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March 25, 2005

Chief Rules and Directives Branch
Division of Administrative Services
Office of Administration
Mailstop T-6D59
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

RE: Comments on the Nuclear Regulatory Commission's (NRC) revised draft "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (NUREG-1800) and the revised draft "Generic Aging Lessons Learned (GALL) Report" (NUREG-1801, Vol. 2, Rev. 1)

Dear Chief:

Enclosed please find our comments on the above-referenced NRC guidance documents for nuclear power plant license renewal. In general, we found these documents to be comprehensive as they apply to the hardware, materials, and structural components of nuclear power plants. Many of the plant hardware concerns that have been identified during plant operation and plant aging have been incorporated into these documents. As a result, they appear to be far-reaching in their detail with respect to plant systems, structures, and components.

However, these documents do not focus sufficiently on the equally important human factors, for example, the "safety culture" of a plant. It is not just the pieces of hardware that are important in predicting a plant's safety—it is also the people who operate and maintain the plant. Although the effectiveness of a plant's safety organization can be inferred from past plant and hardware performance, assessing the safety culture at a plant is essential for predicting future plant performance and safety. When plants malfunction or accidents/incidents occur, human error or a degrading safety culture at a plant is often to blame. Therefore, an evaluation of the plant's management and safety culture at the time of license renewal, and during routine plant inspections, is necessary to obtain a complete and accurate assessment of an aging plant's overall predicted safety and performance.

In our comments, we use examples of "lessons learned" from investigative reports on the Columbia Shuttle disaster (2003) and the Davis-Besse incident (2002) to recommend additional factors important to consider during license renewal reviews.

These lessons seem highly relevant to our nation's aging nuclear power plants, given the current emphasis on increased plant efficiencies, production, and cost-cutting measures – sometimes at the expense of plant safety. NRC should incorporate these lessons learned, as appropriate, into its nuclear power plant safety and license renewal review programs.

If you have any questions regarding the attached comments, please phone me at 916-654-3787 or Barbara Byron at 916-654-4976.

Sincerely,

JAMES D. BOYD
Commissioner and
State Liaison Officer to the NRC

JDB/lb

Enclosure: 1

Comments on the Nuclear Regulatory Commission's (NRC) draft revised "Standard Review Plan for Review of License Renewal Applications for Nuclear Power Plants" (SRP-LR) and the draft revised "Generic Aging Lessons Learned (GALL) Report" (NUREG-1801, Vol. 2, Rev. 1)

A. Background

A plant's application for a license renewal from the NRC requires two concurrent assessments—one related to the review of environmental issues (10 CFR 51) and one related to safety issues (10 CFR 54). The applicant must prepare an evaluation of the potential environmental impacts if the plant operates an additional 20 years and also must provide the NRC with an evaluation of the technical aspects of plant aging, including a description of how to manage the effects of aging. The two draft documents referenced above address the "plant safety" aspects of license renewal.

All facilities applying for license renewal must go through a detailed safety review of all systems, structures and components associated with the power plants. NRC's license renewal process focuses on managing the adverse effects of aging in nuclear power plants. These draft guidance documents for license renewal recommend safety standards for managing these aging effects. The purpose of our review is to identify any gaps or areas requiring additional attention and offer recommendations for improving these guidance documents.

1. Standard Review Plan

NRC's Standard Review Plan (NUREG-1800) for license renewal recommends safety standards for plant aging management programs. It provides guidance to the NRC reviewers for performing safety reviews of applications to renew nuclear power plant licenses (10 CFR, Part 54). The purpose of this plan is to ensure the quality and uniformity of staff review and to have a well-defined base from which to evaluate applicant programs and activities for the extended license period. The safety review is based primarily on information provided by the applicant in the license renewal application.

2. The GALL Report

The Generic Aging Lessons Learned (GALL) report (NUREG-1801) contains the NRC staff's generic evaluation of the existing plant programs. It also documents the technical basis for determining where existing programs are adequate and where programs should be augmented for the extended license period. The report concludes that many of the existing plant programs are adequate to manage aging effects for plant components and makes recommendations on specific areas for which programs should be augmented.

