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MAY 28 1979

MEMORANDUM FOR: Roger J. Mattson, Director
Division of Systems Safety, NRR

FROM: S. H. Hanauer, Assistant Director
for Plant Systems, Division of Systems Safety

SUBJECT: ORGANIZATION TO IMPROVE MANAGEMENT OF EQUIPMENT ENVIRONMENTAL AND SEISMIC QUALIFICATION REVIEWS

In an effort to improve our work on environmental and seismic qualification of safety related equipment, I recommend a minor reorganization be made within the ADPS organization. The change will permit a better managed review of cases and generic Task A-24. The branches affected are ICSB and PSB. The plan is to form two sections in PSB for (1) electrical and (2) mechanical and qualification. I believe the changes will serve to concentrate the review effort, perform the required contract management, coordinate qualification efforts with other branches (MEB, SEB, CSB, RSB, and ASB) and provide the necessary support to the Seismic Qualification Review Team effort. The enclosure sets forth the scope of work, alternatives with pros and cons, and my recommendation.

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/S/
S. H. Hanauer
Assistant Director for Plant Systems
Division of Systems Safety

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& Generic Rvws
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ENCLOSURE

Discussion of Organization Equipment Environmental and Seismic Qualification Casework and Generic Reviews

S. H. Hanauer
May 22, 1979

Scope

The environmental qualification review effort has been carried out by ICSB and PSB with support from MEB, AAB, RSB, CSB, and ASB. For plants conforming to IEEE-323-1971, individual reviewers in each branch include environmental qualification in their work. In addition, generic task action plan A-24 is a separate effort to resolve the qualification issue for plants conforming to IEEE-323-1974. Experience has shown that our fragmented approach has created both internal and external problems in performing reviews and completing the work in a timely manner.

This proposal would place our total effort into one section and thereby provide for improved line management, more consistent interpretation and application of acceptance criteria, single point coordination with other branches and more effective management of technical assistance contracts.

Manpower

A projection of environmental qualification estimated manpower requirements is given in Table I. The work effort in PSB and ICSB is similar in many respects and has been aggregrated. The work effort for ASB is not included.

*The seismic qualification technical review is done primarily in MEB and SEB; the work included here is intended to represent what ICSB and PSB are already doing.

The manpower projection does not include the technical assistance on ICSB environmental qualification being provided by ORNL at a current level of 2 M yr/year. The projection does include the manpower required to administer this ORNL contract. Also, the manpower projection does not include the PSB case review assistance being provided by ORNL at a FY 80 level of 4 M yr/year which currently includes assignment to the ORNL reviewers of environmental qualification within the PSB scope.

Organization Alternatives

In the following paragraphs, three alternative organizations are discussed. Table II shows the manpower requirements of each, based on the total FY 80 requirements of Table I. For the reorganization alternatives (2 and 3), allocations are shown for both the present overall limit of 31 people in (ICSB & PSB). An increased limit should be considered, based on adding the additional manpower I believe will be needed for the projected workload. This increase, and TMI add-ons, are not included in Table II.

Alternative 1. Present Method

Individual reviewers in ICSB and PSB include environmental and seismic qualification in their case reviews, including applicable portions of topical reports. Task action plan A-24 is currently being done separately with the Task Manager being a member of ICSB. Therefore, environmental qualification for lead plants being reviewed using IEEE-323-1974 is not being done by the case reviewers in ICSB and PSB.

To do the work, one would have to assign 2 reviewers in PSB and 3 in ICSB to equipment qualification. With all vacancies filled, and present staffing limits, that would leave 10 reviewers in PSB and 10 in ICSB for

work outside equipment qualification. These would not be "whole bodies," since qualification would be part of each case review. Today, only about 1 reviewer (equivalent) in PSB and 1 in ICSB are working on qualification.

Pro

- Minimum disruption
- Minimum staff requirements

Con

- Work is not getting done
- Non-uniformity of reviews
- Line management is inadequate

Conclusion - Needs to be improved.

Alternative 2. New Section in ICSB

Form a third section in ICSB to deal with the overall environmental and seismic qualification effort. This would require establishment of a new Section - Chief position. The 4 professionals in the section would include people in various disciplines. PSB professionals would descrease by 2; these people, already doing qualification reviews, would transfer to the new section in ICSB. ICSB non-qualification reviewers would remain the same or increase by 1 if we got an extra position for the new section leader.

To make the change today, PSB would transfer 1 professional and 1 vacancy to ICSB for the new section; ICSB would transfer 1 professional and 2 vacancies (including 1 section/leader position) to the new section. These would be "real people," not fractions of all the reviewers.

Pro

·Continuity of reviews and implementation of acceptance criteria

·Uniformity of reviews

·Provides for central source of manpower for DOR assistance, SQRT team efforts and IE efforts

·Provides for centralized coordination of efforts from other NRR branches to accomplish the qualification effort.

Con

Additional work for branch chief of a heavily impacted branch

Reviews involve some skills not really relevant to the expertise of many ICSB personnel

Most of the equipment involved is in PSB's area of review responsibility

Would require assigning personnel without I&C background who could only be used in the single effort of environmental qualification review

Will require 1 additional section leader compared to alternate 1.

