Inconsistent Use of "Qualified Life"

Institute of Electrical and Electronic Engineers
Nuclear Power Engineering Committee

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By Nissen Burstein)

Agenda

- Background
- Issue
- Definitions
- Application of the terms
- “Qualification” in NPEC Standards
- Options
- Recommendation
- Resolution Path
- Conclusions

"Qualification"

- Qualification was created in the Nuclear industry to address two extremes:
  - Seismic
  - Environmental (primarily in containment)
- Qualification experience expanded knowledge into areas of equipment aging (thermal, radiation)
- Qualification is now applied in broad areas to imply a disciplined approach.
- Qualification appears to have replaced "Quality Assurance" related to the documentation of good practices.

Background

- IEEE PC37.105 D10 is titled: ”Draft Standard Qualifying Class 1E Protective Relays and Auxiliaries for Nuclear Power Generating Stations”
- PC37.105 was first issued in 1987
- Reaffirmed in 1990
- Forward: “This standard is for the design qualification portion of the program only.”
- Section 1. Overview: “Relays located inside primary containment …(are)….beyond the scope of this document.”

Issue

- Contrary to IEEE 323, IEEE PC37.105 D10 establishes a “qualified Life” for equipment located in a mild environment.
- (Note: IEEE 649 and 650 establish a “qualified life” for motor control centers and battery chargers in a mild environment.)
- NPEC needs to clarify and standardize terms

Definitions – IEEE 323

- Design Life – The time period during which satisfactory performance can be expected for a specific set of service conditions.
- Service Life – The time period from initial operation to the removal from service.
- Qualified Life – The period of time, prior to the start of a design basis event, for which the equipment was demonstrated to meet the design requirements for the specified service conditions.

Definitions – IEEE 323 (continued)

- Service Conditions – Environmental, loading, power and signal conditions expected as a result of normal operating requirements, expected extremes (abnormal) in operating requirements, and postulated conditions appropriate for the design basis events of the station.

IEEE 323 Criteria

- 4.1 Qualification Objective
  - "A Qualified Life is not required for equipment located in a mild environment and which has no significant aging mechanisms."
- 4.2 Qualified Life
  - "It is necessary to establish a qualified life for equipment with significant aging mechanisms"

IEEE 323 Criteria (continued)

- 6.2.1.1 Significant Aging Mechanisms
  - "An aging mechanism is significant if … while in storage, normal or abnormal service ….it results in degradation that …. renders the equipment vulnerable to failure to perform its safety function under design basis event conditions"
- 7.1 Mild Environment Documentation
  - Design / Purchase Specifications
  - Seismic Test Reports (If applicable)
  - An Evaluation and / or Certificate of Conformance

Definitions - Explained

- Qualified Life applies to equipment located in a harsh environment.
- The qualified life is the “Service Life” before the Accident.
- The qualified life is the time the equipment is pre-aged and pre-conditioned (by test) prior to harsh environmental testing.
- Pre-aging is not in a harsh environment
- Harsh environmental testing is separate from pre-aging

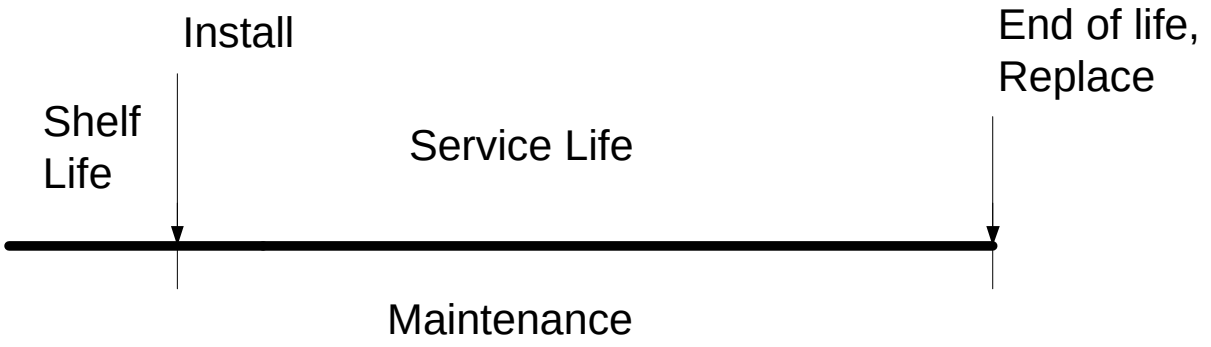
Time–Dependent Terms

- Shelf Life
  - Manufacturers' recommendations or
  - 5% of the Qualified Life or
  - Justified by analysis, test or
  - Reduction in Qualified Life
- Qualified Life – Preconditioed aging programs with a goal of 40 – 60 years.
- Post Accident Operating Time (by test)
  - Short Term: seconds or minutes
  - Intermediate Term: minutes to one day
  - Long Term: 1 – 15 days
  - Extended Term: 15 days to 1 year.

