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PRESERVING EQ

Module 6



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Presentation

Session 6.1:

The need for preserving EQ

Session 6.2:

Organizing for the preservation of EQ

Session 6.3:

EQ preservation elements

The need for preserving EQ

Session 6.1



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- EQ is an ongoing process.
- Equipment items are qualified for specific applications in specific configurations.
- Changes which affect qualification can take place as a result of new requirements, design modifications, revisions to PIE accident analysis, procurement activities, storage, equipment maintenance and material control.
- After such changes the EQ status has to be re-established.

- Configuration management provides a systematic process to ensure that EQ implications are appropriately considered whenever changes occur to the plant, equipment or operating/ maintenance/ replacement activities.
- Operating experience feedback can identify unanticipated changes in service conditions or equipment performance.

Organizing for the preservation of EQ

Session 6.2



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EQ programme participants

- Engineering
- Operations
- Maintenance
- QA/QC
- Training
- AE/Consultants
- Test laboratories
- Equipment suppliers

Tasks of NPP organization responsible for preserving EQ

- Preparing procedures that define the EQ preservation programme.
- Co-ordinating EQ activities between the relevant organizational units.
- Acting as an in-house consultant to those working on plant programmes or activities that may impact EQ.
- Performing EQ evaluations and operability assessments.
- Keeping EQ documentation current and accurate.
- Identifying EQ related training needs and providing training to those involved in the EQ process.
- Preparing response to EQ related inquiries from the regulatory authority.
- Keeping abreast of EQ technology, operational feedback, standards and practices.

Training

Personnel involved in the EQ process (management, engineering and craft) should be trained to ensure that the EQ activities are performed correctly and consistently, and documented in an auditable manner.

EQ training should:

- be specific to the job, task and procedure to perform the task;
- integrate EQ details in the hands-on maintenance training for each equipment type (e.g. training on transmitters will cover EQ related details, DOs and DON'Ts and inspection for degradation);
- cover related responsibilities and their scope;
- be an ongoing activity; and
- extend to both in-house personnel and contract personnel who work on-site during outages and major modifications.

EQ preservation elements

Session 6.3



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Key elements essential to preserving the qualified status of equipment

- maintenance
- replacement of parts/equipment
- plant modifications
- condition monitoring
- environmental monitoring
- degradation trending and failure analysis
- operating experience feedback and R&D
- quality assurance
- documentation

Maintenance

Maintenance activities are relied upon to:

- ensure that the installed equipment remains in its qualified condition (e.g. mounting bolts are torqued to the proper values, parts with limited life expectancy are replaced as required)
- provide timely identification of unforeseen ageing mechanisms that may be causing equipment degradation

- Maintenance and test procedures should identify EQ required maintenance, detailed instructions for maintenance, any associated precautions and required documentation.
- Errors during maintenance could invalidate the qualification established.
- Training of maintenance personnel should address typical maintenance errors, their causes and implications.

Replacement parts/equipment

- When a part is replaced in a qualified equipment item, it is necessary to ensure that the original conclusions regarding qualification of this item remain valid.
- Obsolescence may dictate substitution of the original part with an equivalent or a specially fabricated part. Substitute parts have to be identified and evaluated to ensure that they will perform adequately to preserve qualification.

Engineering evaluation of replacement equipment/parts

Include considerations, such as:

- What documentation is required to demonstrate continued qualification of the parent equipment?
- What critical characteristics (i.e. form, fit, function and materials of construction) of the part(s) are important to preserve the capability of the equipment item in which the part is installed to perform its specified functions in PIE environments?
- Where, when and by whom will the critical characteristics be verified?

Plant modifications

- Changes to either the plant configuration and/or the design basis can affect EQ
- Even temporary changes and routine alterations during NPP outage can affect EQ
- Modifications that involve only non-safety systems or equipment can also affect EQ
- Before implementation, all modifications should be evaluated for their EQ impact

Engineering evaluation of NPP modifications

Factors to be considered - Does the proposed change affect EQ through:

- location of equipment
- required performance levels or duration of operability for the qualified equipment
- temperature, pressure, radiation levels, steam or flooding conditions experienced by the equipment as a result of a PIE
- normal environments (in particular, changes in temperature or radiation levels)
- operating conditions or limits of the equipment

Condition monitoring

- activities performed to assess the functional capability/operational readiness of the equipment
- valuable adjunct to EQ because it can support:
 - assessment of in-service ageing effects and remaining equipment capability;
 - validation and possible revision of the qualified life
 - identification of ageing mechanisms that may not have been adequately addressed during original qualification;
 - identification of incipient failures

Examples of existing condition monitoring techniques

- Motors – current signature analysis, winding temperature trending, dielectric testing
- MOVs – current, torque analysis/trending
- Cables – visual, tactile, indenter, TGA

Environmental monitoring

- Monitoring actual plant conditions under various operating modes and shutdown, may provide a basis for re-evaluating and extending the qualified life.
- General ambient conditions
- ‘Hot spots’ (temperature and radiation) can cause premature degradation

Failure trending and analysis

- Can assist in identifying in-service degradation trends to prevent failure
- Formal programme should be established and provide:
 - guidance for the maintenance staff regarding the information to be collected
 - criteria established by equipment specialists for determination of whether a failure stems from a random cause or from an ageing related cause
 - guidance for replacement of all equipment of a certain type; replacement of a single part of item; and plant modifications to change environmental or operational conditions/procedures

Operating experience feedback and R&D

Exchange of generic information among NPP operators, manufacturers, research laboratories can help in:

- implementing cost effective solutions to equipment problems and EQ preservation activities;
- better understanding of equipment ageing effects and the underlying causes
- estimating time to failure of installed equipment, particularly that with limited access

Review and analysis of experience data should include:

- comparing equipment data and service conditions
- determining if a modified maintenance technique mitigates the underlying failure mechanism in the specific plant application
- determining if a new degradation type or mode is applicable in the specific plant application
- determining if the diagnostic methods employed or the maintenance procedure needs modification

Quality assurance

- EQ is achieved and preserved only when the broad spectrum of related activities is correctly performed and documented.
- The role of the QA function is to ensure that the work is being performed and documented in accordance with procedures and to identify potential weaknesses.

Documentation

Documentation should provide information necessary to verify qualification, such as:

- *Establishing EQ documents*
 - EQ master lists
 - List of limited life items and replacement intervals
 - Maintenance requirements and intervals
 - Qualification test plan and test data
 - Walkdown verification checklists
- *Configuration management history*
 - Installation details
 - Detailed layout and wiring diagrams

- *Procedures controlling preservation activities and work practices*
 - Maintenance procedures
 - Failure trending and analysis procedures
 - Surveillance and testing procedures
 - Equipment and parts procurement procedures
- *Activity and equipment history*
 - Equipment operation, maintenance, parts replacement and failure history
 - Equipment operating and service conditions (normal, abnormal, transient, etc.)
 - Walkdown verification checklists
 - Parts substitution and associated engineering justifications
 - Historical data from condition monitoring programmes