Our comments on NRC's draft revised Standards Review Plan and the draft revised GALL Report follow. Considerable attention is given in our comments to lessons learned from the Space Shuttle accidents and the Davis-Besse incident because of their direct applicability to aging nuclear power plants.

B. Lessons Learned from the Challenger and Columbia Shuttle Accidents

"Those who do not learn from history are doomed to repeat it." George Santayana

The Challenger and Columbia Shuttle accidents and subsequent investigations provide extremely useful lessons applicable to our nation's aging nuclear power plants. Certain parallels can be drawn between NASA and the aging space shuttles, on the one hand, and the NRC and the nuclear utilities and aging nuclear power plants on the other.

On February 1, 2003, the Space Shuttle Columbia was destroyed in a disaster that claimed the lives of its seven-member crew. The Columbia Accident Investigation Board's comprehensive report (August 2003) concluded that the tragedy was not a random event but rather likely rooted to some degree in NASA's history and the human space flight program's culture. [1] Although the physical cause of the loss of Columbia and its crew was a breach in the Thermal Protection System on the left wing, there were organizational causes of this accident. The Board concluded that cultural traits and organizational practices detrimental to safety were allowed to develop, including: reliance on past success as a substitute for sound engineering practices, organizational barriers that prevented effective communication of critical safety information and stifled professional differences of opinion, lack of integrated management across program elements, and the evolution of an informal chain of command and decision-making processes that operated outside the organization's rules.[2]

The Board concluded that NASA's organizational culture had as much to do with this accident as did the foam in the Thermal Protective System and that NASA's current organization did not provide effective checks and balances, did not have an independent safety program, and had not demonstrated the characteristics of a learning organization.[3] Organizational culture refers to the basic values, beliefs and practices that characterize an institution and includes the assumptions employees use as they carry out their work. The Board quoted from Alvin Weinberg when he made his classic statement about the "Faustian bargain" that nuclear scientists made with society. "The price that we demand of society for this magical energy source is both a vigilance and a longevity of our social institutions that we are quite unaccustomed to."[4] They noted that what is true for nuclear energy is also true for the space program.

The Board further concluded that the organizational causes of this accident are rooted in the Space Shuttle Program's history and culture and that:

"Shuttle Program managers and engineering during the events leading up to this accident were clearly overconfident and often bureaucratic in nature. They deferred to layered and cumbersome regulations rather than the fundamentals of safety. The Shuttle Program's safety culture is straining to hold together the vestiges of a once robust systems safety program." [5]

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[1] Columbia Accident Investigation Board (CAIB) Report Vol. 1, August 2003, p. 9, http://www.caib.us
[2] CAIB Report, P. 9 and P. 97.
[3] CAIB Report, p. 12.
[4] CAIB Report, p. 97.
[5] CAIB Report, p. 177.

The Board criticized NASA for the fact that a pattern of acceptance prevailed throughout the organization that tolerated foam problems without sufficient engineering justification for doing so. Following the 1986 Challenger accident, the Rogers Commission recommended improvements to basic deficiencies in NASA's safety system. These recommendations centered on the lack of independent safety oversight at NASA. Without independence, the Rogers Commission believed that safety failures that contributed to the Challenger accident, for example undue influence of schedule pressures and the flawed Flight Readiness process, would not be corrected.[6]

The Board's concerns about NASA's safety culture were similar to those expressed in a 1990 review by the U.S. General Accounting Office (GAO) that questioned the effectiveness of NASA's safety organization and concluded that NASA did not have an independent and effective safety organization.[7] The Board in 2003 concluded that the problems outlined in the GAO report in 1990 persist today and that, "NASA's safety culture has become reactive, complacent, and dominated by unjustified optimism."[8] Over time, slowly and unintentionally, independent checks and balances intended to increase safety have been eroded in favor of detailed processes that produce massive amounts of data and unwarranted consensus, but little effective communication.

