No. 92-85 FOR IMMEDIATE RELEASE
Tel. 301/504-2240 (Thursday, May 28, 1992)

NOTE TO EDITORS:

The Nuclear Regulatory Commission has received two letter-type reports from its Advisory Committee on Reactor Safeguards. They provide comments on the reliability of emergency AC power at nuclear power plants and a definition of the term "large release" to be used with the NRC's safety goal policy for nuclear power plants.

In addition, the NRC's Executive Director for Operations has received two letter reports from the ACRS. They concern an advance notice of proposed rulemaking on severe accident plant performance criteria for future light water reactors and issues pertaining to evolutionary and passive light water reactors and their relationship to current regulatory requirements.

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Attachments:
As stated

May 19, 1992

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: RELIABILITY OF EMERGENCY AC POWER AT NUCLEAR POWER PLANTS

During the 385th meeting of the Advisory Committee on Reactor Safeguards, May 6-9, 1992, we discussed the issue of the reliability of emergency ac power at nuclear power plants. This topic was reviewed in the context of the proposed amendment to 10 CFR 50.63 (Station Blackout [SBO] Rule) and the associated

Revision 3 to Regulatory Guide 1.9, that deals with the assurance of adequate reliability for the emergency diesel generators (EDGs) normally used to provide this power. This was also discussed during a joint meeting of the ACRS subcommittees on Probabilistic Risk Assessment and Control and Electrical Power Systems held on April 22, 1992. The Committee has most recently commented on the proposed amendment to the SBO Rule in a letter to you dated December 20, 1991. We also had the benefit of the referenced documents.

This is a particularly illuminating subject to review, since it carries with it elements of many recent actions of both the Commission and its staff, and poses such a formidable challenge to coherent regulation. These actions include the SBO Rule (itself nonquantitative, but translated into quantitative terms through other regulatory documents), the issues of performance-based maintenance and regulation, the use by the staff of probability and statistics, and finally the complex of proposed actions with respect to the reliability of EDGs — the specific subject of this letter. We mention all these other interlocking issues because the underlying theme — emergency ac power reliability — provides a fine opportunity to proceed in the direction of coherent, performance-based regulation. Both the Commission and we have often supported such a direction. This letter is specifically devoted to EDG reliability, but we think it important to see the subject in its context.

The problem begins in the SBO Rule, where the list of requirements to be met by a licensee includes a demonstration of ability to cope for an appropriate length of time with a loss of all ac electrical power. That capability is in turn dependent (in part) on the "reliability of the onsite emergency ac power sources." For most plants, these are diesel generators. In the implementation of the SBO Rule, licensees have been given the option of declaring the underlying reliability of their EDGs to be either 0.95 or 0.975, depending on other details. While there is no problem in declaring an intent to meet such a reliability standard, there is equally well no realistic possibility of demonstrating that it has or has not been met for any particular plant's EDGs with the current failure-rate data. That is the problem.

It is easy to see. NUMARC has kindly provided us with INPO data on actual industry EDG experience for the years 1988-1990, showing, in round numbers, approximately a hundred failures to start and a hundred failures to load, out of 20,000 and 15,000 attempts respectively. This is for about 200 diesel generators, so the average diesel has a failure of some kind about once every three years. This is simply not the kind of data accumulation that lends itself to individual statistical analysis, or to the determination of individual reliability. There is no evidence (or, to be generous, at best marginal evidence) that any single generator is below its required reliability.

The industry average for those three years is better than 99.5 percent reliability for start and 99 percent reliability for load. This is in fact far above the requirements. But there is a policy issue here — is it the function of this regulatory agency to seek out malefactors (if there are any) and punish them for their own sake? In any population, there will always be a worst performer — should one seek to bring the worst up to the norm (thereby creating a new worst), or to seek a prescribed level of protection for the public? These are not the same objectives. A test whose main objective is to find below-par diesels will inevitably trap large numbers of innocents.

For example, consider the last fifty attempts to start, more than a year's experience for the average EDG. For an EDG of reliability 0.95, there is a greater than 10 percent probability that it will have 5 or more failures. That means that if one were to rely on a criterion of an apparent drop to 0.90 reliability (5 failures in 50 tries), one will trap 10 percent of the innocents with reliability 0.95 in return for less than an even chance of catching a culprit with reliability degraded to 0.90. That is a poor trade in any enforcement environment. (Statisticians call these Type I and Type II errors, and artifices like double triggers help very little in the absence of adequate data.) These numbers become more complicated for the various double trigger thresholds, but the point remains the same — the data will not support defensible enforcement action, because they will not separate the innocent from the guilty.

