NEI
NUCLEAR ENERGY INSTITUTE

Lynnette Hendricks
DIRECTOR, LICENSING
NUCLEAR GENERATION

December 14, 2001

Rules and Directives Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Washington DC 20555-0001

SUBJECT: Draft Regulatory Guide DG-1077, "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety In Nuclear power Plants" (66 FR 51479, October 9, 2001)

The Nuclear Energy Institute (NEI)[1], on behalf of its members, is submitting these comments in response to the Nuclear Regulatory Commission's solicitation of public comments on the subject draft regulatory guide.

Draft Regulatory Guide DG-1077 was developed as part of the NRC's research plan for digital instrumentation and control (I&C)[2]. The shorter-term elements of this research plan were intended to improve the efficiency of the technical review process. The draft regulatory guide fails to meet this objective. Instead, it would likely create ambiguity and regulatory uncertainty in the process of equipment environmental qualification by creating new and unique regulatory guidance applicable to only digital I&C. The industry and the NRC have over many years developed a comprehensive process to demonstrate that equipment important to safety is capable of performing its safety-related function(s) in harsh and mild environments. This comprehensive process has been successfully applied to digital applications in safety-related applications by individual licensees and by vendors. If adopted, the draft regulatory guide would create confusion in what has become a stable and effective regulatory review process.

---

[1] NEI is the organization responsible for establishing unified nuclear industry policy on matters affecting the nuclear energy industry, including regulatory aspects of generic operational and technical issues. NEI's members include all utilities licensed to operate commercial nuclear power plants in the United States, nuclear plant designers, major architect/engineering firms, fuel fabrication facilities, materials licensees, and other organizations and individuals involved in the nuclear energy industry.

[2] SECY-01-0155

1776 I STREET, NW SUITE 400 WASHINGTON, DC 20006-3708 PHONE 202.739.8000 FAX 202.785.4019 www.nei.org

In the Discussion section, the draft guide regulatory guide appropriately notes that the use of computers (i.e., digital devices) in safety systems poses challenges different from those of analog systems. Based on several examples of technical differences, the draft regulatory guide then concludes, *"These differences and analyses suggest a different approach to qualification for digital instrumentation and control (I&C) safety systems."* We disagree. While the design, manufacture, materials and testing of digital devices can create differences from those associated with analog devices, these differences are relevant to the digital design and manufacturing process and the methods used to qualify the design. The processes and standards for environmental qualification are the same for analog and digital devices. The regulatory requirements (10 CFR 50.49) and regulatory review process (NUREG-0800) for equipment environmental qualification are well established and adequate to ensure the qualification of digital systems.

We endorse the concept that either IEEE Standard 323-1983[3] or IEC 60780[4] are appropriate for satisfying the environmental qualification of safety-related equipment. Recognition of the European standard as well as the American standard appropriately reflects the reality of international supply of equipment.

In conclusion, we recommend that the draft regulatory guide be withdrawn and technical insights from the NRC's digital I&C research program be communicated via another mechanism such as a NUREG report.

Please contact Fred Madden (202-739-8114 or fwm@nei.org) or me (202-739-8109 or lxh@nei.org) or if you have any questions or wish to further discuss these comments.

Sincerely,

Lynnette Hendricks

Lynnette Hendricks

c: Ms. C. E. Antonescu, NRC

[3] It is noted that Regulatory Guide 1.89 does not presently endorse this version of the standard.

[4] International Electrotechnical Commission (IEC) 60780, "Nuclear Power Plants – Electrical Equipment of the Safety System – Qualification"

Duke Power
A Duke Energy Company

M. S. Tuckman
Executive Vice President
Nuclear Generation

Duke Power
526 South Church St. EC07H
Charlotte, NC 28202
P. O. Box 1006 EC07H
Charlotte, NC 28201-1006
(704) 382-2200 OFFICE
(704) 382-4360 FAX

66FR51479
10/09/01
(2)

December 12, 2001

Mr. David L. Meyer, Chief
Rules and Directives Branch
Division of Administrative Services
Office of Administration
Mail Stop T-6 D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Comments on Draft Regulatory Guide DG-1077, "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety in Nuclear Power Plants"
66FR51479, dated October 9, 2001

Dear Mr. Meyer:

Duke Energy (Duke) offers the following comments relative to the solicitation for public comments regarding DG-1077, "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety in Nuclear Power Plants."

Duke is of the opinion that current Regulatory Guides offer sufficient guidance for the environmental qualification of electrical equipment important to safety. DG-1077 specifically states that Regulatory Guide 1.89[1], which endorsed IEEE Std 323-1974[2], is appropriate for environmental qualification of electrical equipment and is supported by over 16 years of experience. Additionally, Regulatory Guide 1.180[3], together with current requirements for fire protection contained in 10CFR50, Appendix R, provide adequate guidance for the evaluation of

[1] Regulatory Guide 1.89, "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants" (June 1984)
[2] IEE Standard 323, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Station"
[3] Regulatory Guide 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety Related Instrumentation and Control Systems"

Template = ADM-013

E-RIDS = ADM-03
Add - A. Bernek (AFB)
C. Antonescu (CFAI)

potential stressors resulting from electromagnetic interference/radio-frequency interference and smoke.

Furthermore, Duke is of the opinion that the introduction of the new definition of nuclear plant environments in Section B, page 5, of DG-1077 (Categories A, B, and C) constitutes a staff position different from that previously provided by the staff (mild and harsh environments) in existing Regulatory Guides and, as such, should be subject to systematic and documented backfitting analysis consistent with the requirements of §50.109(a)(2).

Based on the above, Duke's review of Draft Regulatory Guide DG-1077 indicates that it would be more appropriate for the staff to update existing Regulatory Guide 1.89, "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants" (June 1984). The categorization of nuclear power plant environments should be evaluated in partnership with industry and other stakeholders through the appropriate IEEE consensus standards revision process. Without the active participation of component manufacturers and industry representatives in the development of new definitions of environments, the proposed classification terminology will likely cause confusion and uncertainty when qualifying new mechanical/electrical equipment containing embedded microprocessors.

Please address any questions to Jim Effinger at (704) 382-8688.

Thank you for the opportunity to provide these comments.

Very truly yours,

M. S. Tuckman

M. S. Tuckman

bxc: M. T. Cash
L. E. Nicholson
G. D. Gilbert
C. J. Thomas
W. H. Messer
R. J. Smith
K. R. Caraway
J. A. Effinger
ELL

Dominion Generation
5000 Dominion Boulevard, Glen Allen, VA 23060

Dominion

10/9/01
66FR51479
(11)

December 13, 2001

GL01-028

Rules and Directives Branch
Office of Administration
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

COMMENTS ON DRAFT REGULATORY GUIDE DG-1077

Virginia Electric and Power Company (Dominion) appreciates the opportunity to provide the following comments on Draft Regulatory Guide DG-1077, "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety in Nuclear Power Plants."