The Board noted that organizations that successfully deal with high-risk technologies create and sustain a disciplined safety system capable of identifying, analyzing and controlling hazards throughout a technology's life cycle. For example, the Navy submarine program was mentioned as having a strong safety culture that emphasizes understanding and learning from past failures, concise and timely communication of problems using redundant paths, insistence on airing minority opinions, formal written reports based on independent peer-reviewed recommendations from private contractors. The Navy has more than 5,500 reactor years of experience without a reactor accident.[9]

The Board further noted that perhaps the most perplexing question that the Board faced during its seven-month investigation into the Columbia accident was, "How could NASA have missed the signals the foam was sending?" In hindsight, they acknowledged that detection of the dangers posed by foam was impeded by "blind spots" in NASA's safety culture. Shuttle program management made erroneous assumptions about the robustness of a system based on prior success rather than on dependable engineering and rigorous testing.[10]

The premium placed on maintaining operational schedules, combined with ever-decreasing resources, gradually led Shuttle managers and engineers to miss signals of potential danger. Foam strikes on the Orbiter's Thermal Protection System, no matter what the size of the debris, were "normalized" and accepted as not being a "safety-of-flight risk". The Board made the observation that organizations that successfully operate high-risk technologies have a major characteristic in common: they place a premium on

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[6] CAIB Report, p. 178.
[7] "Space Program Safety: Funding for NASA's Safety Organizations Should Be Centralized," General Accounting Office (GAO) Report, NSIAD-90-187, 1990,
[8] CAIB Report, pp. 179 and 180.
[9] CAIB Report, p. 184.
[10] CAIB Report, p. 184.

safety and reliability by structuring their programs so that technical and safety engineering organizations own the process of determining, maintaining, and waiving technical requirements with a voice that is equal to yet independent of Program Managers, who are governed by cost, schedule and mission-accomplishment goals.[11]

Similarities exist between NASA and the nuclear utility industry as operational schedules, combined with resource constraints, can result in "normalizing" or accepting signals of potential danger in aging space shuttles or nuclear power plants.

Recommendation 1: The NRC should review the Columbia Accident Investigation Board's conclusions and recommendations for lessons learned for application to nuclear power plant license renewal. In particular, the NRC should review Chapter 7 of the CAIB Report for developing criteria for evaluating the adequacy of the organizational or safety culture at a plant during license renewal review.

C. Lessons Learned from the Davis-Besse Incident

The most serious safety issue for nuclear power plants, since the Three Mile Island accident in 1979, was identified in March 2002, at the Davis-Besse plant in Ohio. Corrosion had extended through the vessel head to a stainless steel lining, which, if it had given way, would have allowed the water within the reactor vessel to escape, triggering a loss-of-coolant accident which – if back-up safety systems failed to operate—likely would have resulted in the melting of the radioactive core and subsequent release of radioactive materials to the environment. The lessons learned from the subsequent investigations of this incident are applicable to the nation's aging nuclear power plants and reinforce lessons learned from the Challenger and Columbia space shuttle accidents.

The U.S. GAO's report on the Davis-Besse incident concluded that the NRC should have, but did not, identify or prevent the corrosion at Davis-Besse because its oversight did not generate accurate information on plant conditions.[12] The NRC allowed Davis-Besse to delay shutting down to inspect its reactor vessel for cracked tubing. However, soon thereafter, the plant found that leakage from these tubes had caused extensive corrosion on the vessel head—with potentially very serious safety implications when a pineapple-sized cavity developed in the plant's carbon steel reactor vessel head. The reactor vessel head serves as a vital barrier for protecting the public from any release of radiation from the reactor core.

In 2004, the GAO concluded that NRC's safety programs did not identify or prevent the corrosion at Davis-Besse because its oversight did not generate accurate information on plant conditions.[13] NRC relies heavily on its licensees to provide complete and accurate information on plant safety. Although NRC inspectors were aware of

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[11] CAIB Report, p. 184.

[12] "NRC Needs to More Aggressively and Comprehensively Resolve Issues Related to the Davis-Besse Nuclear Power Plant's Shutdown", U.S. General Accounting Office, May 2004, (GAO-04-415, GAO Highlights.