Qualified Life and Service Life

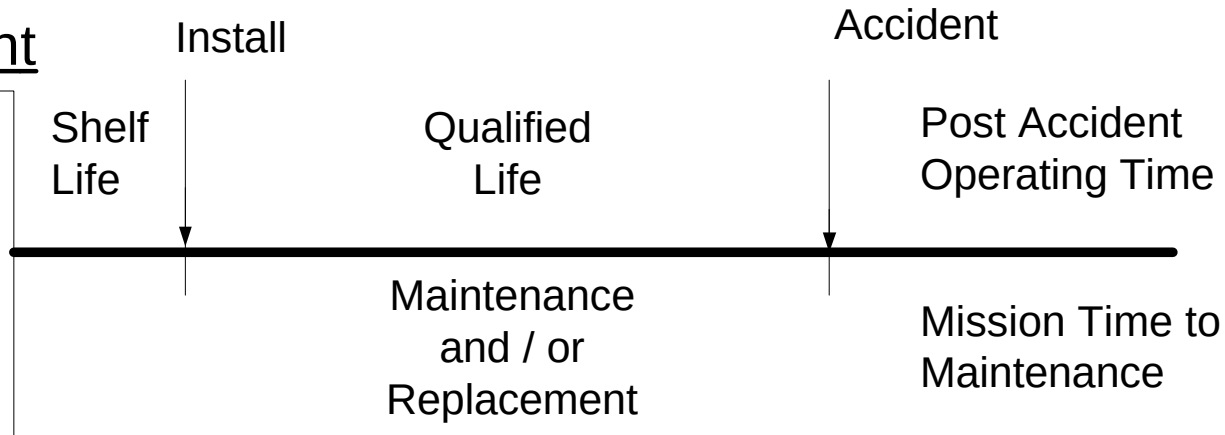
Mild Environment

Service Life
- Commercial Test
- Performance Test
- Aging
- Seismic
- Experience



Harsh Environment

Qualification Test Report
- Qualified Life
  - Performance Test
  - Aging Test
  - Radiation Test
  - Seismic Test
- Harsh Environment Test



EQ Qual Life.vsd, 1/26/05

"Qualification" in NPEC Standards

- 323 Qualifying Equipment in a harsh (and recently mild) environment
- 334 Qualifying Motors in a harsh environment
- 344 Seismic qualification (mild or harsh)
- 382 Qualification for Actuators in a harsh environment
- 383 Type test of Cables in a harsh environment

"Qualification" in NPEC Standards

- 420 Design and Qualification of Control Boards
- 535 Qualification of Batteries
- 572 Qualification of Connection Assemblies
- 627 Design Qualification
- 649 Qualifying Motor Control Centers in a mild environment
- 650 Qualification of Battery Chargers in a mild environment

Options

1. Accept the present situation: “qualified life” can mean whatever is defined in the standard. (inconsistent)
2. Define a Qualified life for a mild and a harsh environment (multiple meanings for the same term)
3. Standardize the term Qualified Life to mean only the Service Life prior to the design basis event
4. Standardize the term Qualified Life to mean only the Service Life prior to the harsh environment

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NPEC Discussion / Input / Comments

Recommendation

- NPEC needs to provide clarification and standardization of the term
  - Qualified Life
- Assist the industry in the interpretation of the standard term.
- Direct the user to commercial standards and testing, operating experience and design verifications for non-accident functions

Resolution Path

- Update IEEE 323 with clear definitions and applications of the terms.
  - Qualification – harsh environment only
  - Design Qualification - aging, non-harsh
  - Qualified Life – harsh environment only
  - Service Life - mild environment
- Ensure consistency of the use of these terms in NPEC documents.
- Ensure consistency of the use of these terms in other documents.

Conclusions

- NPEC's use of "Qualification" and "Qualified Life" have led to confusion in the Industry
- Other Committees are attempting to provide guidance in their areas of expertise
- NPEC needs to lead the effort with clear, useful definitions of standard terms.