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May 10, 1993

Charles Rossi
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: NRC Workshop on Requirements Marginal to Safety

Dear Mr. Rossi:

On April 28, 1993, I attended the Quality Assurance Session of the NRC Workshop on Elimination of Requirements Marginal to Safety. It was an excellent workshop from the standpoint that panelists represented a broad cross-section of the nuclear industry and there was a good mixture of views on whether Appendix B should be amended and, if so, how. Though the Workshop provided ample time for interaction between panelists and the audience, I chose not to comment. I first learned about the Workshop that morning. I felt unprepared and was more interested in hearing what others in the audience had to say.

My views on the need to change Appendix B are contained in the draft topical report, *History of 10CFR50, Appendix B, and Its Impact on Nuclear Power Plant Performance*. I wrote the Report over an 18 month period with input from Bill Morrison, the Regulation's principal author, and others who were involved in its development. The Report concludes that, though Appendix B has had a significant positive impact on plant performance, it contains weaknesses. These weaknesses are discussed in Section 6.0 and, those considered "major" are explored further in Subsection 7.2.

The three quality assurance issues you hoped to address during the workshop were covered, to varying degrees, by the eight panelists and audience. My thoughts on the issues are as follows:

1. **Definition of performance-based QA requirements.** Most everyone understands performance-based QA requirements to be requirements that identify quality objectives and permit a wide range of practical implemenation methods. The "umbrella" objective is a well-designed plant that contains reliable equipment and is operated by qualified personnel who understand and readily accept their quality responsibilities. Performance-based regulations avoid administrative details and contain minimal paperwork requirements.

   Paragraph 4.5.4 of the attached Report discusses this concept. The following examples, of where Appendix B could be more performance-based are as follows:

   - Paragraph 5.2.5 points out that Criterion V requires acceptance criteria for **activities** rather than **items**. The need for more emphasis on items was mentioned by several panelists including Glen Perez, Jim Perry, Roger Reedy, and John Stevenson;

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- Paragraphs 5.4.4(d) and 7.2.3 discuss the need to establish and trend quality indicators. The current approach, which is not performance-based, is to wait for potential problems to become "conditions adverse to quality" before including them in quality trends. This same concern was expressed by Glen Perez; and

- Paragraphs 5.5.8 and 7.2.6 discuss the lack of any type of quality objectives or meaningful examples in Appendix B that would illustrate the applicability of its criteria to plant operation and maintenance. This same concern was raised by Jim Perry and Roger Reedy.

2. **Risk significance of QA requirements.** Herschel Specter, Glen Perez, and Jim Perry discussed using probablistic risk analyses (PRA) to determine what systems, structures, and components should be covered by the quality assurance program and the extent they should be covered. Although I agree in principle with their remarks, I have the following concerns:

   - Criterion II states, "*The quality assurance program shall provide control over activities affecting the quality of the identified structures, systems, and components, to an extent consistent with their importance to safety.*" It is unclear whether "*their*" is referring to "*structures, systems, and components*," "*activities*," or both. This should be clarified. Use of PRAs to evaluate the safety-significance of activities (design, welding, maintenance, etc.) associated with items would be extremely difficult and counterproductive; and

   - Some panelists advocated using PRAs to glean systems from Q-Lists that are marginal-to-safety. For discussion purposes, I would like to lump these systems with others commonly known as "balance-of-plant" (BOP) systems. Herschel Specter estimated that PRA techniques could reduce from thousands to a few hundred, the number of components on a Q-List. The supposed benefit would be lower operating and maintenance costs because fewer systems would be subject to QA program requirements. Paragraph 5.5.8 of the attached Report notes that 75 percent of unplanned plant shutdowns are due to failures in BOP systems. This can be very expensive and, every time a BOP failure activates safety systems, chances increase that a safety system will eventually fail. A failure in a BOP system triggered the March 1979 accident at Three Mile Island 2. The best way of reducing unplanned outages and challenges to safety systems is to include selected BOP systems under the plant's QA program. Utilities should look on quality assurance as a powerful management tool instead of a regulatory burden to be avoided wherever possible. The extent any particular BOP system is subject to QA requirements should ~~be~~ depend on its potential impact on safety-related systems. As mentioned in Paragraph 5.5.4, Appendix B should be amended to require that the preparation of PRAs and Q-Lists and other SAR development work be subject to QA program requirements.

