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UPGRADING EQ

Module 5



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NPPs where EQ upgrade is needed

- Plants that have some elements of EQ (e.g. equipment is seismically qualified, but performance under harsh environmental conditions has not been demonstrated).
- Plants that have few or none of the elements of EQ (industrial grade equipment has been installed).

Presentation

Session 5.1:

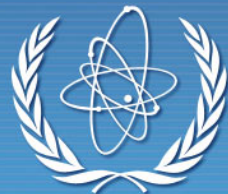
Development of EQ upgrade programme

Session 5.2:

Implementation of EQ upgrade programme

Development of EQ upgrade programme

Session 5.1



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Assessing the need and resources for EQ upgrade programme in an operational NPP

- Review and evaluate current EQ state of the plant
- Determine the type of EQ upgrade programme most suitable for the NPP
- Make an estimate of the resources and the time required to complete the EQ upgrade programme

Review of the existing EQ status

To review the existing EQ status, it is necessary to define:

- the licensing requirements and commitments;
- the installed configuration;
- the standards that were applied to create the installed configuration;
- the EQ standards that will be applied during the implementation of the EQ upgrade programme.

Information considered when determining EQ status of the installed equipment

- Lack of EQ test reports may signify lack of EQ.
- Quality of data demonstrating existing EQ.
- Less/more severe normal environmental conditions may indicate longer/shorter equipment life.
- The maintenance and operating history may provide information on the current state of the equipment.
- Walkdowns may provide additional data.

SCOPE

- Focus on those types of equipment that have been identified as being susceptible to failures resulting from a harsh environment or a combination of harsh environment and ageing degradation.
- Possible simplifying assumptions:
 - exclusion of equipment consisting of all metallic parts;
 - exclusion of EQ for mild environmental conditions.

ORGANIZATION

- Responsible parts of the organization need to be clearly identified
- May entail creation of an interim organization to deal with the upgrade programme
- Could be possibly incorporated into the existing NPP organization without need for creating an interim structure

RESOURCES

- Personnel assigned may require EQ training
- Appropriate staffing levels and mix of skills can reduce the cost by early programme completion
- The accuracy of estimated resources and time to complete the programme depends on info available on the current EQ status and the upgrade effort required

Definition of safety based priorities

- Priorities need to be established as it is would be impractical to address all EQ deficiencies simultaneously.
- In practice, one system is chosen as being first, and the remaining systems are upgraded sequentially.
- PSAs are available as tools for setting priorities at the equipment level. It is possible to identify critical components and concentrate EQ initially on these components.

Justification for interim operation

- Where significant safety deficiencies are identified, interim measures are necessary to justify continued operation of the plant until completion of the upgrade programme.
- Examples of interim measures:
 - installing equipment enclosures or protection barriers (e.g. against radiation or jet forces) to reduce the severity of the environmental conditions
 - temporary change of system operation (e.g. modifications ensuring that a system valve remains in a state that would reduce the severity of the harsh environment following a LOCA)
 - performing more frequent inspections to identify visible signs of deterioration

Agreement on/approval of the upgrade programme

- The utility and the regulator should review and agree on an EQ upgrade programme before its implementation.
- The utility should perform an analysis of the revenues that would be generated over the remaining life of the plant to see if the costs of implementing an EQ upgrade programme would be recoverable.

Implementation of EQ upgrade programme

Session 5.2



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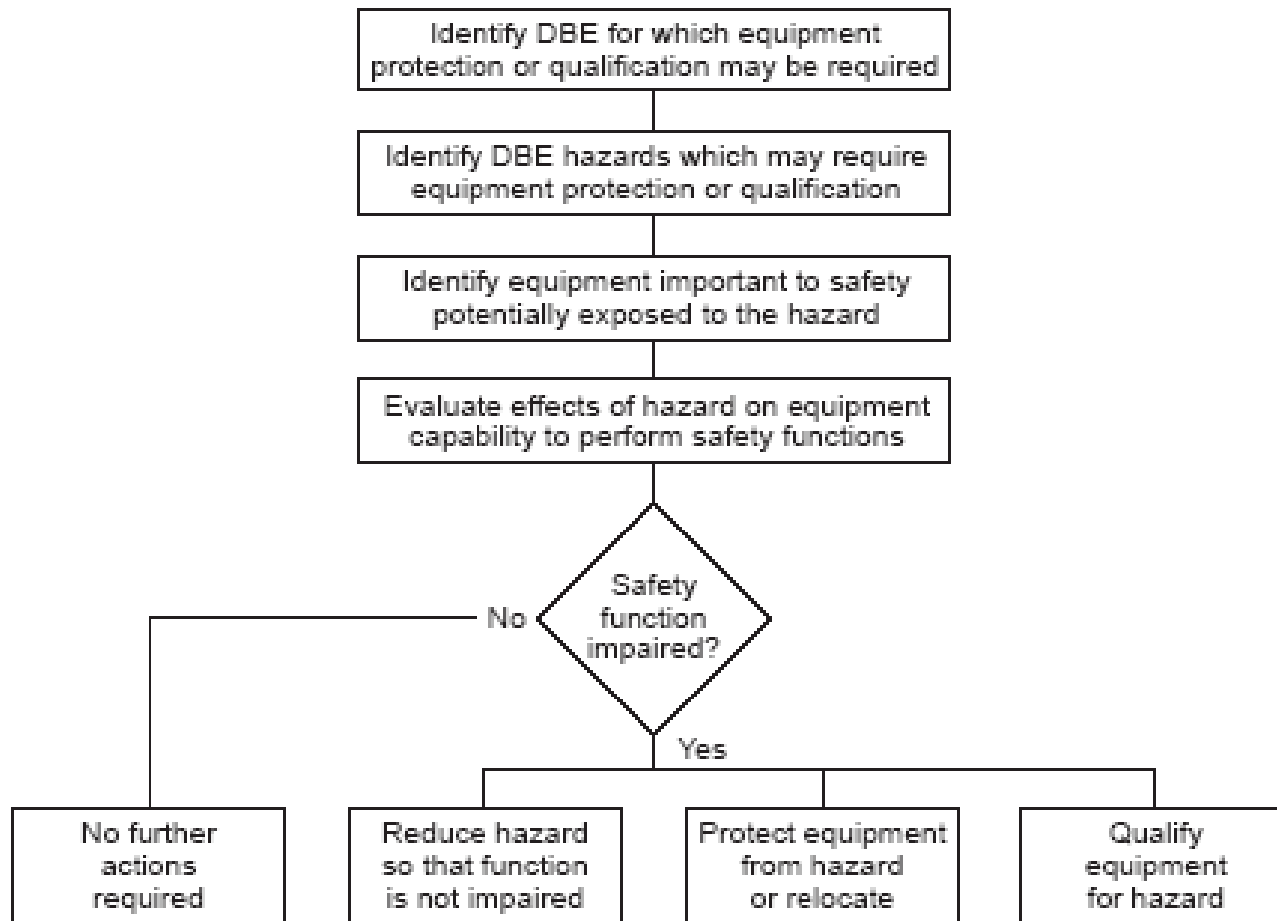
Implementation process