DG-1077 is written to account for qualification of equipment in environments other than harsh or EQ environments as per 10CFR50.49. There is concern on the part of Dominion that DG-1077 could evolve into a "Mild Environment EQ Program" which would be as extensive as our existing harsh environment EQ program. Dominion would be concerned if the NRC intends to invoke requirements for nuclear utilities to establish and maintain a mild environment EQ program as part of the plant's design basis.

Dominion does not presently have any interest in qualifying microprocessors through our 10CFR50 Appendix B program for use in safety related applications. Accordingly, the established design change process would be utilized for any installations of this example. Good engineering practices and use of the plant's accident Environmental Zone Descriptions (EZDs) would be used to prescribe elements of a purchase specification which would be distributed to potential vendors for their evaluation/bid. As such, any qualification requirements [in DG-1077] would be imposed on the vendor to supply the equipment through compliance with the specification. Dominion would not consider a vendor who had not gone through the SER process to qualify their equipment. Dominion is concerned that the population of vendors supplying safety related microprocessors may be reduced should the requirements in DG-1077 be too stringent. Dominion recommends the NRC give the subject vendors an opportunity to comment on their ability to provide microprocessors in accordance with DG-1077. Dominion also recommends DG-1077 not affect SERs already issued for some vendor's equipment.

Template = ADM-013

E-RIDS = ADM-03
Add = A. Beranek (HFIB)
C. Antonescu (CEA1)

On page 5 of DG-1077, three locations are established for mild environments (A, B, and C). The intent is to minimize environmental stresses on digital equipment by establishing threshold values for temperature, dose and humidity for these three locations. Dominion is concerned that these values may be in conflict with values already established in the EZDs for each plant. Dominion is concerned that the creation of these new locations could have an impact on the existing design basis EQ programs.

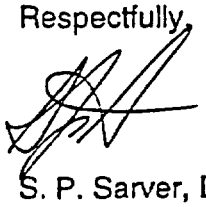
EMI/RFI is introduced into the draft on page 6 as an element which must be evaluated in the qualification process. EMI/RFI is not presently an EQ variable from the standpoint of 10CFR50.49. EMI/RFI is addressed in the design change process for installations of this nature and is an established good engineering practice. Dominion is concerned that the introduction of EMI/RFI into DG-1077 could affect existing EQ programs. There is not sufficient guidance in DG-1077 for EMI/RFI testing of digital equipment.

If you would like further information, please contact either:

Mr. Paul Tucker paul_tucker@dom.com, or (804) 273-2286 or

Mr. Don Olson don_olson@dom.com, or (804) 273-2830

Respectfully,



S. P. Sarver, Director
Nuclear Licensing and Operations Support

PSEG Nuclear LLC
P.O. Box 236, Hancocks Bridge, New Jersey 08038-0236

PSEG Nuclear LLC

LRN-01-0406

10/9/01
66FR 51479
(9)

Secretary of the Commission
U. S. Nuclear Regulatory Commission
Attn: Rulemakings and Adjudications Staff
Washington, DC 20555-0001

Gentlemen:

COMMENTS ON DRAFT GUIDE, DG-1077,
"GUIDELINES FOR EQUIPMENT QUALIFICATION OF MICROPROCESSOR-BASED EQUIPMENT IMPORTANT TO SAFETY IN NUCLEAR POWER PLANTS"
(Federal Register Vol. 66, No. 195, pp. 51479-51480, dated October 9, 2001)

This letter is being submitted in response to the Nuclear Regulatory Commission's (NRC) request for public input to the referenced Federal Register Notice.

The U.S. NRC is developing this draft guide to provide guidance to licensees and applicants on methods acceptable to the NRC staff for evaluating the environmental qualification procedures for microprocessor-based equipment that is important to safety for service in nuclear power plants.

PSEG Nuclear LLC appreciates the opportunity to comment on the DG-1077 and is pleased to submit attached comments. If you have questions regarding the comments, please contact Mr. Howard Berrick at 856-339-1862.

Sincerely,

G. Salamon
Manager – Nuclear Safety and Licensing

Attachment: Comments on DG-1077, "Guidelines For Equipment Qualification Of Microprocessor-Based Equipment Important To Safety In Nuclear Power Plants."

Template = ADM-013

E-RIDS = ADM-03
Add = A. Beranek (AFI3)
C. Anderson (CEA1)

C Mr. H. Miller
Regional Administrator - Region I
U. S. Nuclear Regulatory Commission
475 Allendale Road
King of Prussia, PA 19406

U. S. Nuclear Regulatory Commission
ATTN: Mr. R. Fretz
Licensing Project Manager - Salem
Mail Stop 08B2
Washington, DC 20555-001

U. S. Nuclear Regulatory Commission
ATTN: Mr. R. Ennis
Licensing Project Manager – Hope Creek
Mail Stop 08B1
Washington, DC 20555-001

USNRC Senior Resident Inspector - Salem (X24)
USNRC Senior Resident Inspector – Hope Creek (X24)

Mr. K. Tosch, Manager IV
Bureau of Nuclear Engineering
P. O. Box 415
Trenton, NJ 08625

ATTACHMENT

Comments on DG-1077, "Guidelines For Equipment Qualification Of Microprocessor-Based Equipment Important To Safety In Nuclear Power Plants"

PSEG Nuclear understands the NRC's preference to endorse Regulatory Guides and approved industry standards in their guidance, however if this document is to become the standard for qualification for microprocessor based systems important to nuclear safety then the staff should recognize other acceptable (and NRC endorsed) industry guidance as well. Based on the this, PSEG Nuclear's comment is as follows:

Paragraph C2 (page 7) and Regulatory Analysis section 2.3 (page 16) should be revised to add reference to EPRI TR-102323 as an additional acceptable method for addressing the electromagnetic & radio frequency interference (EMI/RFI) issue. The staff issued an SER for this document endorsing it as an acceptable method and therefore readers should be informed that there is an additional acceptable method for addressing the EMI/RFI issue.

NUCLEAR UTILITY GROUP
ON EQUIPMENT QUALIFICATION

12th FLOOR S
1400 L STREET, N.W.
WASHINGTON, D.C. 20005-3502

TELEPHONE (202) 371-5700

66 FR 51479
10/9/01
(3)

December 14, 2001

Annette L. Vietti-Cook
Secretary of the Commission
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

ATTENTION: Rulemakings and Adjudications Staff

SUBJECT: Nuclear Utility Group on Equipment Qualification - Comments Concerning Draft NRC Regulatory Guidance on "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety in Nuclear Power Plants" (66 Fed. Reg. 51,479 (2001))

Dear Ms. Vietti-Cook:

We appreciate the opportunity to comment on the subject draft regulatory guide concerning environmental qualification of microprocessor-based equipment. On behalf of the

Template = ADM-013

E-RIDS = ADM-03
Add = A. Berarek (AFB)
C. Antonescu (CEA1)

Nuclear Utility Group on Equipment Qualification ("NUGEQ" or "Group"),[1] we submit the attached comments in response to the referenced request for comments. Our principal comment is that the draft regulatory guide is unnecessary and unwarranted because NRC regulations and regulatory guidance already adequately address environmental qualification of digital equipment. Further, the draft guide reflects many positions that are new and inconsistent with the current regulatory processes in this area (e.g., expanding the scope of 10 C.F.R. § 50.49 to apply to equipment in mild environments). Implementation of this guide would serve only to cause regulatory confusion. We recommend, therefore, that the NRC not issue, in final form, the draft regulatory guide.