Conclusion - Marginally acceptable

Alternative 3. New Section in PSB

Form two sections in PSB: one dealing with electrical power and one combining the present PSB mechanical review areas and the environmental and seismic qualification area. The members of the new section would be a suitable mix of people with various specialties, including mechanical, electrical, instrumentation, and materials.

This would require two new section leaders in PSB, plus transfer of 3 qualification reviewers from ICSB to PSB. If the total number of (ICSB & PSB)

positions remained constant, that would leave 10 non-qualification reviewers in ICSB, as in the other alternatives, but the number of non-qualification reviewers in PSB would decrease by one to 9. If we get an extra position or two for the new section leaders, the decrease (which I do not favor) would not be necessary.

Pro

PSB needs section leaders to assist branch chief, thus reducing the workload of the chief of a heavily impacted branch.

Environmental qualification and mechanical reviews involve some of the same skills, but electrical/instrument expertise is also involved.

Most of the equipment involved is in PSB's area of review responsibility

Provides for central source of manpower for DOR assistance, SQRT team efforts and IE efforts

Provides diversity of work tasks for the personnel assigned to the new section

Position descriptions may be made broader and therefore the positions easier to fill

Provides for centralized coordination of efforts from other NRR branches to accomplish the qualification effort

Con

Requires additional staff position compared to Alternatives 1 and 2, because of the increased management manpower.

Conclusion - Acceptable; preferred alternative

4. The other alternatives listed below were considered, but seemed less desirable than the three discussed above:

   ·Separate branch

   ·New Section in ASB

   ·Putting ASB "outside containment environment envelope" with the ICSB/PSB work

5. ASB Scope

   No reorganization or additional staffing is needed for ASB in connection with this proposal. A draft work plan for equipment qualification review of ASB systems is under consideration.

6. Conclusion

   I recommend implementing alternative 3. Its cost is small - ? additional managers compared to the present arrangement - and is well worth its benefits. The principal gain is the additional management attention thus made available for qualification work, as well as for both mechanical and electrical power systems reviews in PSB.

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TABLE I

Manpower Required to do Equipment Qualification Job*
ICSB and PSB

	FY79+	FY80	FY81**
Case Reviews Dependent on Topical Reports	9	14	3
Task Action Plan A-24 Management	1.5	2	1.5
Contract Administration	6	5.5	3
DOR SEP Support Manpower	3	3	3
IEEE 323-1971 Casework (includes support to DOR)	4	10	5
IE E 323-1974 Casework	4	8	10
Research Coordination	1	2	2
Standards and SRP development	1	1	2
IE Bulletin Responses	2	2	0
Commission, FOIA and General Correspondence	2	2	2
Total	33.5MM	49.5MM	31.5MM

*These manpower projections do not include technical assistance on casework or Generic Issue A-24.

**The estimates for FY81 are believed to be lower than actual requirements because casework delayed for FY79 and 80 will increase the load.

+These figures for FY79 are Pre-TMI.

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TABLE II

COMPARISON OF MANPOWER ALLOCATIONS

Component			Person - Years Per Year 1. Present Method	2. Add'l Section on ICSB	3. Form Sections in PSB
Requirements for Environmental Qualification					
Professionals to do the work in Table I			4.5	4.5	4.5
Manpower Allocation					
ICSB	Professionals	Equip. Qual.	3	4	0
		Total	13	14+	10+
	Managers		3	4	3
	Secretarial		1	1	1
PSB	Professionsl	Equip. Qual.	2	0	4
		Total	12	10+	13+
	Managers		1	1	3
	Secretarial		1	1	1
Total	ICSB and PSB		31	31	31

+ Assumes constant total strength, all vacancies filled, in (ICSB & PSB) - in reality, additional manpower authorization may be available.

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APPENDIX A

POWER SYSTEMS BRANCH
MECHANICAL SYSTEMS AND QUALIFICATION SECTION

May 22, 1979

Functional Statement

The section is responsible to the Power Systems Branch Chief for the review, and evaluations of the functional capability of certain auxiliary systems and components related to electric power production and emergency power systems and the environmental and seismic qualification programs for all electrical power, instrumentation and control equipment. These review areas cover systems and components needed for safe plant operation and safe shutdown during normal, transient and accident conditions as described in applications for Construction Permits, Standard Plant Design Approvals and Operating Licenses for nuclear power plants to assure public health and safety and protection of the environment. The section performs studies and analyses of technical issues within the branch's area of review.

PERFORMANCE REQUIREMENTS

1. Performs licensing case reviews.
   a. Evaluates the design of certain auxiliary systems and components, as proposed in Safety Analysis Reports, from the standpoint of functional capability, integrity and systems operation under normal plant operation and for safe plant shutdown during normal, transient and accident conditions. Specifically, the following are analyzed and examined to assure compliance with NRC regulations and other safety criteria derived from these regulations as identified in the Standard Review Plan, Regulatory Guides and Industry Standards and Codes.

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(1) The design bases, features and performance criteria, including applicants' analyses and postulated accidents and operational occurrences that support the adequacy of the design bases, of the auxiliary systems and the technical areas listed.

