March 31, 2000

COMMISSION VOTING RECORD

DECISION ITEM: SECY-00-0007

TITLE: PROPOSED STAFF PLAN FOR LOW POWER AND SHUTDOWN RISK ANALYSIS RESEARCH TO SUPPORT RISK-INFORMED REGULATORY DECISION MAKING

The Commission (with all Commissioners agreeing) approved part 1 of the proposed 4-part effort and disapproved parts 2 through 4. In addition, Commissioner Dicus approved some of part 4. The results are recorded in the Staff Requirements Memorandum (SRM) of March 31, 2000.

This Record contains a summary of voting on this matter together with the individual vote sheets and views and comments of the Commission

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Annette Vietti-Cook
Secretary of the Commission

Attachments: 1. Voting Summary
2. Commissioner Vote Sheets

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
OGC
EDO
PDR
DCS

VOTING SUMMARY - SECY-00-0007

RECORDED VOTES

	APRVD	DISAPRVD	ABSTAIN	NOT PARTICIP	COMMENTS	DATE
CHRM. MESERVE	X	X			X	3/20/00
COMR. DICUS	X	X			X	3/22/00
COMR. DIAZ	X	X			X	2/9/00
COMR. McGAFFIGAN	X	X			X	2/11/00
COMR. MERRIFIELD	X	X			X	2/14/00

COMMENT RESOLUTION

In their vote sheets, all Commissioners approved part 1 of the proposed 4-part effort and disapproved parts 2 through 4, and provided some additional comments. In addition, Commissioner Dicus approved some of part 4. Subsequently, the comments of the Commission were incorporated into the guidance to staff as reflected in the SRM issued on March 31, 2000. Although not agreed to by a majority of the Commission, Chairman Meserve and Commissioner Dicus would have preferred to include additional guidance in the SRM concerning 1) the integration of LPSD risks into current risk-informed efforts on 10 CFR Part 50, 2) evaluation of the adequacy of the staff's tools for LPSD risk assessment in comparison to those used by industry, 3) the continuation to monitor LPSD operations and assess LPSD risks as part of the normal evaluative process, 4) the continuation to pursue the issue of human reliability analysis during LPSD conditions, and 5) identification and recommendations on research required to provide technical support for standards development activities.

Commissioner Comments on SECY-00-0007

Chairman Meserve

I have carefully reviewed SECY-00-0007 and the accompanying December 1999 report by the Office of Research, entitled, "Low Power and Shutdown Risk: A Perspectives Report." I have also reviewed ACRS letters to the Commission on this subject from the past three years, including the most recent one on SECY-00-0007, and I have read the comments of my colleagues on the Commission who have already voted on the staff's recommendations in SECY-00-0007.

I agree with the comments of Commissioners Diaz and Merrifield regarding the relative risks of many low power and shutdown (LPSD) events. Operators clearly have more time to take remedial actions during events occurring at cold shutdown conditions, with the reactor coolant system depressurized. The industry has also made substantial progress in developing tools to assist in outage planning and risk management during these conditions.

Nonetheless, I am concerned that the NRC may not be performing needed work to understand and assess LPSD risk. I find the staff's and ACRS's arguments that LPSD risk can be of the same order of magnitude as power operation risk to be troubling. However, the staff's report and the ACRS's letters and discussion during the March 3, 2000, Commission meeting indicate that the tools used by licensees for these assessments are not sufficiently detailed to permit quantitative assessment of LPSD risk to support risk-informed regulatory considerations. LPSD conditions may include situations that are not well-modeled in PRAs, including multiple trains of equipment out of service, open containments, and equipment availability that can change quickly in a short period of time. The risk during transitions, which was also discussed at the March 3 Commission meeting, is of particular concern, since the plant may be at elevated temperature and/or pressure, thus significantly reducing the time available for mitigative actions. Human performance, which tends to be a weakness of PRAs in general, is even more difficult to model during these periods, since operators may be faced with unfamiliar plant configurations, limited equipment availability, and the need to execute actions without adequate procedural guidance.

Moreover, I note that current initiatives underway, both as a result of economic imperatives and risk-informed regulation, have the potential to affect LPSD risk. For example, economic pressures provide incentives for licensees to shorten refueling outages, with the result that more outage-related activities (e.g., maintenance) will be performed in a shorter time, which could lead to problems in licensee control of many simultaneous tasks. The interactions among these tasks may neither be completely appreciated nor well-modeled with current industry LPSD risk assessment tools. The situation may be aggravated by the fact that risk-informed initiatives related to plant technical specifications (TSs) may allow hot shutdown to be specified as the endpoint for some TS action statements that now require plants to go to cold shutdown. As is true in the case of transitional conditions, the elevated temperatures and pressures during hot shutdown conditions may also lead to increased risk; I note that significant draindown events over the past few years, such as the ones at Wolf Creek (1994) and Waterford (1999) were exacerbated because the reactor coolant system pressure was elevated. In the specific case of Wolf Creek, this also led to the potential for common-cause failure of key safety systems that might have been needed to mitigate the event, had operators failed to diagnose the situation.