[13] "NRC Needs to More Aggressively and Comprehensively Resolve Issues Related to the Davis-Besse Nuclear Power Plant's Shutdown", U.S. General Accounting Office, May 2004 (GAO-04-415).

indications of leaking tubes and corrosion, they did not recognize the importance of these indications and did not fully communicate information about them.

The GAO further concluded that NRC's process for deciding to allow Davis-Besse to delay its shutdown lacked credibility. Because NRC had no guidance specifically for making a decision on whether a plant should shut down, they instead used guidance for deciding whether a plant should be allowed to modify its operating license. The risk estimate NRC used to help decide whether the plant should shut down was also flawed, according to the GAO, and underestimated the risk of allowing Davis-Besse to continue to operate.

The GAO report further concluded that NRC had not yet implemented more than half of its planned actions to help prevent corroding reactor vessel heads at nuclear plants and resource constraints could affect NRC's ability to fully implement the actions. It criticized NRC for not addressing three systemic problems underscored by the Davis-Besse incident:

1. NRC's process for assessing safety at nuclear power plants is not adequate for detecting early indications of deteriorating safety and does not effectively identify changes in the operator's performance or approach to safety before a serious safety problem can develop,

2. NRC has deficiencies in its process for deciding whether to shut down a plant or explain how different safety considerations, such as risk estimates, should be weighed,

3. NRC does not have adequate management controls to track, on a long-term basis, actions taken in response to incidents, such as at Davis-Besse, to determine if the actions were sufficient to resolve the underlying problems and prevent future incidents.

The GAO cautioned that because of unresolved systemic problems, another incident unrelated to vessel head corrosion could occur in the future.

Recommendation 2: NRC should: (1) revise how it assesses plant performance and early indications of deteriorating safety at a plant, including doing more to develop the performance measures that identify weaknesses in the safety and security culture and doing more to promote a strong safety culture, (2) establish a more specific methodology for deciding to shut down a plant, (3) establish management controls for systematically tracking actions that a plant has taken in response to incidents to determine if the actions can resolve problems and prevent future incidents, and (4) encourage programs to air differing professional opinions and advice about plant safety and security.

D. The Importance of a Strong Safety Culture

The Columbia Shuttle disaster's investigative report concluded that:

"NASA safety culture has become reactive, complacent, and dominated by unjustified optimism. Over time, slowly and unintentionally, independent checks and balances intended to increase safety have been eroded in favor of detailed processes that produce massive amounts of data and unwarranted consensus, but little effective communication." [14]

"NASA managers believed that the agency had a strong safety culture, but the Board found that the agency had the same conflicting goals that it did before the Challenger, when schedule concerns, production pressure, cost-cutting and drive for ever-greater efficiency—all the signs of an "operational" enterprise—had eroded NASA's ability to assure mission safety. The belief in a safety culture has even less credibility in light of repeated cuts of safety personnel and budgets—also conditions that existed before Challenger."[15]

These observations by the Board are significant in their implications for aging nuclear power plants. Human factors, such as the plant's safety culture and plant management's commitment to safety, are extremely important predictors of plant safety. Assessing these factors in an aging plant is particularly important in the deregulated, competitive electricity market which places a premium on production, achieving greater efficiencies in operations, minimizing plant refueling and plant maintenance outages, and cost-cutting measures. Pressures to run a plant to get the highest production may contradict efforts to operate it safely.

NASA managers confidently stated that everyone was encouraged to speak up about safety issues and that the agency was responsive to concerns. However, the Board found evidence to the contrary. NASA's bureaucratic structure kept important information from reaching engineers and managers alike. The Board noted that in both pre-accident periods for the Challenger and Columbia accidents, events unfolded over a long time and in small increments rather than in sudden and dramatic occurrences. There were moments for both accidents when management definitions of risk might have been reversed were it not for the many missed signals—an absence of trend analysis, imagery data not obtained, concerns not voiced, information overlooked or dropped from briefings. They noted that people who are marginal and powerless in organizations may have useful information or opinions they don't express. Extra effort must be made to contribute all relevant information to the discussion of risk.