In the event the NRC elects, nonetheless, to issue the final regulatory guide, we have made several suggestions concerning changes we believe would be necessary to more accurately reflect the regulatory requirements related to environmental qualification. In any event, in view of the numerous new staff positions – and inconsistencies with both existing regulations and NRC guidance for implementing the applicable regulations – we believe that, without substantial revisions to the draft, a final regulatory guide could not be issued absent rulemaking and, in any case, performance of a backfitting analysis of the new staff positions in accordance with 10 C.F.R. § 50.109.

Finally, we strongly disagree with the Staff's assertion that it may apply, without a backfitting analysis, the guidance to "operating reactor licensees who propose system modifications, voluntarily initiated by the licensee, if there is a clear connection between the proposed modifications and the guidance" (see DG-1077, Section D, "Implementation"). To the contrary, imposing the new staff positions included in the draft regulatory guide to currently operating reactors represents a backfit. Indeed, licensees may continue to meet a plant's current licensing and design basis, even when making system modifications, unless the NRC imposes the guidance with the appropriate supporting backfitting analysis. Thus, the NRC must perform a backfitting analysis should it choose to issue and apply the final regulatory guide as stated.

Again, we appreciate the opportunity to comment. Please contact us if you have any questions regarding our comments.

Sincerely,

---

[1] The NUGEQ is comprised of member electric utilities in the United States and Canada, including NRC licensees authorized to operate over 90 nuclear power reactors in the United States. The NUGEQ was formed in 1981 to address and monitor topics and issues related to equipment qualification, particularly with respect to the environmental qualification of electrical equipment pursuant to 10 C.F.R. § 50.49.

Original signed by William A. Horin

William A. Horin

Patricia L. Campbell

Counsel to the Nuclear Utility Group on Equipment Qualification

Attachment

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

General Comments

1. **The draft guide as presently structured will create confusion and does not improve the overall review and approval process for digital devices.** According to SECY-01-0155, the draft guide was developed as part of the NRC Research Plan for Digital Instrumentation and Control ("I&C"). That plan indicates that short-term efforts, such as the draft guide, were intended to focus on improving efficiency in the technical review process.[1] Our review of the draft guide indicates that it does not meet this objective. Instead, it creates confusion in what have become stable regulatory review processes for harsh environmental qualification (10 C.F.R. § 50.49) and digital systems (NUREG-0800, "Standard Review Plan," Section 7, including Appendices 7.1-B and 7.1-C[2]). Consequently, the guide should not be issued in its present form. For the reasons described below, the draft regulatory guide, if issued, must be revised based on a review that establishes consistency with existing regulations, guidance, and practices for digital systems and environmental qualification.

It appears that the guide is based solely on the results of several digital research projects, including academic reviews and comparisons of two environmental qualification standards, IEEE 323 (1983) and IEC 60780.[3] Neither the draft guide nor its referenced NUREG research reports examine the adequacy of current regulatory practices – let alone find them to be lacking – for environmental qualification or the review/acceptance of safety-related digital I&C equipment. Instead the limited regulatory analysis in the draft guide appears to assume some problem with the current regulatory scheme in this area. We consider this a significant oversight in the underlying regulatory analysis because practices in both areas appear to be stable, well defined, and technically appropriate.

The NRC's Office of Nuclear Reactor Regulation ("NRR") and the nuclear industry have expended significant efforts to design, qualify, review, and license digital safety-related equipment over the past several decades. In addition to several successful licensing efforts, the lessons learned from these efforts have been incorporated into SRP Section 7. More

---

1 According to SECY-01-0155, "NRC Research Plan for Digital Instrumentation and Control (I&C)," August 15, 2001, development of the draft guide is Task 3.2.3, "Complete Environmental Qualification Guidelines."

2 Appendix 7.1-B, "Guidance for Evaluation of Conformance to ANSI/IEEE Std. 279," and Appendix 7.1-C, "Guidance for Evaluation of Conformance to IEEE Std. 603" (hereinafter "7.1-B" and "7.1-C").

3 Neither of these standards is currently part of the regulatory scheme for environmental qualification.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

recently, there have been significant and successful efforts on the part of EPRI and various digital system vendors to develop and implement methodologies, including environmental qualification, for acceptance of digital I&C safety systems.[1] In fact, NRR has recently expended significant resources reviewing submittals and issuing SERs for several of these digital systems. Our review of the draft regulatory guide suggests that neither these efforts nor existing guidance documents were adequately evaluated during development of the draft guide and, thus, there is no demonstrated need for additional guidance in this area.

Similarly, the NRC and the nuclear industry have considerable experience establishing compliance with the requirements of 10 C.F.R. § 50.49 for electrical equipment located in harsh environments. Several NRC guidance documents, including Regulatory Guide 1.89,[2] NUREG-0588,[3] and NUREG-0800, Section 3.11, "Environmental Design of Mechanical and Electrical Equipment," provide additional clarifying information regarding environmental qualification for both harsh and mild environments.[4] In addition to licensee specific efforts, the NRC has also issued SERs accepting the environmental qualification programs of several vendors (e.g., Westinghouse) for both existing plants and advanced reactors. Our review of the draft regulatory guide suggests that existing practice and guidance documents were not adequately considered during development of the draft guide.

---

1 See, e.g., the following three EPRI reports for licensing of programmable logic controllers (PLC) safety systems and the associated NRC SERs – TR-114017 (TELEPERMXS), TR-110045 (COMMONQ), and 1000799 (TRICON).

2 RG-1.89, "Environmental Qualification of Certain Electrical Equipment Important to Safety for Nuclear Power Plants," Rev. 1 (March 1984).

3 NUREG-0588, "Interim Staff Position on Environmental Qualification of Safety-Related Electrical Equipment," Rev. 1 (July 1, 1981).