This work includes:

(a) Emergency Diesel Auxiliary Systems;

(b) Main Steam Supply System (beyond outer MSIV);

(c) Turbine Generator;

(d) Main Condenser;

(e) Turbine Bypass System;

(f) Turbine Speed Control and Overspeed Protection Systems

(i) The applicants' calculational procedures and the analytical models used to verify system performance.

(ii) The need for and establishment of preoperational and start-up testing programs for systems and components.

(iii) The plant's technical specifications concerning the suitability of the safety limits, limiting safety systems settings, and the limiting conditions for operations; and the adequacy of the frequency and scope of periodic surveillance requirements.

(2) The seismic and environmental equipment qualification test criteria and programs used to verify design adequacy related to all electrical power, instrumentation and control equipment.

b. In performing reviews, drafts questions and positions or requests meetings with the applicant through the Licensing Project Manager to

obtain additional or clarifying information, and to resolve inconsistencies in interpretation of safety criteria. Prepares reports of technical evaluations and recommended actions for inclusion in the Safety Evaluation Report by the Licensing Project Manager.

c. Performs independent calculations and analyses to confirm or verify applicants' predictions of systems and component performance under postulated transient and accident conditions.

d. As identified in the Standard Review Plan, provides technical data and assistance in the areas described above to technical reviewers in other branches who need this information in the conduct of their reviews.

e. Performs on-site technical audits of applicants' plant designs for selected systems in the branch's area of responsibility to observe "as built" implementation of NRC safety criteria.

f. Prepares responses and makes presentations to the Advisory Committee on Reactor Safeguards and upper management on significant technical issues, concerns, or positions developed on licensing cases.

g. Assists in the preparation and presentation of testimony to be presented at public hearings to describe and support technical analyses, evaluations, and positions developed in licensing cases.

2. Performs Topical Report reviews.

a. Evaluates Topical Reports submitted by reactor vendors, architect-engineering firms, and major component manufacturers on safety-related subjects in the branch's area of review and in accordance with applicable sections of the Standard Review Plan.

b. Obtains additional information and coordinates with other technical review branches as may be needed for the review of these reports.

c. Prepares and submits a report containing the evaluation and the recommended NRC position regarding the acceptability of such reports.

3. Performs studies of technical issues and problems of limited scope and normal complexity within the branch's area of review. Prepares reports containing technical bases and recommended positions. In some cases, these positions are incorporated into other major technical studies which result in modifications to the Standard Review Plan, or may later be used as basis for Regulatory Guides and Commission Regulations.

4. Reviews and provides comments and recommendations on Regulatory Guides and Industry Standards developed by or forwarded from the Office of Standards Development.

5. Provides technical assistance to the Division of Operating Reactors on significant safety matters within the branch's area of responsibility that affect operating reactor plants.

6. Participates on research review groups to provide licensing input and monitor the progress of research programs; recommends changes in research programs necessary to meet licensing needs.

7. Provides technical assistance to the Office of Inspection and Enforcement, the Office of Nuclear Material Safety and Safeguards and the Office of International Programs on matters which fall into the branch's area of responsibility or employee's area of technical cognizance.

8. Identifies the need for technical assistance which can be obtained under contract, develops appropriate work scope, and provides technical management of contracts.

9. Assists in the selections of contractors as part of Source Evaluation Boards.

10. Drafts correspondence and reports in response to inquires received from members of Congress, other Federal Agencies, state and local governments, and from the general public.

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APPENDIX B

POWER SYSTEMS BRANCH
ELECTRIC POWER SECTION

Functional Statement

The section is responsible to the Power Systems Branch Chief for the reviews and evaluations of the functional capability of electric power systems and components including related instrumentation and controls. These review areas cover systems and components needed for safe plant operation and safe shutdown during normal, transient and accident conditions as described in applications for Construction Permits, Standard Plant Design Approvals and Operating Licenses for nuclear power plants to assure public health and safety and protection of the environment. The Section performs studies and analyses of technical issues within the branch's area of review.

PERFORMANCE REQUIREMENTS

1. Performs licensing case reviews.
   a. Evaluates the design of electric power systems and components including related instrumentation and control, as proposed in Safety Analysis Reports, from the standpoint of functional capability, integrity, and systems operation under normal plant operation and for safe plant shutdown during normal, transient and accident conditions. Specifically, the following area analyzed and examined to assure compliance with NRC regulations and other safety criteria derived from these regulations as identified in the Standard Review Plan, Regulatory Guides, and Industry Standards and Codes.

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(1) The design bases, design and performance criteria and the systems features of electric power systems and components including related instrumentation and control for the following systems and technical areas summarized below:

a. Offsite Power Systems;

b. A-C Power System (Onsite);

c. D-C Power System (Onsite);

d. Emergency Communication Systems;

e. Turbine Speed Control and Overspeed Protection Systems; and

f. Electric Power/Fire Protection Interface

The review of these systems encompasses the sensors, initiating circuits, logic elements, power supplies, distribution circuitry, bypasses, interlocks, redundancy and diversity features, actuated devices, wiring, cables, raceways, monitoring systems and alarms.

(2) The applicant's analyses of the limiting conditions of operation, postulated accidents, operational occurrences, and failure modes and effects.