3. **Appendix B requirements vs. staff interpretations.** One person in the audience mentioned problems with NRC staff interpretations of Appendix B requirements. Roger Reedy mentioned several incidents where millions of dollars were spent investigating and disproving NRC-identified concerns about the quality of welds. I too have participated in massive investigations required to disprove NRC-identified concerns about the quality of as-built systems, structures, and components. To its credit, in the 25 years I have worked on licensed nuclear facilities, I can only think of three instances where AEC/NRC staff read into Appendix B requirements that did not exist. Though the changes ultimately made to satisfy the NRC had nothing to do with quality, costs were minimal.

The following points, made by panelists during the Workshop, raised important new issues that I would like to comment on:

1. **Protective Coatings** Don Hill suggested "*declassifying coatings as being safety related*" because, in his opinion, they cannot plug containment spray recirculation sumps. The issue is too complex to reach a universal conclusion on without studying each plant's sump design, recirculation flow paths and velocities, coating materials, and subcompartment pressures, temperatures, and radiation levels during a LOCA. Also, some plant's have had severe corrosion of safety-related bolts, steel liners, and other items due to coating defects. Coatings can fail if they are: *1)* stored too long prior to use, *2)* improperly mixed, *3)* placed on damp or dirty surfaces, or *4)* applied too thick or thin.

   Don Hill raised some valid points. It is possible that most safety-related coatings are not really "safety-related." However, I am quite certain that some of the coatings in our 109 operating nuclear power plants are truly safety-related. It is time to revisit Regulatory Guide 1.54, *Quality Assurance Requirements for Protective Coatings Applied to Water-Cooled Nuclear Power Plants*, which was issued 20 years ago and never revised or withdrawn. Regulatory Guide 1.54 endorses ANSI N101.4, *Quality Assurance for Protective Coatings Applied to Nuclear Facilities*, dated November 28, 1972. Paragraph 1.2.2 of ANSI N101.4 says it applies to coatings on systems and components "*which are essential (1) to prevent postulated accidents which could affect public health and safety or (2) to mitigate the consequences of these accidents.*" Based on this, a coating is automatically safety-related if it is on a safety-related item.

2. **Paperwork** Glen Perez, Jim Perry, Roger Reedy, and others said there is too much QA paperwork and resulting documentation gets far more attention than it deserves. The NRC is not to blame. To quote Alex Marion, "*We, the nuclear industry, have been our own worst enemy.*" Though NQA-1 Supplements 2S-1 and 2S-3 place far too much emphasis on personnel qualification paperwork, the real villains are procedures. Little thought is given to minimizing documentation by consolidating forms, reducing the need to record information that is documented elsewhere, and considering whether what must be entered on forms is really meaningful evidence of quality. Too often forms are checklists with column headings titled "ATTRIBUTE," "SAT," "UNSAT," and "N/A." Auditors look over these forms to verify they are signed, dated, and the "SAT" column has been checked. Within five minutes, an inspector could fill out several week's worth of this type of form and auditors would never know the difference. I agree with Reedy, the best way to verify quality is being attained is to look at final products, not records of what was inspected.

   While I agree that too much attention is being given to documentation, I do not believe the solution is to ban QA documentation. We need to continue recording mill test results, personnel qualifications, and inspections. Likewise, auditors should continue verifying that required documentation exists and information in documents is accurate and complete. When questions arise about the quality of an item buried under yards of concrete or backfill, the difference between good records and missing or sloppy documentation can be millions of dollars of special investigations, computer modeling, and state-of-the-art testing. The answer is to improve the quality of documentation requirements in implementing procedures. As mentioned in Paragraphs 5.5.6 and 7.2.5 of the attached topical report, industry standards contain zero guidance on developing effective procedures.