4 Practices acceptable to the NRC for establishing environmental qualification for equipment in mild environments are identified in NUREG-0800, Section 3.11, and in the statements of consideration accompanying 10 C.F.R. § 50.49. In summary, the application of other regulations, such as 10 C.F.R. Part 50, Appendix B, are sufficient to ensure adequate performance of electrical equipment important to safety located in mild environments and the provisions of 10 C.F.R. § 50.49 do not apply. Further, a design/purchase specification containing functional and normal/abnormal environmental descriptions, coupled with the application of quality controls (including the provisions of 10 C.F.R. Part 50, Appendix B, as appropriate), is sufficient documentation to demonstrate environmental qualification for mild environments.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

2. The draft guide should be withdrawn and appropriate insights from the digital research program issued as a Regulatory Information Summary ("RIS"). As enumerated in other specific comments, the draft guide often conflicts with existing regulatory practice and the basis for its conclusions appears limited to the results of several research projects. Absent a review of the adequacy of existing regulatory practices for either environmental qualification or digital system licensing, and a finding of some deficiency therein, the research results are more appropriately described in an RIS or similar communication vehicle "for licensee information" rather than in a regulatory guide. Based on the draft guide and NUREG/CR-6406, "Environmental Testing of an Experimental Digital Safety Channel" (Sept. 1, 1996), the research results that could be described in the RIS include:

- A conclusion that both the IEEE 323 (1983)[1] and IEC 60780[2] standards describe equivalent qualification concepts and processes and are an adequate basis for establishing environmental qualification of electrical equipment in conformance with existing NRC regulations and NRC guidance documents.[3]
- Design guidance regarding component selection, and circuit board, module, rack, and system design considerations that can be used to "build-in" tolerance to certain environmental stressors.
- Results of temperature/humidity tests on prototypical digital modules which suggest that the combination of high humidity and high temperature may generate digital system errors at conditions below the published equipment limits for some digital devices.
- Results of smoke exposure investigations, including the benefits of conformal coatings and chip packaging to minimize potential degradation and failure.

---

[1] IEEE 323, "Standard for Qualifying Class 1E Equipment for Nuclear Power Generating Stations," Institute of Electrical and Electronics Engineers, 1983.

[2] IEC 60780, "Nuclear Power Plants – Electrical Equipment of the Safety System – Qualification," International Electrotechnical Commission, 1998.

[3] NUREG/CR-6479, "Technical Basis for Environmental Qualification of Microprocessor-Based Safety-Related Equipment in Nuclear Power Plants," January 1998, compares IEEE 323-1974 and IEEE 323-1983 and concludes that the 1983 version is adequate for applicability. Similarly, NUREG/CR-6741, "Application of Microprocessor-Based Equipment in Nuclear Power Plants – Technical Basis for a Qualification Methodology" (Draft Report for Comment), August 2001, concludes that both IEEE 323-1983 and IEC 60780 are appropriate for establishing environmental qualification.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

- An observation that aging "does not appear to pose a significant design concern for digital systems in mild environments because the equipment is accessible for monitoring, calibration, and replacement" and can be "assumed to have like-new performance."[1]

The RIS, after an appropriate review of existing regulatory guidance documents and ongoing practices, could also affirm the adequacy of applying existing environmental qualification guidance to digital systems and equipment.

Specific Comments on "Discussion" Section of Draft Regulatory Guide

3. Discussion (4th paragraph) incorrectly suggests that EMI/RFI is a significant aging mechanism per 10 C.F.R. § 50.49(e)(5): EMI/RFI is not a significant aging mechanism and consequently need not be included in the environmental qualification testing sequence as part of preconditioning. The NRC does not provide references or a technical basis for this conclusion. In addition, we are unaware of information suggesting that EMI/RFI is a significant aging mechanism. According to IEEE 323 (1983) a significant aging mechanism is one that "causes degradation during the installed life of the equipment that progressively and appreciably renders the equipment vulnerable to failures to perform its safety function under DBE conditions." EMI/RFI can cause failures to inappropriately designed equipment, but such effects do not render the equipment, particularly equipment located in mild environments, vulnerable to failure during accidents. Consequently, while testing for EMI/RFI susceptibility is appropriate to demonstrate equipment capability and tolerance, it need not be performed as part of the environmental qualification testing sequence.

4. Discussion (4th paragraph) incorrectly suggests that "accumulation of deposits" is a significant aging mechanism per 10 C.F.R. § 50.49(e)(5): The draft guide does not provide references or a technical basis for this conclusion. It would appear that these "deposits" are in reference to fire and smoke effects. It is inappropriate to assume that any safety-related digital equipment exposed to such fire and smoke effects would then be placed back in service without repair or replacement. Consequently, it is unclear how such deposits are considered significant aging mechanisms, as that term is applied in the existing regulatory scheme. In addition, like existing analog designs, digital devices in harsh environments would have their circuitry protected from direct exposure to LOCA or HELB steam conditions. Such protection would similarly protect the circuitry from smoke/deposit effects.

5. Discussion beginning at the 5th paragraph inappropriately uses two "significant differences" between analog and digital systems as a basis for proposing a different

---

[1] See NUREG/CR-6406, p. 7.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

environmental qualification approach for digital equipment. There is general agreement with the guide's observation that the use of computers in safety systems poses challenges different from those of analog systems. However, these differences are not relevant to the overall process of establishing environmental qualification of this equipment for harsh or mild environments. These differences are relevant to the digital design process and the methods used to qualify the design (e.g., software qualification and verification/validation). This perspective is consistent with the information in SRP Section 7, including referenced regulatory guides, IEEE standards, as well as ongoing industry/NRC efforts to license digital safety systems.

The draft guide identifies two "significant" differences between analog and digital systems that "suggest a different approach to qualification for digital instrumentation and control (I&C) safety systems".[1] We disagree with this assessment. Regarding metal oxide semiconductors ("MOS") radiation tolerance, several NRC documents, including Regulatory Guide 1.89 (Section B, "Discussion"), already caution that MOSs have experienced failures at doses below 10^4 rads.[2] Importantly, MOS technology is not unique to digital devices or systems. The vast majority of integrated circuits used in analog devices use MOS technology. Existing qualification guidance already cautions that devices exposed to low-level radiation doses should not be considered exempt from radiation qualification unless analysis supported by test data establishes operability at these levels.[3] There is broad industry recognition that commercial MOS technologies can have degradation thresholds as low as 10^3 rads.[4] Given these considerations, existing guidance and practices regarding radiation qualification appear to be adequate and a different approach is not warranted.

---

1 The first difference is the low threshold radiation level for metal oxide semiconductor ("MOS") devices and the second is the rapid evolution of digital technology (increasing density and complexity).

2 Even the DOR Guidelines identifies radiation susceptibility for MOS technology at levels of 10^3 to 10^4 rads.

3 See, e.g., NUREG-0588, ¶ 1.4(12).

4 See, e.g., the EPRI EQ Reference Manual, "Effects of Radiation on Semiconductors" p. 3-11, and the referenced biblographical compilations: NUREG/CR-3156, "A Survey of the State-of-the-Art in Aging of Electronics With Application to Nuclear Power Plant Instrumentation" (Sandia National Laboratories, April 1983), and "Bibliography of Total Dose Radiation Effects on Electronics" (National Aeronautics and Space Administration Jet Propulsion Laboratory, California Institute of Technology, JPL D-2817, Vols. 1-3, October 15, 1985).