(3) The need for and establishment of preoperational and start-up testing programs for electric power systems and components including related instrumentation and control.

(4) The plant's technical specifications concerning the suitability of the safety limits, limiting safety system settings, and the limiting conditions for operations; and, the adequacy of the frequency and scope of periodic surveillance requirements for electric power systems and components including related instrumentation and control.

b. In performing reviews, drafts questions and positions or requests meetings with the applicant through the Licensing Project Manager to obtain additional or clarifying information needed to resolve inconsistencies in interpretation of safety criteria. Prepares reports of technical evaluations and recommended actions for inclusion in the Safety Evaluation Report by the Licensing Project Manager.

c. Performs independent calculations and engineering analyses to confirm or verify applicants' predications of systems and component performance under postulated transient and accident conditions.

d. As identified in the Standard Review Plan, provides technical data and assistance in the areas described above to technical reviewers in other branches who need this information in the conduct of their reviews.

e. Performs on-site technical audits, of the applicant's plant designs for selected systems in the branch's area of responsibility to observe "as built" implementation of NRC safety criteria.

f. Prepares responses and makes presentations to the Advisory Committee on Reactor Safeguards and upper management on significant technical issues, concerns, or positions developed on licensing cases.

g. Assists in the preparation and presentation of testimony to be presented at public hearings to describe and support technical analyses, evaluations, and positions developed in licensing cases.

2. Performs Topical Report reviews.

   a. Evaluates Topical Reports submitted by reactor vendors, architect-engineering firms, and major components manufacturers on safety-related subjects in the branch's area of review and in accordance with applicable sections of the Standard Review Plan.

   b. Obtains additional information and coordinates with other technical review branches as may be needed for the review of these reports.

   c. Prepares and submits a report containing the evaluation and the recommended NRC position regarding the acceptability of such reports.

3. Performs studies of technical issues and problems of limited scope and normal complexity within the branch's area of review. Prepares reports containing technical bases and recommended positions. In some cases, these positions are incorporated into other major technical studies which result in modifications to the Standard Review Plan, or may later be used as bases for Regulatory Guides and Commission Regulations.

4. Reviews and provides comments and recommendations on Regulatory Guides and Industry Standards developed by or forwarded from the Office of Standards Development.

5. Provides technical assistance to the Division of Operating Reactors on significant safety matters within the branch's area of responsibility that affect operating reactor plants.

6. Participates on research review groups to provide licensing input and monitor the progress of research programs; recommends changes in research programs necessary to meet licensing needs.

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7. Provides technical assistance to the Office of Inspection and Enforcement the Office of Nuclear Materials Safety and Safeguards and the Office of International Programs on matters which fall into the branch's area of responsibility or employee's area of technical cognizance.

8. Identifies the need for technical assistance which can be obtained under contract, develops appropriate work scope, and provides technical management of contracts.

9. Assists in the selection of contractors as part of Source Evaluation Boards.

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Rod FYI

Pretty good summary

EQUIPMENT QUALIFICATION

AN UPDATED VIEW FROM THE UTILITY PERSPECTIVE

M.D. Sulouff

PRESENTED AT ANS 25TH ANNUAL CONVENTION
JUNE, 1979
ATLANTA, GEORGIA

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EQUIPMENT QUALIFICATION-AN UPDATED VIEW FROM THE UTILITY PERSPECTIVE

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Abstract

For about four years, WPPSS has been heavily involved in equipment qualification as it relates to qualifying Class IE Electrical/I&C and interfacing mechanical equipment. WPPSS's early involvement included establishing a position with IEEE 323-1974 and implementing a program to satisfy this position. The program has evolved around the changing documentation requirements issued by regulatory agencies with respect to equipment qualification.

Due to early efforts to establish an equipment qualification program and have it in place when necessary, direct schedule impact on the WPPSS projects has been relatively low. The cost impact has not been low, however. The estimated costs for five nuclear power plants for this program are $36,000,000. WPPSS has been actively involved in defining and reducing these costs whenever possible.

The equipment qualification issue can be solved when maximum attention is directed by utilities, A/Es and vendors to sharing knowledge, insuring that documentation is available to utilities, and forming owners groups, when possible, to share costs.

Introduction To Equipment Qualification-What Is It?

A definition of the term, equipment qualification, is contained in IEEE 323-1974. , A take off from that definition is:

> Equipment qualification is the documenting that electrical equipment important to plant safety and the safety of the public (Class IE equipment) will function during normal, abnormal, or postulated accident conditions.

An important point to emphasize is that equipment qualification does not simply include subjecting the equipment to the effects of temperature, pressure or humidity. It includes insuring that the equipment will perform in the presence of all postulated service conditions; including seismic. The type of qualification used depends on the equipment to be qualified.

The types of equipment which compose a nuclear power plant are many. They include mechanical and electric components. Equipment qualification principles in this discussion will apply primarily to I&C/electrical equipment.

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What types of equipment are required to be qualified?

Typical types are:

- o Large Mainsteam and Feed Water isolation valves.
- o Switch gear.
- o Motor Control Centers.
- o Dry-type transformers.
- o Batteries, battery chargers.
- o Diesel Generator Control equipment.

