UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, D. C. 20555

October 12, 1979

Mr. Lee V. Gossick
Executive Director for Operations
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: SYSTEMS INTERACTIONS STUDY FOR INDIAN POINT NUCLEAR GENERATING UNIT NO. 3

Dear Mr. Gossick:

In a report dated July 13, 1978 concerning operation of the Indian Point Unit No. 3 at its full power level of 3025 MWt, the ACRS made several recommendations, including one that requested, "Review of the Station for systems interactions that might lead to significant degradation of safety."

In its earlier report of June 9, 1976 concerning full power operation of Zion Units 1 and 2, the ACRS had made a similar recommendation for that plant. In response to the recommendation for Zion, Commonwealth Edison arranged to have a study performed of Licensee Event Reports (LERs) covering the period between 1969 and 1977 to determine which indicated a potential systems interaction question. The results of this study were then applied to the Zion station to see if the potential for any of the same systems interactions were present and needed correction.

The ACRS has recently been asked by Consolidated Edison and the NRC Staff whether an LER systems interactions study similar to that performed for Zion would be an adequate response to its recommendation for a systems interactions study for Indian Point Unit No. 3, which, like Zion, was designed and constructed prior to ACRS identification of the generic need to examine the matter of systems interactions (letter to L. M. Muntzing dated November 8, 1974).

The ACRS believes that some types of systems interactions can be identified by an LER study such as that performed for Zion. However, the Committee believes that such an effort can only be considered to represent a treatment of part of the problem and does not recommend that type of study for Indian Point Unit No. 3.

As the Committee has stated in NUREG-0572 (September 1979), "Review of Licensee Event Reports (1976-1978)," a detailed review of LERs cannot be expected to identify all systems interactions. By far, the bulk of the LERs deal with failure of individual components and equipment, with relatively few cascades of failures resulting from an initiating event. It is not to be expected that LERs will include a relatively comprehensive set of examples of low probability events involving the coupled failures of systems where the initiating event itself is unlikely.

Thus, there will be important aspects of systems interactions which are unlikely to be exposed by a study of LERs. The important question is how to uncover vulnerabilities which may have potentially serious effects the first time they occur. In its letter of November 8, 1974 to Mr. Muntzing, the ACRS gave several examples of possible systems interactions to illustrate the matter. Since a question has arisen concerning what constitutes a reasonably appropriate study of systems interactions at Indian Point Unit No. 3, the ACRS has the following additional comments.

There are at least two general areas of investigation of systems interactions which are unlikely to be covered by a review of LERs.

1. There is a possibility of systems interactions within an interconnected electrical or mechanical complex. In such a study, it is necessary to consider failures which may be outside the usual context of failure analysis. For example, a component may run away or it may partly fail and hang up somewhere between its normal and its "failed" state, in either case leading to some excess in whatever service (voltage, frequency, flow, pressure, temperature, etc.) is provided or controlled by the system comlex under consideration. This kind of failure, which usually is less likely than total functional failure of a sub-system, is unlikely to be revealed by LERs. Investigation of such failures generally will require an appropriate application of failure modes and effects analysis with the use of the systems diagrams.

2. There is a possibility of interactions between nonconnected systems due to the physical arrangement or disposition of equipment and to possibilities of transporting damaging influences, such as heat or water, within a given plant or site. Such interactions are likely to be unique to each plant and are unlikely to be revealed by LERs since the probability for such interaction to occur may be modest. There are exceptions to this, of course, and many reductions in the potential for systems interactions resulted from evaluation of the Quad Cities event of June 9, 1972 in which a rupture in the circulating water system flooded the turbine building basement and some safety-related equipment. Generally speaking, however, neither LERs nor a study of plant diagrams and other drawings will consistently reveal the potential for such interactions between nonconnected systems, because such drawings generally show single features or systems; composite drawings which include all systems are difficult to make without their becoming unmanageably complicated. Thus, uncovering the potential for interaction of nonconnected systems will usually require careful, in-situ examination of the physical plant. This examination must consider all features having the potential to damage safety systems, including the safety systems themselves.

   The physical inspection of the plant could be approached by dividing the plant into "compartments" following discernable structures -- such as walls, ceilings, and floors with appraisable strengths and weaknesses. Doors, stairs, ventilation ducts, piping, and other penetrations would be evaluated for potential influence transport (fire, steam, hot air, etc.). Structures, which act as barriers to the flow of a damaging influence, would be assessed for the adequacy of their resistance to such influences.

In each compartment the elements of the safety systems, including such extensions as instrument lines and power or control wiring should be identified on a "train" basis. The physical vulnerability of the safety system elements to nonstandard conditions (temperature, pressure, water, spray, etc.) should be identified. The characteristics of such systems as influence generators under faulted conditions would have to be assessed if such system elements exist as redundant elements within the identified "compartment" boundaries.

The influence potential of all non-safety elements including such items as sewer and drain lines, combustible gas transport and storage, compressors, and heavy-power-circuits and transformers, within the given compartment should be assessed with respect to potential for damaging or disrupting (as with induced electrical noise) critical system(s) within the "compartment" and the "compartment" boundary itself.

The invasion of damaging influences through the barriers or boundaries into the identified compartment would also have to be assessed. This would include consideration of entry of personnel carrying influence generators such as welding equipment.

Special consideration would have to be given to the identification of convergence of safety functions into single compartments and the degree of convergence within the given space. The study of interactions between nonconnected systems would also have to include the possibility of non-visible interactions, such as the possibly adverse effect of failure of one buried pipe on a neighbor due to scouring. A study of plant drawings would be required in connection with this aspect.

The ACRS believes that one practical method to pursue such a systems interactions investigation is by formation of a small but competent interdisciplinary team, perhaps four to six individuals, who would pursue the two areas of investigation described above. The report of the team should identify the detailed approach employed and tabulate the results in a reviewable form.

The Committee believes that the two areas of investigation described above can be used in defining a suitable approach to a systems interactions study for Indian Point Nuclear Generating Unit No. 3 and are generally applicable to such studies on other LWRs.

Sincerely,

Max W. Carbon
Chairman