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

Regarding the rapid evolution of digital technology, system/component reliability analyses and the associated digital design and component selection practices necessitate the conservative design, manufacture, and application of digital components within their published capabilities. Component manufacturers establish these capabilities based on extensive device testing in accordance with their quality assurance programs. Although the digital technologies have evolved more rapidly than other technologies, the manufacturing and quality practices, including stress-screening tests, demonstrate a level of device reliability and performance rarely achieved by other technologies. These activities are appropriately part of design verification and quality practices and should not be considered as elements of an environmental qualification program. Consequently, evolution of digital technology is not an appropriate basis suggesting a different environmental qualification approach for digital technology.

6. **Discussion (9th paragraph): The NUREG/CR-6406 results are based on experimental apparatus that do not reflect derating and conservative design practices.** We generally agree that it is inappropriate to assume that components will always accurately function at their maximum design conditions. However, conservative design practices for digital safety systems dictate that component selection and module/circuit board design should be conservative to ensure reliable performance at environmental extremes. When design practices are not sufficiently conservative, then testing at the environmental extremes plus margin should be used to demonstrate performance. The use of either conservative design practices or system environmental tests is consistent with existing guidance in SRP Section 7 (see ¶ 7.1-B 6 and ¶ 7.1-C 10). Finally, regarding the NUREG/CR-6406 test results, the report also observes that high relative humidity ("RH") conditions are not likely in a controlled environment such as a control room.[1]

7. **Discussion (10th paragraph): The proposed three environmental categories are inconsistent with existing regulations and guidance, are unnecessary, and lack a cited technical basis.** Based on several regulatory positions in draft guide Section C, equipment in the suggested "Category A" would be qualified in accordance with 10 C.F.R. § 50.49 and Regulatory Guide 1.89. This is an inappropriate expansion of the intended scope of 10 C.F.R. § 50.49 and does not meet its criteria for equipment in a harsh environment. As noted in Comment 11, Category A is inconsistent with the scope criteria in 10 C.F.R. § 50.49. Further, based on the limits of Category B, Category A would include all digital equipment satisfying any of the following:

- normal (including anticipated operational occurrence) operating temperatures in excess of 38°C,
- normal operating relative humidity in excess of 80%, or

---

[1] NUREG/CR-6406, p. 100.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

- normal plus accident integrated radiation dose in excess of 10^4 rad.

Regarding temperature, there is no cited basis for the 38°C limit. While conservative component selection and design practices should be used to establish equipment temperature limits, dogmatic application of a 38°C limit is inappropriate. This is particularly true for safety-related equipment designed for substantially higher operating temperatures with supporting prototype or production test data. The 80% RH criterion is similarly inappropriate and without basis, particularly for safety-related equipment designed for substantially higher RH levels with supporting prototype or production test data.

Equipment exposed to radiation levels in excess of 10^4 rad during normal operation need not be included in the scope of 10 C.F.R. § 50.49. Adequate assurance of performance during normal operation for such equipment can be achieved by the conservative application of radiation-hardened MOS technologies combined with circuit analysis. The provisions of 10 C.F.R. § 50.49 apply only when accident conditions are significantly different than normal.[1] The basis for this distinction recognizes the capabilities of surveillance and operating testing to identify degradation during normal conditions to minimize common-mode failures for equipment appropriately designed for the specified service conditions. Since this capability is not available during accidents, qualification in accordance with 10 C.F.R. § 50.49 provides reasonable assurance of operability for accident conditions that are significantly different than normal conditions.[2]

Regarding Categories B and C, the 400 rad limit is without basis and substantially below the generally recognized damage threshold (1000 rad) for the least capable CMOS [complementary metal oxide semiconductor] devices.[3] Further, the 40-year time duration is unnecessary since semiconductor damage is related to integrated dose and not whether the dose occurs over 10, 40, or 60 years. The only other difference between these categories is

---

1 10 C.F.R. § 50.49(c) states: "Requirements for ... (3) environmental qualification of electric equipment important to safety located in a mild environment are not included within the scope of this section. A mild environment is an environment that would at no time be significantly more severe than the environment that would occur during normal plant operation, including anticipated operational occurrences."

2 See EPRI EQ Reference Manual, Section 5.2, "Mild-Environment Qualification," and Section 5.7, "Distinguishing Mile and Harsh Environments," for additional information concerning the basis for qualification differences for equipment in mild and harsh environments.

3 See Comment 5.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

the accident service temperature (38°C for Category C and 90% of maximum rated temperature for Category B). As noted above, this 38°C limit is inappropriate.

Specific Comments on "Regulatory Position" Section of Draft Regulatory Guide

8. **We agree that either IEEE 323 (1983) or IEC 60780 is appropriate for satisfying the environmental qualification of safety-related equipment.** The draft guide limits its endorsement of these two standards to microprocessor based equipment. The general concepts in these standards, however, were intended to apply to all types of electrical and electromechanical equipment. The NRC should consider endorsing the standards more broadly. The IEEE has twice reaffirmed the 1983 version and continues to state that the 1983 version was issued to clarify the requirements and it imposes no additional requirements for qualifying Class 1E equipment. Further, the provisions of the 1983 version appear fully consistent with current regulatory practice regarding compliance with 10 C.F.R. § 50.49 and extension of qualified life. Consequently, we suggest that the NRC recognize the acceptability of IEEE 323 (1983). Since the NRC-sponsored evaluation concludes that IEEE 323 (1983) and IEC 60780 are essentially equivalent, it would seem appropriate to also recognize the adequacy of the IEC standard for achieving compliance with 10 C.F.R. § 50.49.

9. **Regulatory Position 1 is redundant to existing guidance and is unnecessary.** SRP Section 7, specifically ¶ 7.1-B 6 and ¶ 7.1-C 10, specifies that tests on components, racks and panels "as a whole" demonstrate adequate performance over the range of transient and steady-state conditions for the environment and energy supply. Section 7 also permits the use of a confirmed conservative design for the range of conditions in lieu of testing (see ¶ 7.1-B 6 and ¶ 7.1-C 10). This regulatory position should be deleted.

10. **Regulatory Position 2 is unnecessary and could cause confusion.** Regulatory Guide 1.180[1] and SRP Section 7 currently identify the need to perform EMI/RFI testing and identify acceptable methods of qualifying equipment for these conditions. Such testing for digital systems is specified by Regulatory Guide 1.180, IEEE 7-4.3.2, and various EPRI

---

[1] RG 1.180, "Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems," January 2000.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

reports concerning qualifying digital safety systems.[1] No further guidance regarding the use of Regulatory Guide 1.180 is needed.