This list may seem small until it is recognized that these major "blocks of equipment" contain components which are also necessary to be qualified in order to ensure that the equipment block can perform its safety function under the service conditions postulated. When all of the components are taken into account, WPPSS has found that in excess of 4,000 pieces of equipment per unit must be listed and undergo qualification as well as be tracked for replacement and periodic maintenance. This list may change from plant to plant and utility to utility. It appears to be however, representative.

All of this equipment must be subjected to a qualification process to be considered qualified with respect to the definition. There are essential elements, however, of qualification which can be obtained by interpretation of IEEE 323-1974 and other more specific standards. These elements appear to be the "basics" which must be addressed by the qualifier:

1) Identification of Equipment and Its Application - This includes an equipment description; including manufacturer's model number, methods of mounting and interfaces with other equipment (e.g., connections to piping).

2) Preparation of a Qualification Program - The essential elements of any qualification program should include:

   - Identification of potential aging mechanisms.
   - Development of a qualification plan.
   - Implementation of the qualification plan.
   - Determination of the qualification status (e.g., pass/fail).

3) Documentation of the Program - The qualification plan, test results and other data necessary to substantiate qualification should be provided.

There are general methods used to ensure that Class IE equipment is in fact qualified according to the definition. These methods are analysis, combined analysis/test and type testing. Generally, type testing or combined analysis/testing is used to qualify active, Class IE I&C/electrical equipment. The qualification methods expose the equipment to the postulated service conditions. The common tests used to simulate service conditions mentioned in IEEE 323-1974 are:

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1) Aging - Thermal and mechanical conditioning of the devices using any method described above.

2) Radiation - Exposure of the device(s) to an actual radiation source is generally the technique used; although analysis is growing in popularity as more data is gained with respect to the effects of radiation on equipment functions.

3) Seismic Forces - All qualification methods are commonly used to expose the device to the required response spectras.

4) Operation Cycling - The device's safety function (e.g., valve actuator unit closes during a postulated DBE) should be checked during and after exposure to the postulated event.

5) Design Basis Event (DBE) Qualification - If it is possible that the equipment could be exposed to LOCA conditions during operation, it will generally be subjected to those same simulated conditions using type testing.

The data obtained and the subsequent ability of the device to perform its safety function after completion of the qualification program will determine the qualification status of the device(s). This brief discussion has brushed the subject of equipment qualification and what it is. The next major point is--How did we get into all of this?

Background-Why are we performing equipment qualification?

Equipment qualification is not such a recent issue as some may think. The issue has about a ten-year history. It is useful to look at the events which occurred to gain a better perspective on why we are doing what we are. The events occurred in the following sequence:

1) IEEE 279 was issued in 1971 - Section 4.4 of that standard, contained the words, "equipment qualification". The standard also required that the "range of energy supply" be addressed as well as requiring the system's minimum performance functions be analyzed or tested to assure functionality during postulated conditions.

2) 10 CFR 50.55a endorses IEEE 279-1971 - Making it a requirement in the design of nuclear power plants.

3) IEEE 323-1971 Issued, April 1971 - This standard required environmental qualification of Class IE equipment located in containment but did not specifically require aging of equipment.

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4) Other similar standards issued - The industry prepared guides for the qualification of major components such as Electric Valve Operators, Motors and Cables. This occurred primarily in 1971 and 1972. The seismic qualification of those components was also addressed by IEEE-344-1971, issued during this period.

5) The industry issued IEEE 323-1974 for trial use on February 28, 1974 - Unanimous approval of revision 7 was provided by the IEEE standards board. For the first time, an IEEE standard specifically required aging and sequential qualification of Class IE electrical/I&C equipment. The standard was basically derived from and based on IEEE 323-1971.

6) Industry tries to interpret the aging requirements of IEEE 323-1974. - During 1974 and 1975 the major areas of change from the 1971 version of IEEE 323 were noted by the industry; especially the requirement for aging equipment. There was a lack of sufficient utility knowledge and information to enable all groups to implement effective age qualification programs. Many positions were proposed by companies to the NRC. The NRC stated that the industry had established the standard and should be willing to abide by it. In July, 1975 NPEC issued a position statement to be included in the forward of IEEE standard 323-1974 which attempted to clarify the aging issue.

7) Utilities organize in small consortiums-1975 through 1976 - To establish a position statement to IEEE 323-1974. Many of them, including WPPSS, were trying to establish positions in their PSAR's with respect to the standard. The basic problem appeared to be that the state-of-the-art had not advanced sufficiently to allow the aging requirement to be implemented.

8) ACRS (Advisory Committee on Reactor Safeguards) tries to interpret the radiation source term in IEEE 323-1974 - Regulatory Guide 1.89 was issued for comment in 1975. The source term definition provided in the guide caused considerable controversy. This was due to the assumption that the worst case fuel meltdown would occur and release of gasses was to be based on that condition. The Regulatory Guide also endorsed IEEE 323-1974. The NRC continued trying to specify a sufficiently conservative radiation term in a simple manner so as to eliminate the need for detailed radiation dose calculations.

