



# IEEE SC-2

## International Standard Review

RCC-E (1993)

versus

IEEE 323-2003

# Historical Use of Standard

- *On 10/19/1980, EdF, Framatome and Novatome establish AFCEN (French Society for Design & Construction Rules for Nuclear Island Components)*
- Purpose AFCEN:
  - Prepare rules for design, manufacture, installation and commissioning of components used for NPPs
  - Revise such rules based on experience, technology advances and regulatory changes
  - Publish the rules and any revisions
- AFCEN published RCC-E, the French design and construction rules for nuclear island electrical components
- RCC-E is considerably broader than EQ, but includes EQ elements



# Comparison to IEEE 323

- Scope of Standard
- Principles of Qualification
- Qualification Methods
- Qualification Program
- Documentation

# Scope of Standard

- Includes commercial elements (prime contractor, contractor)
- Responsibility for equipment rests with the prime contractor, not owner
- Includes procurement and manufacturing

# Scope of Standard

- Electrical equipment whose failure could adversely affect safety or seriously affect plant availability
  
- Applies to all Class 1E equipment; defined as essential to:
  - Emergency Reactor Shutdown;
  - Containment Isolation;
  - Emergency Reactor Core Cooling;
  - Residual Heat Removal from the Reactor;
  - Heat Removal from Reactor Building; or
  - Prevent Significant Release of Radioactive Materials.

# Scope of Standard -Comparison

- IEEE 323 primarily a qualification standard
- IEEE 323 driven by “first principles” that are difficult to reconcile with RCC-E scope
- RCC-E references many more equipment-specific standards than IEEE 323
- RCC-E scope much broader than IEEE 323

# Principles of Qualification

Standard Qualification Procedures for K1, K2, K3 used to demonstrate equipment performance:

- K1 - Inside Containment Subject to Normal, Seismic, Accident and/or Post-Accident Conditions
- K2 - Inside Containment Subject to Normal Ambient Conditions and Seismic Loading
- K3 - Outside Containment Subject to Normal Ambient Conditions and Seismic Loading, as well as Accidental Ambient Conditions specified for certain materials

IEEE 323, to accommodate 10 CFR 50.49, is driven by “first principles” that are difficult to reconcile with K1, K2, K3 of RCC-E

# Qualification Methods

- Testing – Sample of equipment subjected to tests representative of intended service conditions to demonstrate performance
- Analysis – Mathematical/logical proof to demonstrate performance for intended service
- Combined Method – Combines qualification by testing and qualification by analysis



# Qualification Methods

Combined Qualification shall be used to:

- Maintain EQ when equipment has undergone major modifications
- Identify possible unsafe failures or failure mechanisms
- Qualify equipment items based on one or more qualified models
- Qualify equipment when testing cannot be used (e.g., size)

# Qualification Methods

Data used to support proof may be:

- Operating Experience with Similar Equipment
- Partial Tests or Tests on Prototype

Acceptance Criteria are:

- Function to be Verified shall be stated in Qualification Program
- Tests shall confirm stated Functional Characteristics

# Qualification Program

- K1 – Refers to NF M 64-001, Procedure for qualification of electrical equipment in Containments of PWRs subject to accident conditions; Refers to other methods for specific types of equipment
- K2 – Also refers to NF M 64-001 and RCC seismic test procedure
- K3 - Refers to IEC standards and other sections of RCC-E

# Qualification Program

- Specific numeric values provided for normal ambient conditions and seismic loading
- Provides temperature, pressure and dew point profiles that envelope accident conditions

# Documentation

## Qualification Report shall include:

- Identification of Qualified Equipment
- Document References defining Method of Qualification
- Identification of Qualifying Organization
- Reports of the Qualification Stages, along with the Results obtained
- Anomalies during Qualification Testing and Disposition
- Statement that Equipment conforms to Qualification Specification or identification of non-conformances

RCC-E documentation requirements similar to IEEE-323

# EMI/RFI

Rules for protection against electrical and EMI

Criteria are in accordance with standards for:

- Noise
- Shields (screens)
- Electromagnetic shield
- Armor
- Mitigation in low voltage circuits, using resistors, capacitors, and diodes

There is no reference to IEC documents used in the US for EMC testing, such as IEC -61000



# Microprocessor Based Review

- RCC-E has a section on electronic components (integrated circuits, printed circuit boards, etc.)
- Neither RCC-E nor IEEE 323 have explicit requirements regarding microprocessor based equipment

# Conclusions and Recommendations

- A major effort is required to incorporate RCC-E approach into IEEE 323, since details are buried in many specific referenced standards
- NF M 64-001, Procedure for qualification of electrical equipment in Containments of PWRs subject to accident conditions, might provide a better basis for IEEE 323 comparison
- Manufacturing and commercial issues are an integral part of RCC-E, while the technical aspect of EQ is the only subject of IEEE 323
- RCC-E appears to be more of a specification than a standard and lacks the level of detail to permit a direct comparison to IEEE 323
- Micro-processor equipment is not explicitly addressed in either RCC-E or IEEE 323
- Should focus thrust for consistency with International Standards on IEC and hope to convince French to concur with International approach