to fouling. Components within the scope of the programme include all safety-relevant systems and components (e.g. piping, piping components, and piping elements; heat exchanger tubes; reactor coolant pump elements; and any other plant components) subject to ageing management review that are exposed to an environment of lubricating oil (including non-water-based hydraulic oils).

1. ***Preventive actions to minimize and control ageing degradation:***

This programme maintains oil system contaminants (primarily water and particulates) within acceptable limits.

1. ***Detection of ageing effects:***

Moisture or corrosion products increase the potential for, or may be indicative of, loss of material due to corrosion and reduction of heat transfer due to fouling. The programme performs periodic sampling and testing of lubricating oil for moisture and corrosion particles in accordance with industry standards. The programme recommends sampling and testing of the old oil following periodic oil changes or on a schedule consistent with the equipment manufacturer’s recommendations or acceptable national or international industry standards (e.g., ASTM International D 6224-02 [7] or EN ISO standards [8-12]). Plant-specific operating experience also may be used to augment manufacturer’s recommendations or industry standards in determining the schedule for periodic sampling and testing when justified by prior sampling results.

In certain cases, as identified by the AMR Items in this report, inspection of selected components is to be undertaken to verify the effectiveness of the programme and to ensure that significant degradation is not occurring and that the component intended function is maintained during the period of extended operation.

1. ***Mitigating ageing effects:***

This programme performs a check for water and a particle count to detect evidence of contamination by moisture or excessive corrosion.

1. ***Monitoring and trending of ageing effects:***

Oil analysis results are reviewed to determine if alert levels or limits have been reached or exceeded. This review also checks for unusual trends.

1. ***Acceptance criteria:***

Water and particle concentration should not exceed limits based on equipment manufacturer’s recommendations or national or international industry standards. Phase-separated water in any amount is not acceptable.

1. ***Corrective actions:***

Specific corrective actions are implemented in accordance with the plant quality assurance (QA) programme implemented in accordance with national regulations (e.g., 10 CFR Part 50, Appendix B [13]). For example, if a limit is reached or exceeded, actions to address the condition are taken. These may include increased monitoring, corrective maintenance, further laboratory analysis, and engineering evaluation of the system. So, it could be necessary to evaluate where water input or corrosion could have taken place. System engineers could plan further investigation either during the planned next revision or earlier when the limit is exceeded.

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.

The operating experience at some plants has identified (a) water in the lubricating oil and (b) particulate contamination. However, no instances of component failures attributed to lubricating oil contamination have been identified.

Research and development efforts and an effective experience exchange are important elements for implementing continuous improvement in this programme and in defining adequate corrective actions.

At the time when this AMP was produced, no relevant R&D was identified.

1. ***Quality Management:***

### Site quality assurance procedures, review and approval processes, and administrative controls are to be implemented in accordance with the different national requirements (e.g., 10 CFR Part 50, Appendix B [13]).

### References

[1] DIN 51562-1, Viscometry - Measurement of kinematic viscosity by means of the Ubbelohde viscometer - Part 1: Viscometer specification and measurement procedure

[2] DIN 51365, Testing of lubricants; determination of total dirt in used engine oils; separation by centrifuging

[3] DIN EN ISO 2592, Petroleum and related products - Determination of flash and fire points - Cleveland open cup method (ISO 2592:2017)

[4] ISO 3733:1999, Petroleum products and bituminous materials — Determination of water — Distillation method

[5] ISO 3771:2011, Petroleum products — Determination of base number — Perchloric acid potentiometric titration method

[6] DIN 51592, Testing of Lubricants; Determination of the Content of Solid Foreign Matters in Lubricating Oils

[7] ASTM INTERNATIONAL, ASTM D 6224-02, Standard Practice for In-Service Monitoring of Lubricating Oil for Auxiliary Power Plant Equipment, West Conshohocken, PA, 2002.

[8] EN ISO 12185 Crude petroleum and petroleum products – Determination of density – Oscillating U-tube method.

[9] EN ISO 3104 Petroleum products – Transparent and opaque liquids – Determination of kinematic viscosity and calculation of dynamic viscosity.

[10] EN ISO 14596 Petroleum products – Determination of sulfur content – Wavelength-dispersive X-ray fluorescence spectrometry.

[11] EN ISO 6245 Petroleum products – Determination of ash.

[12] KTA 1403 Ageing Management in Nuclear Power Plants, Bundesanzeiger BAnz No. 199a, December 30th 2010.

[13] UNITED STATES NUCLEAR REGULATORY COMMISSION, 10 CFR Part 50, Appendix B, Quality Assurance Criteria for Nuclear Power Plants, Office of the Federal Register, National Archives and Records Administration, USNRC, Latest Edition.