While I agree with the observations of my fellow Commissioners that some higher-risk situations are obvious (e.g., reduced inventory, loss of inventory, and loss of decay heat removal), there may be more subtle situations or combinations of failures that could also lead to elevated risk that may not be as obvious and that current methods and tools for assessing LPSD risk may not be capable of modeling. I also note that in some areas, there are large uncertainties that can affect the estimates of LPSD risk.

Although I believe that LPSD events warrant continued scrutiny, I share the perceptions of my colleagues that some of the tasks proposed by the staff are premature. Accordingly, my positions on the staff's proposals are to:

1. Approve Task 1, continued participation in the American Nuclear Society's work to develop LPSD PRA standards.

2. Disapprove Task 2, development of improved guidance. The staff notes that improved guidance will be one of the results of the standards development program (Task 1). Beyond this, I believe it is premature to develop further specific LPSD guidance until the methods and tools for assessing LPSD risk have been improved. However, RES should continue to reflect and integrate new insights on LPSD risk into the work that is progressing in current efforts to risk-inform 10 CFR Part 50 and associated NRC documentation.

3. Disapprove Task 3, development of improved methods and tools for human reliability analysis (HRA) and Level 2 risk specifically during LPSD conditions. Staff efforts in this area should be an integral part of ongoing work in modeling human performance, i.e., the ATHEANA project.

4. Disapprove Task 4, evaluation of other areas important to risk. However, in light of the recommendations in the ACRS's letter of March 13, 2000, the staff should evaluate the adequacy of its tools for LPSD risk assessment in comparison with those used by the industry. If those tools are found to be inadequate, the staff should recommend to the Commission a course of action to address the inadequacies. In this regard, the staff should clearly indicate the priority of any proposed activities and address the questions cited by Commissioner Merrifield from the ACRS's current report on the safety research program (NUREG-1635, Vol. 3). The ACRS should review the staff's evaluation and provide the Commission its independent assessment of high-priority issues requiring additional research.

The staff should also continue to monitor industry performance during LPSD operations, and to assess LPSD risk as part of its normal evaluative process. The staff should inform the Commission if the staff detects a significant adverse trend in LPSD events and/or risk.

Commissioner Dicus

The staff has made substantial progress in bounding some of the aspects of risk associated with low power and shutdown operations and has indicated that current methods provide a strong foundation for considering LPSD accident risk. In addition, licensees have developed qualitative and quantitative tools for managing safety during LPSD operations. So the issue appears to become --what additional information is needed to support regulatory decision-making? In this area, I believe the staff has not advanced compelling arguments and has not provided a substantial or persuasive discussion that describes the cost-benefit or fully explains the tangible regulatory results.

I believe that continued efforts to develop a ANS low power and shutdown PRA standard are worthwhile. Therefore, I approve continued participation in the ANS's work to develop LPSD PRA standards (Part 1 of proposed research plan).

Under Part 4 of the proposed research, I support further evaluation of certain areas as potentially important to risk and believe that the staff should consider stakeholder input. However, the staff should develop criteria for considering and prioritizing these research efforts. Emphasis should be placed on those areas of common interest with our cooperative research partners and areas where research resources and cost can be appropriately leveraged. Before proceeding on additional research activities, the staff should provide the Commission with its criteria for prioritizing these areas, more detailed discussion of ongoing activities in those areas of interest (e.g., NRC, industry, national and international), a qualitative and quantitative discussion of the expected regulatory benefits, and a breakdown of resources expected to be expended on each activity.

The staff should provide additional information on how low power and shutdown operations is already considered, if at all, in the ongoing human reliability analysis (HRA) program.

Commissioner Diaz

The operating nuclear power industry has changed and continues to change rapidly. Nuclear regulation is also changing rapidly. I believe there is strong evidence that the sum total of these changes is good for safety and good for the nation. In particular, the mission of assuring adequate protection of public health and safety is being enhanced by risk-informed regulation. Risk-informed regulation, in its simplest interpretation, means focusing attention and resources on those issues that are most important to safety. Both the industry and the NRC face daily challenges from the dynamic interaction between industry's operational safety and licensing needs and the safety-focused, risk-informed regulatory regime being established by the NRC.