It is even worse for the proposed criterion of seven consecutive successful starts as a condition for return to service after a "problem" indication. Here a 0.95 EDG has a better than 70 percent chance of passing the test, higher still if it is allowed some failures before the successful string. It would be far better to inspect the EDG and repair the presumed cause of the failure — as would surely be done anyway.

This is a problem the Commission has brought on itself (and ACRS must share the blame) through inattention to the implications of the unfortunate wording of the SBO Rule. If the proposed changes are made, they will only further ossify an untenable position.

We believe that this case provides an excellent opportunity to create a paradigm for performance-based regulation, but it will require coherent consideration of all the elements of emergency ac power reliability, not just the EDGs, and also require Commission guidance on the emphasis of regulation — punitive or protective.

We recommend that the current initiative be scrapped as statistically flawed, that the requirement in the SBO Rule for diesel reliability be interpreted as applying to populations rather than to individuals, that it be monitored on an industry-wide basis (where the statistics are adequate over a period of years), and

that any modification in the maintenance and testing requirements for EDGs be pursued on an issue-by-issue basis. Some of the proposals contained in the proposed Revision 3 to Regulatory Guide 1.9 dealing with EDG testing and maintenance appeared reasonable if divorced from the flawed statistical bases for their implementation.

To be very specific, the premise that there are bad diesels out there (made to us verbally by some staff members on several occasions) cannot be supported with any reasonable assurance by the data. It may be true, but neither the staff nor we know it to be.

Finally, there is legitimate regulatory interest in knowing to just what extent it is in fact possible to use the individual and community diesel failure data to learn something about the reliability of individual diesels. Such information would be useful in assessing the more detailed health status of the diesel population. There exist a number of reputable statistical techniques which can be brought to bear on this problem, and which could also serve to sharpen some of the arguments we have made above. They have not been used by the staff in formulating the proposed amendment to the Station Blackout Rule.

Additional comments by ACRS Members James C. Carroll, Ivan Catton, Carlyle Michelson, and Paul G. Shewmon are presented below.

Sincerely,

David A. Ward, Chairman
Advisory Committee on
Reactor Safeguards

Additional Comments by ACRS Members James C. Carroll, Ivan Catton, Carlyle Michelson, and Paul G. Shewmon

While we support much of what is said in the Committee's report, we do not agree with two of the Committee's four recommendations. We do not believe that "the current initiative should be scrapped." We note that the staff has revised the package to make it clear that "the trigger concept should not be viewed as a statistical estimate of the EDG reliability, but rather as a method to identify the potential degradation of reliability." We support the effort in progress by the Committee's consultant on statistics and reliability theory and believe that it could lead to statistically based trigger values instead of the present empirically based values.

Given the current industry EDG reliability experience, we believe that the proposed amendment to the SBO Rule and its associated regulatory guide provide a reasonable, performance-based regula-

tory basis for ensuring EDG reliability. Promulgation of this Rule will provide valuable experience to the NRC and licensees in performance-based regulation that will be useful in the implementation of the maintenance rule. Licensees with good EDG maintenance programs and root cause analysis techniques will have little difficulty in staying below any of the proposed trigger values. (We do agree with the Committee's comment that the proposed criterion of seven consecutive successful starts as a condition for return to service after a "problem" indication should be changed.)

Finally, we do not agree with the Committee's recommendation that any modification in the maintenance and testing requirements for EDGs should be pursued on an issue-by-issue basis. We fail to see how this provides a viable enforcement basis for dealing with individual licensees with poorly performing EDGs.

References:

1. 57 Federal Register, 14514, April 21, 1992, Proposed Rule, Loss of All Alternating Current Power, U. S. Nuclear Regulatory Commission.
2. Draft Regulatory Guide DG-1021 (Second proposed Revision 3 to Regulatory Guide 1.9), "Selection, Design, Qualification, Testing, and Reliability of Emergency Diesel Generator Units Used as Class 1E Onsite Electric Power Systems at Nuclear Power Plants," dated April 1992.
3. Letter dated March 5, 1992 from A. Marion, NUMARC, to H. Lewis, ACRS, transmitting data on U.S. nuclear power plant EDG performance for years 1988-1990.
4. Memorandum dated March 30, 1992, from P. Boehnert, ACRS, to W. Minners, NRC, RES, transmitting H. Lewis' comments dated March 23, 1992 on "Diesel Reliability."
5. ACRS report dated December 20, 1991, Subject: Resolution of Generic Safety Issue B-56, "Diesel Generator Reliability."