Similarly, GAO concluded that NRC was unaware of the extent to which the safety culture of FirstEnergy [16]--the owner of Davis-Besse-- had degraded. This degradation had allowed the incident to occur with no forewarning because NRC's inspections and performance indicators, according to the GAO report, do not directly assess safety culture.[17] For example, following the 2002 incident, NRC found numerous indications that FirstEnergy emphasized production over plant safety. GAO defined safety culture as a group of characteristics and attitudes within an organization that establish, as an

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[14] The CAIB Report, p. 180.
[15] Columbia Accident Investigation Board Report Vol. 1, August 2003, p. 202, http://www.caib.us
[16] FirstEnergy's organization and performance related to ensuring safety at Davis-Besse.
[17] GAO Report, p. 28.

overriding priority, that issues affecting nuclear plant safety receive the attention their significance warrants.

NRC's task force identified numerous problems at Davis-Besse that indicated human performance and management failures and NRC concluded that FirstEnergy did not foster an environment that was fully conducive to ensuring that plant safety issues received appropriate attention.[18] The NRC task force concluded that NRC's implementation of guidance for inspecting and assessing a safety-conscious work environment and employee concerns programs failed to identify significant safety problems.

The GAO noted that the International Atomic Energy Agency (IAEA) and its member nations have developed guidance and procedures for assessing safety culture at nuclear power plants and that several countries, e.g., Sweden, Brazil, Canada, Finland, United Kingdom assess plant safety culture or licensees assess their own safety culture. They use such criteria as workloads are not excessive, staff training is sufficient, responsibility for safety has been clearly assigned within the organization, the corporation has clearly communicated its safety policy, and managers sufficiently emphasize safety during plant meetings. One reason many place such an importance on safety culture is because management and human performance aspects are among the leading causes of unplanned events at nuclear facilities, particularly in light of deregulation of the electricity market.

In 1998, NRC's commissioners decided that the agency should have a performance-based inspection program of overall plant performance and should infer competency and management performance from the results of that program. However, NRC's Advisory Committee on Reactor Safeguards recommended that NRC again pursue the development of a methodology for assessing safety culture. It also asked NRC to consider research to identify leading indicators of degradation in human performance and a method for quantifying or evaluating human performance.[19]

A strong management commitment and leadership in creating a strong safety culture is essential to plant safety. Vigilance is important in identifying trends in a plant's history of system or component breakdown, which could be predictive. Similar to a human body's aging, a nuclear plant can develop trends in component or system weaknesses, of the long term, that warrant special attention or focused preventive measures.

A recent speech by the new NRC Commissioner Gregory Jaczko similarly stressed the importance of a strong safety culture. He mentioned three guiding principles to effectively implement NRC's mission: (1) instill a safety and security culture, (2) transparency and (3) communication. He said NRC "must do more to develop the performance measures that identify weaknesses in the safety and security culture and promote strengths in culture before problems emerge." We strongly support this guiding principle and recommend that it be incorporated into the Standard Review Plan and GALL for plant license renewal. Commissioner Jaczko also said that the NRC should

[18] GAO Report, p. 50
[19] GAO Report, p. 54.

encourage this safety culture in NRC's own staff by encouraging programs such as differing professional opinions.

Recommendation 3: NRC should develop criteria for assessing during license renewal reviews a plant's safety culture and its effectiveness. As a condition for approving a plant's license extension, NRC should require an assessment of the safety culture and should require routine updates. This assessment should include, for example, a plant's follow-up corrective actions taken following incidents to prevent these incidents from happening again. The performance and competency of plant management, in particular, instilling a safety and security culture, should also be part of the routine NRC inspection program. NRC also should develop research to identify leading indicators of degradation of human performance and a program to monitor such indicators.