9) Qualification standards issued based on IEEE 323-1974, 1974 through 1976 - IEEE Standards were issued to provide information on how to qualify major equipment such as Electrical Penetration assemblies (IEEE 317-1976), Class IE motors (IEEE 334-1974), and Class IE Electric Cables (IEEE 383-1974). IEEE 344-1975 was issued during this period.

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10) Regulatory Guide 1.89, "Qualification of Class IE Equipment for Nuclear Power Plants" was issued in November, 1974 - This regulatory guide confirmed the need for aging and also required that a conservative radiation source term be considered in the qualification of Class IE equipment.

11) Utilities establish positions with respect to IEEE-323-1974 - Various utilities such as WPPSS established positions in their PSAR's on how they planned to meet IEEE 323-1974. A widely used position was that the applicant would comply with IEEE 323-1974 to the extent that the state-of-the-art allowed implementation of the aging criteria.

12) Connectors fail Sandia lab's LOCA testing - In August, 1977, results were received from Sandia labs with respect to LOCA testing on connectors. It appears from these tests that the electrical connectors, typical of signal carrying connectors purchased according to IEEE-323, had failed the LOCA test programs for environmental qualification. From the test results, it was found that most of the tested electrical connectors exhibited a severe decrease in conductor-to-conductor and conductor-to-ground resistance. It appears that the main cause of this was the absence of potting compound and the tendency of electrical wires to rub against sharp corners of the connector.

13) Union of Concerned Scientists (UCS) petitioned Congress and the NRC to take "emergency and remedial action" regarding the connector failures - The Union of Concerned Scientists petitioned the NRC to "....halt further failure of Class IE equipment" in November, 1977. They also addressed the question of fire protection. NRC completed a survey of the plants and required several utilities to conduct qualification of connectors to ensure that they would meet the sequential testing requirements of IEEE 323-1974.

14) NRC issues requirements for applications implementing IEEE 323 and IEEE 344-1975 - October, 1977 - The NRC required that test plans and test procedures used to qualify Class IE electrical/I&C equipment be provided to the staff for review prior to the formal submittal of the FSAR. They also required a list of all the Class IE equipment.

15) Utilities respond to the requests - Late 1977 - Utilities state that they will comply when the data is available.

16) Utilities provide requested information - Mid 1978 - Utilities submit test plans and test procedures to the NRC. Due to the volume of data, the NRC revised its reporting requirements to require summaries of the equipment qualification plans. They also reference a Standard Question No. 4. The NRC states that this question provides detailed requirements with respect to the documentation required to ensure that Class IE equipment is qualified.

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Standard Question No. 4 requires summaries of test results for Class IE equipment not subject to a DBA with progressively more information required for equipment subject to a DBA.

17) NRC issues IE circular 78-08, May 31, 1978. - This circular states that documented qualification was found to be inadequate in many cases. The NRC emphasized that items such as connectors, penetrations, terminal blocks, limit switches, and cable splices should have qualification documentation. No written response to the circular was required.

18) WPPSS and other utilities meet with the NRC to clarify Standard Question No. 4 and how they plan to qualify equipment - 1978 Through 1979 - Utilities meet with the NRC to discuss and propose programs to meet IEEE 323-1974 and Regulatory Guide 1.89.

19) WPPSS and other utilities negotiate with NSSS suppliers and Balance-of-Plant equipment vendors to establish acceptable qualification programs - 1978 Through 1979 - Utilities were working with the NSSS vendors to establish an equipment qualification program. Negotiations were also held between the utilities and the individual balance-of-plant equipment vendors to establish acceptable qualification programs.

20) Three Mile Island incident occurs March 28, 1979 - All facts are certainly not in from the incident, but it does appear that the environmental qualification of equipment will be further studied to determine if the present qualification procedures are adequate; in light of the incident.

A review of the evolution of equipment qualification, covers a span of approximately ten years. It starts out with the industry trying to define what equipment qualification is, and continues with NRC, industries and utilities trying to further define the type of qualification documentation acceptable.

Today, we find vendors have the capability to qualify a larger percentage of the plant equipment.

Current Status of the WPPSS Equipment Qualification Program

The WPPSS approach to equipment qualification consists of:

- ensuring that the Class IE electrical/I&C equipment meets the intent of the "WPPSS Acceptance Criteria for Class IE Qualification".
- Documenting that fact.
- Providing sufficient information to the NRC to minimize time for the operating license and also to establish that the equipment is, in fact, qualified.

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The approach WPPSS is taking to equipment qualification consists of the following steps:

1) An information report has been prepared which states the position of the Supply System on environmental and seismic equipment qualification, provides a basic sample of the types of equipment to be qualified, discusses the qualification methodology and also provides example summaries of major equipment qualification programs. Documentation required by Standard Question No. 4 along with the required format is also provided in the information report. This report is applicable to both WNP 1/4 and WNP 3/5 projects and will be submitted to the NRC for review.

2) WPPSS is anticipating that the NRC will review the information report and concur from a high-level technical and format basis that the documentation contained is acceptable.

3) WPPSS will then incorporate comments from this information report and submit section 3.10, "Seismic Qualification of Seismic Category I Instrumentation and Electrical Equipment," and 3.11, "Environmental Design of Mechanical and Electrical Equipment," of the FSAR, which will reference summary reports on types of equipment qualification. The Summary Report will describe the safety function performed by the equipment, the manufacturer and model number of the equipment, the qualification plan methodology, summary of test results and references to detailed documentation available for audits. These summaries will then be referenced in SRP 3.10-3, 4 and SRP 3.11-2, 3, and 4.