One area especially affected by these interactions is low power and shutdown (LPSD) operations. It certainly has had the attention of the Commission and the industry, and will receive the scrutiny of the public. The staff, in the December 1999 Low Power and Shutdown report, has provided an assessment of LPSD based on current data that included operational and regulatory experiences, and I thank them.

The history and significance of LPSD events are now understood. Many significant developments have taken place since the Diablo Canyon and Vogtle LPSD events and the issuance of Generic Letter 88-17. I agree that there are measurable frequencies for actual LPSD events. However, although there are potential risks in any event, there have been no actual measurable consequences, i.e., nothing approaching a radiological event. Furthermore, the just-released Phase 1 study and the interactions with stakeholders, including the LPSD workshop, support the conclusion that licensees have developed qualitative and quantitative methods and tools for managing safety during LPSD operations. Thus, it would not be an overstatement to say that nuclear power plants and the NRC are very aware of LPSD risks, of where and when additional risks could occur, and of the remedial actions that have been taken to reduce the risks. It is widely accepted that calculated core damage frequency during transitional periods of LPSD could be comparable to those at power; however, these risks are dominated by a few, short periods of well-recognized vulnerabilities. There is also agreement that realistic consequences are low (especially if credit is given for operator actions) and that necessary actions can be taken to prevent and mitigate occurrences. Of course, physical facts during LPSD events work in favor of mitigating or even eliminating consequences. These physical facts include orders of magnitude reductions in the reactor core heat content and pressure, in cooling requirements, and reductions in the radioactive source terms. All these physical facts substantially increase the time for remedial actions.[(1)]

The regulations and licensee programs already provide frameworks for addressing LPSD risk. Moreover, the new Maintenance Rule (10 CFR 50.65) especially addresses normal shutdown operations and the added paragraph (a)(4) requires licensees to "assess and manage the increase in risk that may result from the proposed maintenance activities." (Emphasis added). Regulatory Guide 1.174 provides general guidance on risk-informing LPSD license amendment activities. Industry's NUMARC 91-06 and the revised NUMARC 93-01 (Section 11) also provide guidance on maintaining key safety functions during LPSD conditions.

I believe that, at this time, our goal of improving safety would be better served by recognizing the limited impact of the remaining uncertainties associated with LPSD, and the management of that impact, rather than by attempting to further quantify those uncertainties. While human error appears to be a large contributor to potential LPSD risk (including the associated uncertainties), improvements in human risk factors need to be addressed as part of the overall effort in this area and should not be addressed piecemeal. This approach is consistent with the simple principle of risk-informed regulation cited above, i.e., focus resources on those issues which are most important to safety.

Based on the above considerations, I do not find compelling reasons to approve the entire Proposed Staff Plan for Low Power

and Shutdown Risk Analysis Research to Support Risk-Informed Regulatory Decision Making. I approve only the staff's active participation in the ANS work to develop LPSD PRA standards. I am confident that the staff knows and has clearly informed licensees of the potential LPSD high-risk areas. The staff should continue participation with industry in its efforts to clarify its existing guidance. Additional NRC guidance is unnecessary.

The agency's initiative on risk-informing its regulations will continue to provide the foundation for further improvements in the consideration of LPSD risk. After thirteen years of analyzing and attempting to further regulate LPSD risk, I am of the opinion that we already have the knowledge and means to manage LPSD risk and that the proposed plan would not be a wise use of NRC resources.

Commissioner McGaffigan

I concur in Commissioner Diaz's well-argued vote. The staff should proceed with only part (1) of its four part second phase proposal.

Commissioner Merrifield

I cannot support the staff's proposed plan for low-power and shutdown (LPSD) risk analysis research. Specifically, I **approve** Task 1 of the proposed second phase of the program which supports the staff's active participation in the American Nuclear Society's (ANS) work to develop LPSD PRA standards. I do not believe that the staff has presented an adequate basis for supporting Tasks 2, 3, and 4, and thus I **disapprove** them.

I have carefully reviewed the Office of Nuclear Regulatory Research's (RES) December 1999 perspectives report on low power and shutdown risk. The report was valuable because it provided me with a better historical perspective on this matter and helped frame the regulatory and operational challenges associated with low power and shutdown conditions. I commend the staff for their efforts associated with this report.