- identification of equipment to be qualified
- definition of EQ parameters
- evaluation of the EQ status of the individual equipment
- definition of corrective actions
- implementation of interim measures
- qualification of the selected equipment

Identification of equipment to be qualified

- The activities associated with this task consist of:
- (a) Identification of the PIEs for the NPP;
 - (b) Identification of a list of systems important to safety credited with the safety analysis for each PIE, their function and mission times;
 - (c) Generation of a list of equipment important to safety associated with these systems;
 - (d) Generation of a list of equipment important to safety that is exposed to harsh environment resulting from a PIE.

EQ upgrading application of a hazard analysis flowchart



EQ Master List (EQML)

- Controlled list which identifies the scope of equipment requiring harsh environment qualification.
- EQML serves as a source document for engineering, procurement, operations and maintenance personnel, identifying the scope of equipment that has to meet the EQ requirements.

- **Equipment service conditions**
 - environmental conditions (temperature, pressure, humidity (moisture and water spray), radiation, water immersion, chemicals (including sprays), vibration and seismic motion)
 - operational conditions during normal operation and PIEs
- **Equipment mission times**

Severity of environmental conditions

- The less severe the environmental conditions to which the equipment is exposed, the higher is the probability of successful demonstration of EQ.
- Environmental conditions may be shown to be less severe by refining the calculations and by utilizing actually measured environmental data specific to the location of the equipment of interest.

Two-Phase Process:

- Confirmation of Requirement for Qualification
- Verification of Qualification

Confirmation of requirement for qualification

- Determine if individual components or pieces of equipment are to be qualified
 - Review EQ Master List, licensee commitments, and regulatory correspondence
- Identify any required parts replacements or other maintenance to maintain qualification

Verification of Qualification

- **Review EQ Documentation:**
 - safety analysis reports
 - EQ test reports
 - EQ requirements
 - equipment specifications/datasheets
 - detailed equipment parts lists
 - procurement documents
 - installation documents
 - maintenance history records
 - Peer review and audit reports
 - calculations and measurements of environmental conditions (for PIEs as well as for normal operation)

- Equipment Walkdown
 - Planning the walkdown (what information about the equipment is to be obtained by physical inspection)
 - Preparation for the walkdown (shift supervisory approval)
 - Conduct of the walkdown (use knowledgeable, qualified plant staff)
 - Documentation , reporting and interpreting findings (document conditions observed, particularly if deficient or different from what was qualified)

Corrective action plan and priorities

If an equipment located in a harsh environment has a qualification deficiency, the following EQ upgrade options are available:

- *Test* - Simulate the harsh DBE environment and demonstrate that the equipment will function.
- *Analyse* - Provide evidence by comparison or by calculation that the equipment can be considered qualified.
- *Protect* - Change the local environment.
- *Relocate* - Move the equipment to a less harsh environment.
- *Modify* - Replace parts which are the cause of the equipment's failure to meet the qualification requirements.
- *Replace* - Put in a fully qualified equipment.

Implementation of interim measures

To continue safe operation of the plant during EQ upgrade implementation, interim measures may be necessary to make up for the identified EQ deficiencies, based on the experience of other utilities:

- (a) Sealing components against moisture intrusion
- (b) Splicing low voltage, low current signal cable termination points in the harsh environment locations
- (c) Ensuring that other electrical terminations are protected against moisture intrusion
- (d) Providing drainage points in junction boxes and conduits
- (e) Replacing components or materials known to fail in a harsh environment
- (f) Replacing unidentifiable or unqualifiable lubricants with standard lubricants qualified for the required applications.

Options:

- **Replace by qualified equipment**
- **Qualify or re-qualify existing equipment**
 - by analysis in combination with test data to determine qualified life
- **Ongoing qualification**
 - less effort on accelerated ageing
 - must define qualified condition, i.e. condition indicators and acceptance criteria

Verification and follow-up

- Walkdown should verify that the installed configuration reflects the assessed configuration
- Maintenance requirements identified in the EQ assessment have to be implemented
- Ongoing plant modifications should be reviewed for EQ requirements