This draft guide creates confusion when it inappropriately specifies that EMI/RFI testing be performed as part of the environmental qualification test sequence. This is not common practice and is inappropriate and unnecessary. Further, when digital equipment is tested for EMI/RFI, the module/rack/system configuration appropriate to demonstrate EMI/RFI tolerance may not necessarily be the appropriate (i.e., limiting) configuration to demonstrate temperature/humidity or seismic capability. Requiring sequential tests forces unnecessary compromises when specifying the prototype system to be tested (see Comment 3 regarding EMI/RFI as an aging mechanism). Finally, this testing demonstrates tolerance of the design to EMI/RFI, which is not an environmental condition. The regulatory position should either be deleted or limited to a simple reference to Regulatory Guide 1.180.

11. Regulatory Position 3 is inconsistent with 10 C.F.R. § 50.49 based on the definition of Category A locations. 10 C.F.R. § 50.49 is the governing regulation for harsh environment qualification. According to 50.49(c), a harsh environment (i.e., non-mild) is an environment that is significantly more severe than the environment occurring during normal plant operation, including anticipated operational occurrences. Draft guide DG-1077 has established Category A conditions without regard to the "significantly more severe" criterion. Further, technical bases are not provided for the proposed Category A radiation, temperature, and humidity limits. For harsh environment equipment, 50.49(e)(5) contains criteria regarding qualified life (or "end-of-installed life") and preconditioning by natural or artificial aging. A qualified life is not required by regulations or existing staff guidance for equipment in a mild environment. For mild environments, equipment design, component selection, and controlled environmental conditions (e.g., HVAC) preclude significant environmental aging mechanisms. We suggested the following revision to Regulatory Position 3:

> 3. 10 C.F.R. § 50.49 requires preconditioning to an end-of-life condition for harsh environment equipment, including microprocessor-based equipment, qualified by sequential type tests. Preconditioning (accelerated aging) may be applied in accordance with IEEE 323-1983 or IEC 60780-1998, depending on the standard being applied. In addition, the enumerated exceptions and clarifications in Regulatory Guide 1.89 apply.

---

[1] See, e.g., previously referenced EPRI reports on specific PLCs (supra n. 4), as well as these other NRC-reviewed reports: TR-107330, "Generic Requirements Specification for Qualifying a Commercially Available PLC for Safety-Related Applications in Nuclear Power Plants," and TR-1001045, "Guideline on the Use of Pre-Qualified Digital Platforms for Safety and Non-Safety Applications in Nuclear Power Plants."

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

12. Regulatory Positions 4 and 5 are inconsistent with existing regulations and guidance based on the draft Category B and C criteria. Generic practices acceptable to the NRC for establishing environmental qualification for electrical equipment in mild (i.e., non-harsh) environments are identified in NUREG-0800, Section 3.11, "Environmental Design of Mechanical and Electrical Equipment," and in the Statement of Considerations accompanying 10 C.F.R. § 50.49.[1] Additional guidance for digital systems is provided in NUREG-0800, Section 7, specifically ¶ 7.1-B and ¶ 7.1-C. The applicable sections for equipment qualification (¶ 7.1-B 5 and ¶ 7.1-C 9) and for channel/system integrity (¶ 7.1-B-6 and ¶ 7.1-C 10) are consistent with the generic practices for mild environment equipment. In summary:

- Current regulations, such as 10 C.F.R. Part 50, Appendix B, are sufficient to ensure adequate performance of electrical equipment important to safety located in mild environments and the provisions of 10 C.F.R. § 50.49 do not apply.
- A design/purchase specification containing functional and normal/abnormal environmental descriptions, along with certification to the specification, is sufficient documentation to demonstrate environmental qualification for mild environments.
- Mild environment qualification should conform to IEEE 323.[2]
- System/component tests should demonstrate that performance is adequate over the range of electrical and environmental conditions or other information should confirm that the system/components are conservatively designed to operate over the range of service conditions.

DG-1077 apparently establishes Category B and C conditions without regard to the existing regulatory guidance and industry practice. Further, technical bases are not provided for the proposed Category B and C radiation, temperature, and humidity limits. The draft guide should be revised to be consistent with existing regulatory practice.

Regulatory Positions 4 and 5 should be deleted or revised. If the positions are revised, the following text is suggested:

> 4. For microprocessor-based equipment in a mild environment, qualification may be demonstrated by specifying equipment operation under normal, abnormal, and accident service environments that are conservatively

---

[1] 48 Fed. Reg. 2,729 (1983). See NRC response to Comment 3, Scope – Equipment in a Mild Environment – Paragraph 50.49(b).

[2] IEEE 323 (1983), Section 8.6, identifies documentation guidance for mild environment equipment and is consistent with the above regulatory guidance.

within the manufacturer's specified operating service environment. Applicable quality assurance programs require an adequate technical basis, including tests, for the specified service environment. Preconditioning is not required.

For equipment that is operated outside the manufacturer's specified operating service environment, qualification should be based on testing for the required range of environmental conditions plus margin. The need for preconditioning should be based on an assessment of environmental factors to identify aging mechanisms that may significantly contribute to common-mode failures at the tested conditions. Preconditioning is not required if accident conditions are not significantly different than normal operating conditions.

13. Regulatory Position 6 concerning margin is unnecessary and could cause confusion. Regulatory Guide 1.89, which endorses IEEE 323, contains adequate regulatory guidance in Position C.4 regarding margin for accident environmental testing. Further clarification regarding saturated/superheated temperature margin is unnecessary and may create unnecessary confusion.[1] Regarding mild environments, testing margin need not conform to the IEEE 323 "accident" margin recommendations, which were developed for LOCA and HELB accident conditions. This position should be deleted.

14. Regulatory Position 7 concerning life-limited components is unnecessary and could cause confusion. This guidance is unnecessary since no unique characteristics of digital devices/systems suggest component analysis and periodic maintenance/replacement evaluation methods should differ for analog and digital systems. Further, such activities are typically focused on operational duration (i.e., installed life) and not on "shelf life". Existing guidance regarding harsh environment devices requires the identification and scheduled replacement of life limiting components. For mild environment digital devices, the conservative design practices necessary to achieve high reliability, coupled with sophisticated self-diagnostic and self-test schemes and performance monitoring, maintain high availability and are not considered part of environmental qualification. This position should be deleted.

15. The environmental stress screening tests identified in Regulatory Position 8 are not part of environmental qualification. These stress-screening tests do not replicate operating conditions, but are intended to reveal failure modes and mechanisms under accelerated stress conditions. The regulatory position appropriately characterizes these tests as providing evidence of quality processes. They are not, however, environmental

---

[1] The standards permit a smaller temperature margin under saturation LOCA/HELB steam conditions in order to prevent excessive test pressures.

qualification tests, since they do not represent operational conditions. Along with numerous other considerations, these tests provide useful information for system/module designers in selecting components and manufacturers with proven reliability and capability. Such tests are not unique to digital integrated circuits. Similar tests are employed for analog devices and other components (e.g., capacitors, connectors) in both digital and analog circuits. The "component" qualification suggested by this regulatory position is inconsistent with the "equipment/system" environmental qualification practices for other types of equipment. This position should be deleted.

