

## **XI. M39 Lubricating Oil Analysis**

- XI.M39-1. Prior comment element 3: Exceptions to inspections are taken routinely. Testing for flash point of lubricating oil is only needed for lubricating oil that could become contaminated by fuel or gasoline. Lubricating oil in many applications is not subject to this contamination (such as steam driven turbines or motor driven pumps) and testing for flash point is not needed. Revise NUREG-1801 to delete reference to flash point testing since flash point testing does not provide information related to the effects of aging.
- XI.M39-2 Elements 2, 3, 6 and 10 should discuss sampling for water as the primary means of maintaining the quality of lubricating oils. Lubricating oils are not good electrolytes and the oil film on the wetted surfaces of components tends to minimize the potential for corrosion. When water and other contamination are present and the water and contamination settles in stagnant areas such as tanks and the bottom of heat exchangers, aging is expected. In flowing systems, even if contaminated, water and contaminants cannot accumulate and aging is not expected under flowing conditions. Sampling for water in combination with One Time Inspections will manage aging in lubricating oil systems.
- XI.M39-3 Elements 2, 3 and 6 should delete particulate sampling. Sampling for particulate contamination will not manage aging of the passive components in a lubricating oil environment. Particulate contamination of lubricating oil in rotating equipment such as pumps or diesel engines is introduced while performing equipment active functions subsequent to bearing failure, excessive vibration, or other causes.

---

## **XI. M39 Lubricating Oil Analysis**

### **Program Description**

The purpose of the Lubricating Oil Analysis Program is to ensure the lubricating oil and hydraulic oil environments in the mechanical systems is maintained to the required quality. The Lubricating Oil Analysis Program maintains oil systems contaminants (primarily water ~~and particulates~~) within acceptable limits, thereby preserving an environment that is not conducive to loss of material, cracking or reduction of heat transfer. Lubricating oil testing activities include sampling and analysis of lubricating oil for ~~detrimental contaminants~~ water. The presence of water ~~or particulates~~ may also be indicative of in leakage and corrosion product buildup.

### **Evaluation and Technical Basis**

1. **Scope of Program:** On a periodic basis, this program samples lubricating oil and hydraulic oil from plant components subject to aging management review.
2. **Preventative Actions:** The lubricating oil analysis program maintains oil systems contaminants (primarily water ~~and particulates~~) within acceptable limits.

3. **Parameters Monitored:** For components with periodic oil changes in accordance with manufacturer's recommendations, a ~~particle count and~~ check for water ~~are~~ is performed to detect evidence of ~~abnormal wear rates,~~ contamination by moisture, ~~or excessive corrosion.~~ For components that do not have regular oil changes, viscosity, ~~neutralization number, and flash point are~~ is also determined to verify the oil is suitable for continued use. ~~In addition, analytical ferrography and elemental analysis are performed to identify wear particles.~~ Water content is determined by titration (ASTM D4928 or D6304), distillation (ASTM D95), or visual inspection.
4. **Detection of Aging Effects:** Periodic sampling and compliance with the acceptance criteria provide assurance that ~~lube oil~~ contaminants do not exceed acceptable levels, thereby preserving an environment that is not conducive to aging mechanisms that could lead to the aging effects of loss of material, cracking and reduction of heat transfer.
5. **Monitoring and Trending:** Oil analysis results are reviewed to determine if alert levels or limits have been reached or exceeded. This review also checks for unusual trends.
6. **Acceptance Criteria:** ~~Particle concentration will be determined in accordance with industry standards such as SAE749D, ISO 4406, ISO 112218, and NAS 1638. Water and particle concentration will not exceed limits based on manufacturer's recommendations or industry standards recommended for each components type. Viscosity bands are based on a tolerance around the base viscosity of the lubricating oil as recommended by the components manufacturer or industry standards. Metal limits as determined by spectral analysis and ferrography will be based on original baseline data and manufacturer's recommendations, industry standards, or other justified basis.~~
7. **Corrective Actions:** Pursuant to 10 CFR Part 50, Appendix B, specific corrective actions are implemented in accordance with the plant quality assurance (QA) program. For example, if a limit is reached or exceeded, actions to address the condition are taken. These may include increased monitoring, ~~vibration analysis,~~ corrective maintenance, further laboratory analysis, and engineering evaluation. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.
10. **Operating Experience:** The operating experience at some plants has identified water in the ~~lubricating oil, and particulate contamination.~~ However, no instances of component failures attributed to lubricating oil contamination have been identified.

### References

1. ASTM D4928, 2000, Standard Test Methods for Water in Crude Oils by Coulometric Karl Fischer Titration
2. ASTM D6304, 2004, Standard Test Method for Determination of Water in Petroleum Products, Lubricating Oils, and Additives by Coulometric Karl Fischer Titration
3. ASTM D95, 2005, Standard Test Method for Water in Petroleum Products and Bituminous Materials by Distillation

### **XI.M24 Compressed Air Monitoring**

XI.M24-1 Prior Comment Element 3: Parameters Monitored states “Inservice inspection (ISI) and testing is performed to verify proper air quality and confirm that maintenance practices, emergency procedures, and training are adequate to ensure that the intended function of the air system is maintained.” Emergency procedures and training don’t seem appropriate for aging management programs. This is unlike any other AMP in NUREG-1801. This section fails to identify parameters monitored.