4) WPPSS has established means to ensure that the equipment is in fact qualified. Vendor documentation is reviewed for technical adequacy and correct qualification of equipment before award, during the contract implementation and prior to contract closeout.

The thrust of this program is to qualify Class IE equipment, to obtain documentation and to summarize that documentation for NRC review.

This WPPSS equipment qualification program has not been established without impact on the WPPSS projects, however.

Equipment Qualification Program Impact on WPPSS Projects

Equipment qualification is a licensing issue and causes impact in several areas. These are:

- Schedule.
- Cost.
- Engineering design changes.

The impact of these factors is different for each project due to varying requirements between the projects.

For example, WNP-2 is meeting IEEE 323-1971, while WNP-1/4 and 3/5 must meet the IEEE 323-1974 criteria.

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Schedule Impact

The schedule impact on WNP-2, the WPPSS BWR plant, occurs primarily due to an increase in the amount of equipment qualification documentation review necessary to be completed prior to the issuance of the operating license (OL).

For WNP 1/4 and WNP 3/5 projects, the schedule impact is not a significant issue. It could be in the future, however, when delays in equipment shipping become necessary due to a qualification program not being completed. The potential also exists that the NRC may require additional testing; which would delay equipment shipping.

Schedule impact is not the only problem facing WPSSS with respect to equipment qualification. In addition, costs to qualify equipment and to ensure that documentation is available to prove qualification are significant.

Cost Impact

The equipment qualification costs for the WPPSS projects can be categorized into four major areas:

- Obtaining equipment qualification documentation.
- Review of equipment qualification documentation for adequacy.
- Additional costs for qualification programs.
- NSSS vendor qualification.

WNP-2 is being licensed under the criteria of IEEE 323-1971. One of the problems facing WPPSS right now, is to obtain the necessary documentation with respect to the seimic and environmental qualification to meet that criteria.' In some cases, documentation was submitted by the vendors but exists in the form of a certificate of compliance rather than a full qualification test report. The estimated cost to obtain the existing documentation ranges between $100,000 to $150,000.

The review of existing documentation and that which is being obtained by the process mentioned above is also costly. It is estimated that $200,000 will be spent in engineering time reviewing the qualification documentation to ensure adequacy.

Should any equipment require requalification or should it be necessary to replace that equipment, it is estimated that that cost would be $500 to $1 million. These costs include man hours, installation and vendor charges. This cost could be much higher depending on the type of requalification or replacement requirements. Overall, it is estimated that the costs for WNP-2 will approach one to two million dollars in the equipment qualification area.

WNP-2 is not alone in the costs. WNP-1/4 and 3/5 are also accruing additional costs for equipment qualification.

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For WNP-1/4 and 3/5, the criteria is different. In these plants, the requirements of IEEE 323-1974 apply. In addition, NRC Standard Question No. 4, which requires submittal of selected test results, summaries and additional data with respect to equipment qualification, is also a requirement.

It is estimated that the additional costs for new qualification programs to meet IEEE 323-1974 requirements run approximately $100,000 to $500,000 per Class IE contract. Considering the total number of Class IE instrumentation and electrical equipment contracts existing on WNP-1/4 and 3/5, is estimated that the total qualification cost will be $10 to $25 million. This cost consists of several major items. These are:

- Response to Standard Question No. 4.
- Upgrading NSSS vendor qualification programs to meet IEEE 323-1974 requirements.
- On-going qualification costs.

The additional costs for qualification programs related to IEEE 323-1974 exist mainly in the additional paper work and testing which the vendor is required to perform to qualify a device. For example, the cost of the Class IE, in-containment device on one contract was approximately three times the cost of an outside containment Class IE device with the same manufacturer and model number. Class IE, outside containment located devices range 16 to 33% more expensive than non Class IE equipment in the same location and the percentage difference appears to be increasing; not decreasing.

Standard Question No. 4 requires that summaries of qualification test results and data be submitted to the NRC staff for review. Recent quotes from various consultants and WPPSS internal estimates indicate that it will cost approximately $150 to $200,000 per project to summarize qualification plans, tests and also to provide the information in the format requested. The total cost for WNP-3/5 and 1/4 would $400,000 for both projects. The other area of major cost increase is in the NSSS equipment qualification programs.

On WNP-1/4 and 3/5, WPPSS prefers the approach of requiring the vendor to type test and provide a qualified life approaching 40 years. This approach is also being negotiated with the NSSS vendors. For WNP-1/4 it is estimated that the total cost will approach $3 million for this qualification program. The WNP-1/4 program is WPPSS' share of an estimated $6 to $10 million total cost. A combined analysis/testing approach is being used for WNP-3/5. For this project, it is estimated that $5 to $10 million will be spent in the initial qualified life and on-going qualification program. Many utilities are forming owners groups to try to reduce the costs of equipment qualification.

The total costs related to equipment qualification, for all projects at WPPSS appears to be around $36 million. This figure is conservative.