16. **The multi-tiered "protection" approach identified in Regulatory Position 9 is not part of environmental qualification.** This draft regulatory position provides design recommendations that, while reflecting elements of good design practice, are not elements of environmental qualification. Except for the referenced Regulatory Position 8 and stress screening tests discussed in ¶ 9.1, none of this guidance establishes measurable characteristics or criteria. Such guidance is open to broad interpretation and, thus, is inappropriate as a regulatory position. Furthermore, rigidly implementing portions of this guidance, in lieu of other methods to achieve equivalent or enhanced capabilities, may be counterproductive to the overall design process. Such micromanagement of the design process is inappropriate and not an efficient utilization of either NRC or industry resources. This position and the associated Figure 1 should be deleted.

17. **The guidance in Regulatory Position 10 does not relate to environmental qualification.** In addition to being inappropriate in an equipment qualification regulatory guide, this guidance is redundant to the more detailed information contained in SRP Section 7. In particular Branch Technical Position [NRR Instrumentation and Controls Branch] HICB-17, "Guidance on Self-Test and Surveillance Test Provisions," contains more appropriate and detailed guidance and criteria including specific information on topics such as failure detection, self-test features, periodic testing, and actions on failure detection. This position should be deleted.

Specific Comments on "Regulatory Analysis" Section of Draft Regulatory Guide

18. **The regulatory analysis fails to identify the problems requiring issuance of this regulatory guide.** The "Problem" discussion incorrectly states that "existing guidance does not specifically address the so-call mild environment" and "there is a recognized need to address the full scope of 10 CFR § 50.49." Both statements reflect a misunderstanding of existing regulatory guidance regarding digital equipment in mild environments and the regulatory basis for 10 C.F.R. § 50.49. A reasoned review of existing regulatory guidance, licensee submittals, and NRR review practices for the licensing of digital system would indicate that the overall process is adequate to ensure environmental qualification of these digital systems.

Nuclear Utility Group on Equipment Qualification
Comments on Draft Regulatory Guide DG-1077
(December 14, 2001)

19. The "Take No Action" alternative incorrectly presumes important deficiencies in the existing review process for digital systems and an absence of adequate guidance (see prior Comments 1, 2, and 18). The alternative also incorrectly assumes that without additional guidance NRR review efforts will increase and there could be less consistency among reviewers. As noted in prior comments, there currently is a stable regulatory environment with respect to the licensing of digital systems. The draft guide introduces concepts and guidance, such as the three environmental categories, and EMI/RFI as an aging mechanism, that will produce instability and confusion rather than enhance the licensing process. A reasoned review of existing regulatory guidance, licensee submittals, and NRR review practices for the licensing of digital system will find that the overall process is adequate to ensure environmental qualification of these digital systems.

20. The "Enhance Current Qualification Approaches" option, based on three environmental categories (A, B, and C) is inconsistent with current regulatory guidance for harsh and mild environment qualification and is unnecessary. See Comments 7, 11, and 12.

MPR ASSOCIATES INC
ENGINEERS

66FR51479
10/9/01
(4)

December 14, 2001

Ms. C. E. Antonescu
Rules and Directives Branch
Office of Administration, U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: Comments on NRC Draft Regulatory Guide DG-1077, "Guidelines for Environmental Qualification of Microprocessor-Based Equipment Important to Safety in Nuclear Power Plants"

Dear Ms. Antonescu:

Below please find comments from MPR Associates, Inc. on the subject draft regulatory guide.

- The draft guide states in the Discussion section (page 3, paragraph 4) that for the purposes of this guide, "qualification" is a verification... under the most limiting environmental stresses that can result from design basis accidents. There are a number of areas in nuclear plants whose environment does not change with design basis accidents. However, the location categories (A, B, and C) do not limit the applicability of the guide to those areas with environmental stresses that can result from design basis accidents. The draft guide should redefine the categories to be consistent with the Discussion section.

- Subparagraph 3 of Section C, Regulatory Position, states that IEEE 323 requires a qualified life for microprocessor-based equipment in a Category A environment. IEEE 323 does not use such terminology. The Guide should be revised. IEEE 323 is consistent with the words in the Discussion section of the draft guide, and addresses qualification for "harsh environments" (i.e., environmental stresses that can result from design basis accidents).

- The existing Harsh and Mild equipment qualification categories do not map into the three newly provided categories. The draft guide should define a method that utilities can use to comply with the new guidance, short of a complete re-evaluation of all currently qualified equipment and re-mapping the existing nuclear plants.

Template = ADM-013

E-RIDS = ADM-03
Add = A. Beranek (A1=13)

320 KING STREET ALEXANDRIA, VA 22314-3230 703-519-0200 FAX: 703-519-0224 http:\\www.mpr.com

C. Antonescu (CEA1)

- There is no basis provided for the use of 400 Rads or 10,000 Rads for equipment qualification for Categories B and C.

- We note that experience shows that MOS semiconductor structures start failing at around 1000 Rads integrated gamma dose to the silicon. This failure mechanism fits well with the current definition used by the nuclear industry for a mild environment, which yields a 40-year exposure of about 1000 Rads. We believe that obsolescence will continue to force digital component replacements about every 15 to 20 years, which invalidates any requirement for a 40-year qualified life.

- Modern analog devices also are built from MOS technologies, and are subject to the same radiation-induced failure mechanisms. However, DG-1077 is applicable only to digital devices. The USNRC should provide consistent regulatory guidnace for the use of MOS technology, whether in digital or analog designs.

- DG-1077 provides several interesting observations about water damage. We note that most of the issues with water damage result from water falling from floors above or pipe breaks above the equipment. Guidance should be provided for water resistance on cabinet tops and ventilation slots in cabinet tops, sides, and doors.

- In the definitions for Category B and C devices, we note several inconsistencies and missing definitions, which should be resolved:

  - The RG defines two different conditions for temperature limits for qualification. The RG fails to define where these temperatures apply, e.g. outside the cabinets, at the top or bottom inside the cabinet, at the board, within the semiconductors, etc.

  - The RG defines an expected total integrated gamma dose for normal conditions; however, no definition is provided for accident or abnormal conditions.

  - The RG defines normal conditions as having temperatures less than 100 °F and relative humidity less than 80%. These are not consistent with many nuclear facilities, where normal conditions are defined as 120 °F and 95% relative humidity, non-condensing. Further, there appears to be no basis for forcing modifications in safety-related HVAC systems to support this more restrictive definition of normal conditions.