May 14, 1992

Mr. James M. Taylor
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Taylor:

SUBJECT: ADVANCE NOTICE OF PROPOSED RULEMAKING ON SEVERE ACCIDENT PLANT PERFORMANCE CRITERIA FOR FUTURE LWRS

During the 385th meeting of the Advisory Committee on Reactor Safeguards, May 6-9, 1992, we reviewed an Advance Notice of

Proposed Rulemaking (ANPR) on Severe Accident Plant Performance Criteria for Future LWRs. The ANPR was prepared by the staff to solicit early feedback on its proposals to incorporate additional plant and containment performance criteria into 10 CFR Part 50. This is part of the second phase of a program to separate regulatory requirements for plant design from those for siting. The ACRS commented on earlier parts of this program in reports to Chairman Selin of January 15, 1992, "Proposed 10 CFR Part 50 and Part 100 (Nonseismic) Rule Changes and Proposed Update of Source Term," and February 14, 1992, "Proposed Revisions to 10 CFR Parts 50 and 100 and Proposed Regulatory Guides Relating to Seismic Siting and Earthquake Engineering Criteria." The ACRS report of May 17, 1991, "Proposed Criteria To Accommodate Severe Accidents in Containment Design," also provided Committee views on this subject. During this meeting, we had the benefit of discussions with representatives of the NRC staff and of the documents referenced.

Containments in existing plants were designed without explicit consideration of the effects of severe accidents. Surrogate design criteria were used instead. Over the past decade, experience, analysis, and research into the nature of severe accidents have provided information which can be used to develop a better design basis. An approach to doing this was recommended in the ACRS report of May 17, 1991.

The staff is now proposing that rulemaking be undertaken to specify severe accident criteria for containment design through revisions to 10 CFR Part 50. This would apply to the "passive" generation of LWR plants and future LWRs. The rule change is probably too late to apply directly to evolutionary designs. We were told that efforts will be made to achieve consistency. Because of the complexity and significance of the issues, the staff proposes an ANPR to provide the public and industry with an early indication of the scope of issues and the alternatives being considered, and to solicit feedback. Both technical and administrative issues are of concern. The proposed rule would call for direct consideration of several phenomena associated with severe accidents:

- Hydrogen generation, combustion, and detonation
- Fuel-coolant interaction
- Core-concrete and structural interaction
- High pressure melt ejection
- Overpressure and overtemperature caused by decay heat and chemical energy
- Containment bypass

This ANPR will offer three alternatives for comment. Alternative 1 is a "prescriptive - hardware oriented" approach. Alternative 2 is "nonprescriptive - phenomena oriented." Alternative 3 is the "General Design Criteria (GDC)" approach recommended by the ACRS in its May 17, 1991 report. Each of the three alternatives

addresses the issues we believe to be important if properly implemented.

The Committee position on this overall issue remains essentially as described in earlier ACRS reports. We favor Alternative 3. We emphasize that our proposal, if adopted, would require a major development effort by the staff, as would either of the other alternatives.

This ANPR is an appropriate means for initiating this needed program, and its scope appears to be adequate. It is important to obtain input from the industry, the public, and the reactor safety community. Ultimately, however, the Commission will have to make important and difficult judgments in deciding what it is going to require for future containments.

We were told that NRC procedures require that the regulatory analysis of the rule change ultimately to be proposed will include a cost-benefit evaluation. We suggest that such an analysis should have little influence on any decision about the rule. First, the severe accident and containment issues involved are very complex and difficult to analyze so that any benefit attributed to lowered risk will be very highly conjectural. Second, the essential purpose of containment is to provide physical defense-in-depth as a hedge against important uncertainties. This is an arbitrary, judgment-based requirement, and cannot be fully quantified.

In our discussions, we were told that one of the concerns held by the staff about Alternative 3 is that it proposes that new containment design criteria should be made a part of the GDC in Appendix A of 10 CFR Part 50. The concern is that existing GDC include stringent requirements related to traditional "safety grade" service. These include requirements for redundancy, quality assurance, seismic resistance, and equipment qualification. All of such requirements would not necessarily be appropriate for severe accident mitigation features in containment systems. We agree, but suggest that more than one class of reliability requirements could be specified for containment systems, as a part of new GDC. The important point is that containments should be explicitly designed for the mitigation of severe accidents.

We look forward to further interaction with the staff as this program progresses.