3. **Design Control** Roger Reedy recommended using Registered Professional Engineers (RPEs) to design and interpret quality and technical requirements associated with safety-related equipment. Though this would help, I doubt alone it will solve the problem. I am an RPE with over 10 years of nuclear design experience. I am not a god; like other RPEs, I make mistakes. As mentioned in Paragraphs 5.2.4 and 7.2.2 of the Topical Report, what is needed is better design verification. Also, because RPEs are just as capable of mistakes as doctors, lawyers, and bankers, implementing procedures should provide for appeals of unreasonable interpretations and independent resolution of quality concerns and honest technical differences of opinion.

   As discussed in the attached topical report, management apathy has been the nuclear industry's biggest quality problem. Design errors, not defects in construction or purchased equipment, have been the industry's second biggest quality problem. Large engineering staffs are placed at plant sites to correct design errors identified during construction, start-up, and plant operation. It is not at all unusual for drawings and specifications to be revised ten to fifteen times after they are issued for construction. Design flaws in concert with operator errors caused or contributed to the world's most serious reactor accidents: Chernobyl, Three Mile Island, Windscale, SL-1, Chalk River, Fermi, and Lucens. If there is another serious accident, chances are it will be due to a combination of design and operator errors. Though Appendix B requires design verification, its requirements need clarification. Picking up on Reedy's suggestion, the NRC should consider strengthening design reviews by requiring that review team leaders be Registered Professional Engineers.

   John Stevenson said, because design verification takes so long, design documents are often released for construction prior to verification. Sometimes, even after the plant has been built, several years of design verification remains to be completed. Stevenson recommended that all design documents receive a quality check and selected documents be subjected to a peer review or technical audit. Remarkably, though this is seldom done, it is precisely what Appendix B requires. Criterion VI requires a quality check and Criterion III requires design verification which can take the form of an independent technical audit of selected design documents.

4. **Commercial-Grade Items** Roger Reedy has found that, because the hurdles in EPRI-5652, *Guidelines for the Utilization of Commercial-Grade Items in Nuclear Safety Related Systems*, are so great, utilities usually have no choice but to buy "nuclear-grade" items. John Stevenson estimated that nuclear-grade items cost 30 to 35% more than commercial-grade items.

   As discussed in the Topical Report, Appendix B was written in response to major problems with commercial-grade equipment in America's first ten nuclear power plants. Admiral Rickover had similar problems using commercial-grade equipment in nuclear submarines. MIL-Q-9858, *Quality Assurance Program Requirements*, was his response to these problems. Indiscriminately lifting all restrictions on the use of commercial-grade items will not benefit the nuclear power industry. There is hope, however. ISO 9001, *Quality Systems - Model for Quality Assurance in Design/Development, Installation, and Servicing*, contains requirements that come very close to those of Appendix B. More and more companies are voluntarily developing QA programs and being surveyed and certified as ISO 9001 manufacturers. The NRC and ASME should attempt to close the gap between its QA requirements and those of ISO 9001. Eventually, utilities should be able to purchase equipment from ISO 9001 manufacturers for use in safety-related applications without having to survey, qualify, and audit the manufacturers' QA programs.

Because of questions about copyrighted documents referenced in the attached topical report, please consider the Report a draft and limit distribution to NRC employees having a need to know. This is all new to me. I have no idea what may be involved or how long it will take to resolve these questions. In the meanwhile, should you need to provide copies of the Report to others, give me a call first.

After considering this letter and input from others, I trust you will come to the conclusion that 10CFR50, Appendix B, should be amended. It is recommended that work on the amendment be coordinated with NUMARC because of ongoing, related industry QA initiatives. If you have any questions or I can be of help, do not hesitate to give me a call at work (703) 276-9300 or home (703) 385-9294.

Sincerely,

Marc J. Meyer