XI.M24-2 Elements 1 through 6 should discuss preventative measures such as managing air quality monitoring and system/component performance monitoring as the primary means of managing aging in compressed air systems. Air quality monitoring and performance monitoring will maintain a moisture free environment that minimizes the effects of aging to prevent loss of system/component pressure boundary functions. Leak testing and associated inspections will detect aging after loss of pressure boundary function.

### **XI.M24 COMPRESSED AIR MONITORING**

#### **Program Description**

The program consists of air quality monitoring and performance monitoring inspection, ~~monitoring, and testing~~ of the ~~entire~~ system. This ~~includes~~ program consists of (a) frequent leak testing of valves, piping, and other system components, especially those made of carbon steel and stainless steel; and (b) preventive monitoring that checks air quality at various locations in the system to ensure that oil, water, rust, dirt, and other contaminants are kept within the specified limits and (b) system performance monitoring. The aging management program (AMP) provides for timely corrective actions to ensure that the system air quality and performance is ~~operating~~ within specified limits.

The AMP is based on results of the plant owner’s response to Nuclear Regulatory Commission (NRC) Generic Letter (GL) 88-14, augmented by previous NRC Information Notices (IN) 81-38, IN 87-28, and IN 87-28 S1, and by the Institute of Nuclear Power Operations Significant Operating Experience Report (INPO SOER) 88-01. The NRC GL 88-14, issued after several years of study of problems and failures of instrument air systems, recommends each holder of an operating license to perform an extensive design and operations review and verification of its instrument air system. The GL 88-14 also recommends the licensees to describe their program for maintaining proper instrument air quality. The AMP also incorporates provisions conforming to the guidance of the Electric Power Research Institute (EPRI) NP-7079, issued in 1990, to assist utilities in identifying and correcting system problems in the instrument air system and to enable them to maintain required industry safety standards. ~~Subsequent to these initial actions by all plant licensees to implement an improved AMP, some utilities decided to replace their instrument air system with newer models and types of components. The EPRI~~

then issued TR-108147, which addresses maintenance of the latest compressors and other instrument air system components currently in use at those plants. The American Society of Mechanical Engineers operations and maintenance standards and guides (ASME OM-S/G-1998, Part 17) provides additional guidance to the maintenance of the instrument air system by offering recommended test methods, test intervals, parameters to be measured and evaluated, acceptance criteria, corrective actions, and records requirements.

### Evaluation and Technical Basis

1. **Scope of Program:** ~~Scope of Program:~~ The program manages the effects of corrosion and the presence of unacceptable levels of contaminants on the intended function of the compressed air system. The AMP includes ~~frequent leak testing of valves, piping, and other system components, especially those made of carbon steel and stainless steel, and~~ a preventive maintenance program to check air quality at ~~several~~ locations in the system.
2. **Preventive Actions:** The system air quality is monitored and maintained in accordance with the plant owner's testing and inspection plans, which are designed to ensure that the system and components meet specified operability performance requirements. These requirements are prepared from consideration of manufacturer's recommendations for individual components and guidelines based on ASME OM-S/G-1998, Part 17; ISA-S7.0.01-1996; EPRI NP-7079; and EPRI TR-108147. ~~The preventive maintenance program addresses various aspects of the inoperability of air-operated components due to corrosion and the presence of oil, water, rust, and other contaminants.~~
3. **Parameters Monitored/Inspected:** ~~Inservice inspection (ISI) and~~ Testing is performed to verify proper air quality. ~~and confirm that maintenance practices, emergency procedures, and training are adequate to ensure that the intended function of the air system is maintained.~~
4. **Detection of Aging Effects:** Guidelines in EPRI NP-7079, EPRI TR-108147, and ASME OM-S/G-1998, Part 17, ensure timely detection of degradation of the compressed air system function. Degradation of the piping and any components would become evident by ~~observation of excessive corrosion, by the discovery of unacceptable leakage rates, and by~~ failure of the system or any item of components to meet specified performance limits.
5. **Monitoring and Trending:** Effects of corrosion and the presence of contaminants are monitored by ~~visual inspection and~~ periodic system and component tests. ~~including leak rate tests on the system and on individual items of components.~~ These tests verify ~~proper operation by comparing~~ measured values of performance with specified performance limits. Test data are analyzed and compared to data from previous tests to provide for timely detection of aging effects.

6. **Acceptance Criteria:** Acceptance criteria are established for the system and for individual components that contain specific limits or acceptance ranges based on design basis conditions and/or components vendor specifications. The testing results are analyzed to verify that the design air quality and performance of the system is in accordance with its intended function.
7. **Corrective Actions:** Corrective actions are taken if any parameters are out of acceptable ranges, such as moisture content in the system air. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the corrective actions.
8. **Confirmation Process:** The site corrective actions program, quality assurance (QA) procedures, site review and approval process, and administrative controls are implemented in accordance with the requirements of 10 CFR Part 50, Appendix B. As discussed in the appendix to this report, the staff finds the requirements of 10 CFR Part 50, Appendix B, acceptable to address the confirmation process and administrative controls.
9. **Administrative Controls:** See Item 8, above.
10. **Operating Experience:** Potentially significant safety-related problems pertaining to air systems have been documented in NRC IN 81-38, IN 87-28, IN 87-28 S1 and license event report (LER) 50-237/94-005-3. Some of the systems that have been significantly degraded or have failed due to the problems in the air system include the decay heat removal, auxiliary feedwater, main steam isolation, containment isolation, and fuel pool seal system. As a result of NRC GL 88-14 and consideration of INPO SOER 88-01, EPRI NP-7079, and EPRI TR-108147, performance of air systems has improved significantly.