Sincerely,

David A. Ward, Chairman

Advisory Committee on
Reactor Safeguards

References:
1. Memorandum dated April 3, 1992 from Warren Minners, NRC Office of Nuclear Regulatory Research, for Raymond F. Fraley, ACRS, Subject: ACRS Review of Advance Notice of Proposed Rulemaking (ANPR) on Severe Accident Performance Criteria for Future LWRs enclosing draft SECY paper dated April 3, 1992 (Predecisional)
2. SECY-92-070 dated February 28, 1992 for the Commissioners from James M. Taylor, NRC Executive Director for Operations, Subject: Staff Comparison of ACRS-Proposed Criteria to Accommodate Severe Accidents in Advanced Light Water Reactor Containment Designs with Related Criteria Proposed by Industry (M910607A)
3. ACRS report dated May 17, 1991, to NRC Chairman Carr, Subject: Proposed Criteria to Accommodate Severe Accidents In Containment Design.

May 13, 1992

The Honorable Ivan Selin, Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: DEFINITION OF A LARGE RELEASE FOR USE WITH THE SAFETY GOAL POLICY

During the 385th meeting of the Advisory Committee on Reactor Safeguards, May 6-9, 1992, we reviewed a staff proposal for the definition of the term a "large release" to be used in conjunction with the Safety Goal Policy. During this meeting, we had the benefit of discussions with representatives of the NRC staff and of the documents referenced.

As a part of a program to implement the Safety Goal Policy, the staff was directed by the Commission to develop a definition for a parameter to be termed a "large release." This would be a major release of fission products to the environment from a severe accident which is coupled with containment failure. Such a large, but exceedingly rare, event would be a surrogate definition for the major accident which would create a public health

threat equivalent to the Quantitative Health Objectives (QHOs) in the Commission's Safety Goal Policy. The intent would be that a release of this magnitude or greater would occur with a frequency of less than once in a million reactor-years of operation.

Development of a practical definition has proven to be difficult. The staff has completed a comprehensive analysis and has done an excellent job in illuminating the many facets of the issue. The ACRS has previously recommended, and the Commission has endorsed, a position that surrogates for the QHOs should be simple and not be so conservative as to create a *de facto* new policy. In addition, the Commission had recommended to the staff that the large release definition should be related to a dose outside the plant boundary which would cause one hypothetical death per accident.

The staff has found that these boundary conditions have been impossible to satisfy. Using risk analysis information for a number of plants, and the MELCOR Accident Consequence Code System (MACCS) code to calculate the health consequences of radioisotope releases, staff calculations have shown that releases sufficient to cause one fatality would be equivalent to health objective values far less than the QHOs. In addition, calculated health impacts were shown to be very complex functions of the details of the particular plant and of the accident sequence. The goals that the surrogate would be simple, but not excessively conservative, have been elusive.

The staff has proposed that, rather than a quantitative definition of a large release in terms of a number of curies or a fraction of core inventory as ACRS has previously suggested, a qualitative definition should be used. The definition proposed by the staff is as follows:

> "A large release is any release from an event involving severe core damage, reactor coolant system pressure boundary failure, and early failure or significant bypass of the containment."

We agree with the staff proposal to use this qualitative definition on a trial basis.

Sincerely,

David A. Ward, Chairman
Advisory Committee on
Reactor Safeguards

References:

1. Memorandum dated April 3, 1992 from Warren Minners, NRC, RES, to Raymond F. Fraley, ACRS, transmitting Draft SECY

dated April 2, 1992, Subject: Formulation of a Large Release Magnitude (Draft Predecisional)

2. ACRS reports on Implementation of the Safety Goal Policy dated May 13, 1987; April 12, 1988; and February 16, 1989

May 13, 1992

Mr. James M. Taylor
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Mr. Taylor:

SUBJECT: ISSUES PERTAINING TO EVOLUTIONARY AND PASSIVE LIGHT WATER REACTORS AND THEIR RELATIONSHIP TO CURRENT REGULATORY REQUIREMENTS

During the 383rd, 384th, and 385th meetings of the Advisory Committee on Reactor Safeguards, March 5-7, April 2-4, and May 6-9, 1992, we discussed with representatives of the NRC staff the staff's positions, recommendations, and resolution schedules concerning the certification issues for evolutionary and passive light water reactors contained in the draft SECY paper dated February 7, 1992. We also had the benefit of the documents referenced. The staff requested ACRS comments on the draft SECY paper. Our comments and recommendations on some of the staff's positions are given below.

I. SECY-90-016 Issues

Item M. Elimination of Operating Basis Earthquake

Appendix A to 10 CFR Part 100 currently establishes the Operating Basis Earthquake (OBE) at a level one-half of the Safe Shutdown Earthquake (SSE). With this specification, the OBE exerts undue influence over the seismic design and requires a full spectrum analysis in addition to that of the SSE. The staff's proposal is to effectively decouple the OBE from design. We agree with the staff's recommendation.

