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

February 24, 1998

MEMORANDUM TO: ACRS Members, Staff, and Fellows

MEMORANDUM #: AWC-102.98

FROM: A. W. Cronenberg, J. Sorensen

SUBJECT: Additional Thoughts on Expert Elicitation of Research Priorities

Summary: This is a follow up to a previous memo (AWC-101.98: *Expert Elicitation of Research Priorities*), related to recent efforts at ranking of the agency's research programs. As discussed in AWC-101.98, senior managers from NRR and RES were asked to compare the relative importance of the 14 elements that constitute the agency's research program, based on three criteria: Safety Significance, Regulatory Policy, and Success. Using the *Analytic Hierarchy Process (AHP)* method, the 14 research elements were ranked, both separately for each criterion and for a composite score based on an importance weighting of these criteria. Though results varied depending on criteria, research programs related to advanced instrumentation & control, PRA, and pressure vessel integrity were generally given a high priority ranking.

Though there is no evidence that the results of this study have lead to significant changes in the agency's research program, Dr. Larkins has expressed the concern that these results may *de facto* influence future decisions regarding research priorities. Specifically he has expressed the concern that this ranking study ignored the Commission's request that any review of research include an evaluation the need to maintain a cadre of experts in areas of technical interest to the agency, particularly to meet commission goals toward risk-informed/performance-based regulation. He requested that we consider how the Commission's request for maintenance of technical expertise and implementation of risk-informed/performance-based regulation, might best be factored into the AHP prioritization study; which is the subject of this memo.

Although we believe that maintenance of technical expertise and implementation of risk-informed/performance-based regulation should be factored into any final decisions regarding research, our view is that the use of multiple criteria in the AHP prioritization process clouds results. We are of the opinion that a ***single criterion*** is best used in the AHP ranking of NRC's research program. We argue here for an initial ranking of research elements based solely on the agency's prime mission at regulation **to protect the public health and safety.** We refer to this as a first tier ranking, where the AHP methodology might best be employed to rank the various research elements solely according to their safety significance. Second tier criteria, such as regulatory implementation or the need to maintain technical expertise, we believe are best considered in a more subjective manner in any final decisions regarding agency research efforts. We argue here for such an approach.

Discussion: As discussed in AWC-101.97, the relative importance of the following three criteria was first established in the agency's attempt to rank/prioritize the various (14) elements of the FY98 research program using the Analytic Hierarchy Process (AHP):

> **Safety Significance:** the potential for the operating plan (research element) to contribute to the solution of a safety problem, or better define the nature/extent of the problem.
>
> **Regulatory Policy**: the potential to resolve a matter of regulatory policy. Will the work covered by the research plan be of use in enactment of regulatory guidance or to the issuance of new/modified codes or standards.
>
> **Success**: the likelihood that the research plan will be successfully completed.

Results of that assessment are:

RES:	Safety=62%	Regulatory Policy=20%	Success=18%
NRR:	Safety=45%	Regulatory Policy=16%	Success=39%
Both:	Safety=53%	Regulatory Policy=18%	Success=29%

As indicated, both NRR and RES were in agreement that the ***Safety Significance*** of the various research programs is of greatest importance. We would agree with this emphasis on safety, since safety assurance is the prime mission of the agency---that is formulation of ***regulation to protect the public health and safety***. To make our case, we cite one example, that is current research efforts related to proposed changes to regulatory fuel failure criteria.

Design basis analysis (DBA) for fuel requires consideration of both LOCA and Reactivity Insertion Accidents (RIAs). The prescribed regulatory RIA-DBA for PWRs is a control rod ejection accident, while for BWRs the RIA is a control blade detachment from its drive mechanism (ie: rod-drop accident). Present regulatory criteria for RIAs was obtained from fuel failure test data obtained in the early 1970s, using fresh or low-burnup (< 5000 MWD/t) fuel. These data indicated fuel integrity to energy depositions of about 300 cal/g. Current fuel licensing criteria are based on these data, with a regulatory limit of 280 cal/g peak fuel rod enthalpy for RIAs (Section 4.2 of the Standard Review Plan). However, more recent data for elevated burnups (>40,000 MWD/t) indicates cladding failures at much lower energy deposition levels (≈30-60 cal/g). These lower failures for high-burnup fuel prompted NRC to initiate research into the adequacy of its RIA fuel failure criteria. The NRC research program has centered on testing and code update efforts to validate fuel failure thresholds for elevated burnups. The regulatory impact of this research would be a change in Section 4.2 of the Standard Review Plan, where the licensee must demonstrate that fuel energy depositions of 100 cal/g would not be exceeded for DBA-RIA conditions and that highly irradiated Zircaloy cladding would remain intact to such energy levels.

If one looks at the high-burnup/RIA fuels research in terms of the three criteria used in the AHP prioritization process (i.e. Safety Significance, Regulatory Policy, and Success), this research could be judged as quite successful in terms of the Regulatory Policy and Success, since the research can be directly tied to a change in regulations and successfully completed. A high score for these two criteria can thus be envisioned. Concerning *Safety Significance* the scoring is less clear, since for current reactors with limited worth individual control rods, it is difficult to envision reactivities leading to the 100 cal/g limit. One could thus envision a medium score for Safety Significance, but high scores for both Regulatory Policy and Success, with a high composite score. Though this example may be imperfect, it does illustrate the salient point that prioritization of a group can be largely impacted by the *criteria* used to assess the importance of the members of that group.

We believe that a prioritization of the agency's research program, using the *AHP methodology,* is best accomplished using a single ranking criteria, that is judged solely on the prime mission of the agency--- ***to protect the public health and safety*** (ie Safety Significance). Other criteria such as Regulatory Policy, Maintenance of Agency Expertise, or PRA Implementation, we believe relate more to the internal workings of the agency rather than to the fulfillment of the agency's prime mission, and thus are of secondary importance. We note however, that any research program must have some likelihood of success to have an impact on the agency's safety mission. We therefore recommend that application of the AHP methodology for research prioritization, might best be accomplished by blending *Safety Significance and Success* into a single criterion. Once an AHP ranking/prioritization has been made based solely on *Safety/Success Significance*, we believe that additional criteria, including the need to maintain technical expertise and implementation agency goals for risk-informed/performance-based regulation (as noted by Dr. Larkins), should be considered in any final implementation of research priorities.