E. Plant-Specific or Site-Specific Issues and Local Concerns

Neither of the two operating plants in California - the Diablo Canyon Power Plant or the San Onofre Nuclear Generating Station (SONGS) - has applied for an operating license extension. Diablo Canyon's operating licenses expire in 2021 (Unit 1) and 2025 (Unit 2) and SONGS' operating licenses for Units 2 and 3 expire in 2022. Over the years of operation of these plants, certain safety and environmental issues specific to these plants have arisen. These safety and environmental issues should be reviewed, evaluated and an opportunity provided for state and local comment during the license renewal review process, if and when these licensees apply for license renewal. These issues are sufficiently important to warrant an updated assessment and an opportunity for formal public comment during NRC's review of a plant's license renewal application. These issues include:

- Marine Biological Impacts: Marine impacts from once-through cooling water systems, including thermal degradation, impingement and entrainment of marine resources, are a major concern for power plants located along California's coastline. The once-through cooling impact issue is undergoing increasing scrutiny in California's Integrated Energy Resource Planning efforts and has become more significant in the California Energy Commission's (CEC) power plant relicensing reviews. The issue is particularly significant at coastal nuclear power plants, since they release daily billions of gallons of warm water through their once-through water cooling systems resulting in significant adverse impacts on marine environments. These impacts, including their long-term cumulative impacts and the effectiveness of mitigation measures, should be reevaluated during relicensing reviews of coastal nuclear power plants.
- Seismic safety issues: California's operating nuclear power plants are located in seismically active coastal zones. Although seismic evaluations and updates were required as part of the operating license and the plants were designed to meet very stringent seismic safety criteria, an updated review by the licensees using state-of-the-art techniques and findings, allowing for independent review and comment from state and local officials and the public, should be provided during the license renewal review process. An updated assessment using the most current seismic

knowledge and technology to evaluate seismic risk is important in light of the much larger volumes of spent fuel to be stored onsite than was originally envisioned when the original operating license was issued. Members of the public have expressed concern about the continuing generation, storage and accumulation of spent fuel in seismically active zones along the California coast. Seismic safety issues need to be revisited and updated in a public forum at the time of license renewal review.

- Post 9/11 Security: the adequacy of on-site security to protect against 9/11-equivalent attacks should be assessed in a public forum, recognizing that sensitive information that might compromise plant security would not be released to the public.

- Update Licensee Emergency Evacuation Studies and Plans: as population densities increase around nuclear power plants as well as increases in traffic congestion on access roadways, traffic flow patterns and speeds during emergency evacuations would be expected to change. At the time of license renewal the issue of changing population densities surrounding a plant, changing traffic flow patterns, and how traffic flow would be managed during an emergency evacuation in a fast-breaking emergency should be reviewed during license renewal.

- Spent Fuel Storage and Transport: the risks associated with increasing the spent fuel inventory at reactors, given there is no current available option for permanent disposal of these wastes, should be assessed during license renewal review. Nuclear power plants were originally licensed for 40 years and licensees have the option for multiple 20-year license extensions.

  When these plants were originally licensed, few envisioned that most of the spent fuel generated by these plants would remain stored on site 40 years later. In light of the considerable uncertainties with the federal program for the disposal of these wastes, as well as the potential for a private interim storage facility offsite, what are the safety implications of expanded long-term spent fuel storage at the reactor site in a seismically active coastal zone? What is the relative risk of long-term storage, given seismic safety and post-9/11 concerns, relative to transporting spent fuel offsite to an interim or permanent spent fuel facility?

- Aging Plant Management: Each plant has its unique history of mishaps, component malfunctions, breakdowns and shutdowns. Have the follow-up actions taken by the licensee been sufficient to prevent a repeat of these occurrences? Are there particularly problem-prone plant components or systems that warrant special attention, preventive measures or tracking to prevent future incidents or accidents?

Recommendation 4: NRC should include in its review and analysis during the license renewal review process certain plant and/or site-specific issues related to the safety and environmental impacts from license renewal. These issues include: seismic safety, marine resource degradation from the plant's cooling system (for coastally sited plants), post-9/11 preparedness, updated plant emergency preparedness, the accumulation of spent fuel onsite in a seismically active coastal site, and aging plant management issues.