RES's perspectives report highlights the extensive domestic and international research that has already been conducted in this area and the tools that have been developed. It also highlights the guidance and regulatory framework that has already been developed to ensure licensees understand and manage the risks associated with low power and shutdown operations. Specifically, the report discusses initiatives undertaken by the NRC to improve its oversight of LPSD operations, including Generic Letter 88-17, as well as guidance provided by the NRC in Regulatory Guide 1.174 for using risk information in regulatory decision-making. Industry initiatives in this area include NUMARC 91-06 and NUMARC 93-01. Recent revisions to the Maintenance Rule (10 CFR 50.65) and NUMARC 93-01 provide further evidence that the importance of managing the risk associated with low power and shutdown operations is well-understood by the nuclear industry. For example, RES's perspectives report captures several insights including: 1) LPSD risk appears to be dominated by three classes of initiating events - loss of shutdown cooling, loss of coolant, and loss of offsite power, 2) the most risk dominant plant operational states are characterized by high decay heat and reduced inventory, 3) transition risk can be significant, and 4) risk management is important during maintenance activities. These insights are similarly captured in NUMARC 93-01 in that it provides guidance to licensees on assessing and managing risk associated with the performance of maintenance activities during shutdown conditions, it addresses transition risk, and it focuses licensees on the importance of assessing not only decay heat removal capability, inventory control, and power availability, but also reactivity control and containment. My point is that based on my review of industry guidance and the NRC's regulatory framework associated with LPSD conditions, I am confident that the staff and our licensees understand the vulnerabilities associated with low power and shutdown conditions, and are taking the steps necessary to adequately manage risk during these conditions.

I believe that my views are supported by two important conclusions of RES's perspectives report. First, the staff concludes that licensees have developed qualitative and quantitative methods and tools for managing safety during LPSD operations. Specifically, the staff found that to manage LPSD risk, industry guidance has already been developed and implemented which provides a qualitative means for licensees to manage safety during outages. Furthermore, most licensees supplement this qualitative guidance with some type of quantitative probabilistic risk analysis tools and information. Second, the staff concludes that current methods provide a strong foundation for considering LPSD accident risks in regulatory activities. Specifically, the staff found that the qualitative and quantitative methods now used by licensees appear to have been very successful in maintaining safety during outages. The importance of these two conclusions cannot be overstated, especially in assessing the **need** for additional regulatory actions or guidance.

As was discussed at the February 9, 2000 Commission meeting on the RES program review, the agency is subject to increasing budgetary pressures. Therefore, we must prioritize our regulatory activities, including research initiatives, so that agency resources are dedicated to those activities that have the potential for the greatest safety benefit. In their draft report on the NRC's research program that was provided to the Commission on February 7, 2000, the ACRS reiterates the importance of assessing the value of research initiatives and provides the following 3 questions to facilitate that assessment.

- Is this issue delaying or otherwise restricting the meeting of performance goals?
- What specific results will improve definite measures by which performance goals are met?
- What are the consequences of not having the knowledge that the research is designed to provide?

These questions helped facilitate my assessment of the value of the four proposed tasks outlined in SECY-00-0007. Based on the information provided, I believe it is worthwhile for the staff to support the development of an American Nuclear Society

LPSD PRA standard (Task 1). I agree with the staff that it is important to provide the technical expertise necessary on the standard so that it meets NRC needs and can be used to support risk-informed regulatory activities. Our support will also help resolve technical issues important to the development of plant-specific PRAs. I believe this task can clearly be linked to NRC Performance Goals in the Nuclear Reactor Safety arena and that it supports several of the key strategies designed to achieve these performance goals. Furthermore, I believe the potential benefits to both our licensees and the NRC outweigh the costs associated with this task. Regarding Tasks 2, 3, and 4, while I appreciate the staff's desire to improve NRC guidance, methods, and tools in the LPSD area, I do not believe they have provided a sufficient basis for doing so. Specifically, I do not believe the staff has sufficiently demonstrated a **need** for these tasks to be carried out, nor made a compelling case as to how these tasks would enhance safety, improve the regulatory framework associated with LPSD conditions, or assist the staff in achieving the strategic and performance goals of this agency. The staff has simply not made the case that the perceived benefits justify the costs. Thus, I believe our resources could more prudently be spent on other matters of greater safety significance.

Finally, I share Commissioner Diaz's view that the agency's initiatives to risk-inform its regulations will continue to provide the foundation for further improvements in the consideration of LPSD risk.

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1. From full reactor power to shutdown's short periods of well-recognized vulnerabilities, the following risk-significant reductions take place: 1) the reactor heat content and core cooling requirements decrease by about three orders of magnitude (~ 3000 MW th to a few MW th); 2) the reactor coolant system pressure decreases by three orders of magnitude (from about 2200 psi (PWR) or 1000 psi (BWR) to ambient pressure); 3) the radiological risks are reduced by not less than order of magnitude. The time required to take remedial action for a depressurized system goes from minutes to hours.