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WPPSS Involvement in Equipment Qualification-What Are We Doing About It?

WPPSS believes that the most effective way of solving equipment qualification problems, reducing costs and meeting the licensing requirements is to get actively involved. There are three main activities which WPPSS conducts, related to equipment qualification. These are:

- o Generic activities
- o interface with vendors
- o documentation activities

Generic activities are those which are applicable to all WPPSS projects. An example of generic activity is: developing an initial position on IEEE 323-1974 with respect to aging. The generic activities are primarily performed by an organization in engineering which monitors equipment qualification activities on the projects. A project equipment qualification engineer for each project handles the general day-to-day equipment qualification activities relating to that project.

Another type of generic activity is the development of the WPPSS standard specification for equipment qualification. The standard specification has several major benefits. These consist of allowing the buyer to include costs for replacement of equipment in the bid evaluation; which would penalize vendors with a low qualified life, allowing the buyer to evaluate the quality of the vendor's equipment qualification program prior to contract award and allowing vendors to respond to buyer's specific equipment qualification requirements when bidding.

OH-OH
Implementation of this Policy may be a problem

In another, similar generic activity, WPPSS has held NRC meetings to firm up equipment qualification requirements and to discuss responses to those requirements with the staff.

Other generic activities are participation in equipment qualification work with EPRI, IEEE committees and other industry associations.

A very important generic activity is to insure that Class IE spare parts/maintenance procedures consider aspects of equipment qualification (e.g., on-going qualification).

The primary means for insuring that equipment qualification requirements get implemented is to take steps which ensure that the vendor building that equipment understands those requirements. WPPSS gets heavily involved with the architect engineer and vendors in the implementation of vendor's equipment qualification programs. Reviews of the program are conducted as they are received and discussions are held with vendors to ensure that the "WPPSS Class IE Equipment Qualification Acceptance Criteria" is met. Meetings with the vendor then take place to review the test results and resolve anomolies.

The only real result of equipment qualification is the production of documentation which ensures that the equipment installed in the plant will perform its safety function during all postulated service conditions. To accomplish this, WPPSS maintains files systems and a computerized record tracking system.

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Engineering working files are used which contain the equipment qualification plans, test results, and correspondence solely relating to equipment qualification. Project files, controlled through Quality Assurance procedures, are also available at each site containing the same information.

All information related to equipment qualification such as correspondence, plans and test results, is logged on a computerized sort to provide instant recall of information related to equipment qualification.

One of the requirements of Standard Question No. 4 is to provide a list of Class IE equipment; another activity related to documentation. WPPSS prepares Class IE equipment lists, in conjunction with the architect/engineer, which contain equipment qualification related data. This list will be used by operations, by the NRC, and by engineering to be able to ascertain the qualification status of a particular piece of Class IE instrumentation/electrical equipment. Items such as the equipment's safety function, qualified life, location, type of seismic qualification performed and type of environmental qualification performed are examples of information included in the Class IE equipment list.

Equipment Qualification-The Future

This paper has examined the past, present status and how WPPSS has been involved in equipment qualification. It is anticipated that the future of equipment qualification will be less concerned with the technical problems of qualification and more concerned with ensuring that documentation is available to prove qualification.

The Three Mile Island plant incident and its effect on equipment qualification is unknown at the present time. The investigation results could cause additional requirements related to equipment qualification.

The equipment qualification documentation problem can be solved by utilities, A/Es and other consultants sharing data necessary to meet equipment qualification requirements. For example, the Licensing Information Service (LIS) of NUS is starting an organization to provide data to meet 78-08 circular and 79-01 bulletin. EPRI has task forces to discuss solutions to the equipment qualification problem and to produce a data base containing aging mechanisms of materials and equipment.

Work is also underway by Sandia, Wyle, and other test labs to develop aging libraries containing information on the materials' aging mechanisms. Test labs and others are also developing qualification methods for complex electronic systems.

Summary

Equipment qualification to meet both technical and documentation requirements, is becoming more and more complex and costly. It appears that, however, the nuclear industry is on the "knee" of the learning curve.

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This means that the industry is beginning to be able to qualify certain types of equipment to the necessary requirements. Considerable sums of money are being invested in qualification and documentation of that qualification. More and more utilities, vendors, consultants and architect engineers are working together to reduce the equipment qualification costs and problems. This is being accomplished by sharing documentation, costs and knowledge.

In spite of the different goals, requirements, and schedules, we must continue down the path of encouraging the various groups building nuclear power plants to get on with the job and solve the equipment qualification problem.

References:

1. Specification Requirements for Qualification, by Newell S. Porter, WPPSS, Paper Presented at Three Day Course, Drexel University.

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3. "Regulatory Guide 1.70, Standard Format and Content of Safety Analysis Report for Nuclear Power Plants - LWR Edition," Revision 3.

4. "Regulatory Guide 1.89, Qualification of Class IE Equipment for Nuclear Power Plants."

5. Standard Question on Environmental Qualification of Class IE Equipment, (PSB Standard Question No. 4), (ICSB Review Reminder No. 32, Rev. 1).

6. "IEEE 323-1974, IEEE Standard for Qualifying Class IE Equipment for Nuclear Power Generating Stations".

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