II. Other Evolutionary and Passive Design Issues

Item A. Industry Codes and Standards

We agree with the staff's recommendation to use the newest codes and standards that have been endorsed by the NRC in its reviews of both the

evolutionary and passive plant design applications, and its recommendation that unapproved revisions to codes and standards be reviewed on a case-by-case basis.

Item D. Leak Before Break

We agree with the staff's recommendation to extend the application of the leak-before-break approach for both evolutionary and passive advanced light water reactors.

Item E. Classification of Main Steamlines of Boiling Water Reactors (BWRs)

We agree with the staff's recommendation for resolution of the main steamline classification for both evolutionary and passive BWRs.

Item F. Tornado Design Basis

Based on a study (NUREG/CR-4661) that compiled a considerable quantity of tornado data, the staff recommends that the maximum tornado wind speed of 300 mph (compared with the present 360 mph) be used for the design-basis tornado. We agree that the best available data should be used, but caution that design-basis specifications have sometimes been established conservatively to provide margins to deal with events not specifically addressed in the design basis. We recommend that the staff's position be approved with a qualification that the staff require assurance that other potential loads that may have been previously subsumed within the tornado design basis be taken into account if necessary.

Item H. Containment Leakage Rate Testing

The staff recommends that the maximum interval between Type C leakage rate tests for both evolutionary and passive designs be increased to a 30-month interval from the 24-month interval now required in 10 CFR Part 50, Appendix J. No significant safety penalty caused by this change has been identified. We agree with the proposed staff position.

Item I. Post-Accident Sampling System (PASS)

The staff is requesting approval of changes in requirements for the PASS currently found in 10 CFR 50.35(f)(2)(viii). These requirements, and the guidance contained in Regulatory Guide l.79 and in NUREG-0737, resulted from consideration of the TMI-2 accident.

We agree with the staff's proposal but have the following comments:

1. The requirements as contained in the above referenced regulation refer to "the reactor coolant system and containment that may contain TID-14844 source term radioactive materials" and to measurement of these and other materials. In light of source terms now considered in severe accident analysis, it is advisable to revise this obsolete description.

2. The proposal for "Elimination of the Hydrogen Analysis of Containment Atmosphere Samples" is appropriate, given that safety grade hydrogen monitoring instrumentation will be installed.

3. The Electric Power Research Institute (EPRI) proposed elimination of an existing requirement for the capability to sample the reactor coolant at operating pressure in order to measure the dissolved gas and chloride in the coolant. EPRI claims that maintaining the systems on existing plants produces significant exposure of operating personnel, and that given a severe accident, no useful information, not otherwise available, is provided by this capability. The staff proposes to retain the requirement, but to change the time after accident onset at which the capability must be available from 8 to 24 hours. During our discussion with the staff, we were unable to elicit any reason for this requirement other than that it was established following the TMI-2 accident. We cannot endorse continuation of the requirement for high pressure sampling on the basis of information available to us.

4. The staff proposes approval of a position that "would require the capability to take

samples for boron and for activity measurements 8 hours and 24 hours, respectively, after the end of power operation." The intent appears appropriate, however, we suggest that it might be better to specify a time at which the information from measurements becomes available to the operator rather than the time at which samples can be taken. Further, we assume that what is required is boron concentration rather than the presence or absence of boron. Finally, we suggest that the phrase "after the end of power operation" be made more specific.

Item N. Site-Specific Probabilistic Risk Assessment

If, as concluded by the staff, enveloping analyses are practical for both seismic events and tornadoes, it is appropriate that these be part of the submittal at the time of certification. However, enveloping analyses are not as practical for other external events such as river flooding, storm surge, tsunamis, hurricanes, and volcanism. Therefore, the staff recommends that these other types of site-specific PRA information be submitted at the combined operating license (COL) stage. We agree with this recommendation but would like to hear more about how the staff proposes to deal with any unacceptable findings at the COL stage.

Sincerely,

David A. Ward, Chairman
Advisory Committee on
Reactor Safeguards

References:

1. Draft SECY paper dated February 7, 1992, for the Commissioners, from James M. Taylor, NRC Executive Director for Operations, Subject: Issues Pertaining to Evolutionary and Passive Light Water Reactors and Their Relationship to Current Regulatory Requirements (Draft Predecisional)
2. SECY-90-016 dated January 12, 1990 for the Commissioners from James M. Taylor, NRC Executive Director for Operations, Subject: Evolutionary Light Water Reactor (LWR) Certification Issues and their Relationship to Current Regulatory Requirements

3. U.S. Nuclear Regulatory Commission, NUREG/CR-4661, Subject: Tornado Climatology of the Contiguous United States, dated May 1986