  - For Category B, the RG defines abnormal and accident conditions the same as normal conditions. As noted above, many nuclear facilities cannot maintain the "normal conditions" defined in the RG during accident and abnormal conditions. Rather, the conditions are limited to 120 °F and 95% relative humidity, non-condensing. There appears to be no basis for forcing modifications in safety-related HVAC systems to support these tighter conditions.

  - For Category C, the RG defines abnormal and accident condition temperatures as being limited to less than 90% of the manufacturer's maximum temperature limits and 95%

relative humidity. We are concerned that without precise definition of the location of the measured temperature, the conditions specified may exceed the chip capability. This would be especially true if integrated circuits are installed in tightly sealed enclosures.

- For Category B, the RG defines a total integrated dose of 10,000 Rads to the silicon. Unless the digital devices are implemented in radiation hardened integrated circuits, standard commercial devices will not withstand that level of radiation. In order to assure that the digital devices would survive this exposure level, about an inch of lead or two inches of steel would be required for shielding.

- We conclude that the guidelines provided in this section are applicable and targeted to new designs, built especially for nuclear use. However, we note that with the exception of some specialized analog replacement devices being designed now, no plant licensee is requesting special nuclear-only digital designs. Thus, we question the utility of this section.

- Most (if not all) of the digital devices that are being installed in nuclear plants are commercial-off-the-shelf designs. Most of them do employ solder masks, thus following the guidance provided in this RG. We have not seen many commercial devices with conformal coating. Conformal coating is a technique usually reserved for military equipment, or equipment that is designed to be used in high humidity environments. We are not likely to find conformal coating on most equipment. Most design engineers would also state that conformal coating provides a greater resistance to heat flow, and thus would require lower temperature limits than those provided herein.

- The RG establishes a new and quite rigorous approach to qualification of components. The RG appears to ask us to credit the commercial integrated circuit vendor's integrated circuit testing for commercial dedication of these devices. But, in order to accept this credit, the licensee will need to make use of currently existing guidance for commercial grade dedication. The industry and the NRC use EPRI NP-5652, "Guideline for the Utilization of Commercial Grade Items in Nuclear Safety Related Applications," for means and methods for acceptance of vendor testing, such as the vendor testing that the RG credits. However, application of EPRI NP-5652 Acceptance Method 2, Commercial Grade Survey of Supplier in Conjunction with a Certificate of Conformance, has always required a quality audit by QA certified inspectors. The EPRI report strongly discouraged use of such surveys when components pass through distributors, which is possible for any COTS integrated circuits. The EPRI report then has the utility incorporate the approved vendors into the Approved Vendor List at the accepting utility. Most utilities then require a Certificate of Conformance for the items. COTS equipment and normal commercial manufacturing practices makes achieving these goals unlikely. The DG must establish methods of qualification that the licensees can implement. The following list of questions must be clarified in the RG.

- Does inclusion of this requirement in this DG require the utilities, or some group such as NUPIC or NPIC, to audit all of the integrated circuit manufacturers, place them on their AVL, and continue to audit them forever?

- Does inclusion of this requirement mean that the utilities are expected to open COTS equipment (voiding the warranty), inventory the integrated circuits, return to the equipment vendor and/or manufacturer, find any traceability maintained by the equipment vendor and/or manufacturer, and then start the process of reviewing lot records for each integrated circuit lot from all the vendors used in this device?

- For purposes of this RG, do the devices characterized as "integrated circuits" include integrated resistor and capacitor packages, or did you intend to restrict the term to only packages containing active devices?

- For purposes of this RG, do we, the licensees, need to perform this review function on chips performing analog functions, or should these requirements be limited only to digital devices? Should mixed function devices, such as analog to digital converters and digital potentiometers, be included in this review?

- We question the ability of any utility to assure this traceability and perform the mandated audits on COTS equipment. This activity would have to be performed after the device is received, so there is no chance of implementing Acceptance Method 3, Source Verification, for the integrated circuits.

- We question the need for this activity, based on purchase of qualified devices, which the vendor assures us are built from commercially dedicated devices or assemblies already subjected to an EPRI-5654 compliant process, which the NRC has earlier accepted.

- In general, we question the value of this section, based on the ideas that we are either purchasing equipment from a 10 CFR 50 Appendix B vendor program or commercially dedicated through a 10 CFR 50 Appendix B program. In either case, commercially procured items, including integrated circuits, will have been processed through an EPRI NP-5654 compliant program, or equivalent. We fail to see the value added by repeating this requirement in this RG.

- "First, qualification should begin at the IC manufacturing level... built in quality can be enhanced by ensuring, among other process control methodologies, a minimum of stress tests and a guarantee of correct operation in a specified environment." These tests by the manufacturer "guarantee" nothing; rather, they MINIMIZE the likelihood of failure.

- Clarification is required for the statement "Despite these qualification stress tests at the IC component level, tests documented in NUREG/CR-6406 show that at high relative humidity, digital equipment can fail at temperatures considerably below (the) manufacturer's maximum

operating limit. Thus, (the) manufacturer's ratings alone cannot be relied upon to guarantee reliable operation under abnormal and accident nuclear power plant environments."

- The statement is ambiguous. One reading would assure us that the vendor's specifications can not be believed or trusted, since elevated temperature and humidity testing fails at levels significantly below the manufacturer's specifications. A more benign reading would be that integrated circuits fail no matter what the temperature or humidity. Other interpretations are possible. The DG should be clarified to clearly convey the requirement.

- We question the use of the word "guarantee" since not even the integrated circuit manufacturer will guarantee that their equipment does not fail. In fact, their specifications and ratings are based on the idea that staying within the ratings will maintain the failure rates at their specified levels; in other words, use outside their ratings will increase failure rates. Again, we suggest that the RG be clarified.

- In Section C, Item 10, page 9, the elements mentioned are methods of addressing random failures. We would suggest adding guidance that a visible, easily observed method for annunciating these failures to Operations, Maintenance, or Engineering staff be provided. Many failures have been obvious only when someone queried a user interface, observed a lamp hidden behind closed and locked cabinet doors, or opened the display screen where a small, innocuous message indicated a failure.

- In Section C, Item 10, page 9, in the discussion on diagnostics, generalized guidance was provided that advanced and on-line diagnostics are a good idea. There is a caution provided that overly involved or complex diagnostics are a bad idea, as they may result in additional failure modes or faults. The RG should provide some guidance as to the meanings the NRC applies to "complex" and "involved."

- In Section C, Item 10, page 9, the DG states that "These will minimize the chance for multiple latent failures that are detected only when the equipment is demanded to operate." In risk assessment, one may have a single latent fault that becomes a failure, and multiple latent faults are not required. The RG should be re-worded accordingly. The DG should also contain a definition of the word "latent."

Sincerely,

David Herrell

320 KING STREET ALEXANDRIA, VA 22314-3230 703-519-0200 FAX: 703-519-0224 http:\\www.mpr.com