



UNITED STATES
NUCLEAR REGULATORY COMMISSION
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APR 28 1994

Mr. Edwin Kintner, Chairman
Nuclear Safety Research Review Committee
Bradley Hill Road
P.O. Box 682
Norwich, VT 05055

Dear Mr. Kintner:

This letter, with the enclosed material, is our response to the reports on the NSRRC's reviews of research on (a) Advanced Instrumentation and Controls and Human Factors, (b) Advanced Reactors, and (c) High-Level Waste at its January 13-14, 1994, meeting (letters from retiring Chairman D. Morrison to E. Beckjord, dated January 14 and February 16, 1994).

I want to start by responding to the main thrust of the Committee's comment about a need for a "strategy of integrating the human with the plant through I&C." (Enclosure to Chairman Morrison's January 14 letter, pp. 3-4.) I understand the thrust of the Committee's views to mean that RES should aim at producing practical guidance on the requirements for overall I&C systems performance that will constitute acceptability of the applicants' designs for purposes of design certification and the licensees' designs for replacing analog-hardwired with digital I&C systems. Although the Committee will recognize that NRR has the job of design review for certification and for operating plant modification, RES, because of the research carried out in support of NRR reviews, develops much of the technical basis for review, and is therefore in a position to develop and strongly influence guidance for these purposes.

I also understand the Committee's interest that RES draw on the experience with advanced digital I&C systems outside of the nuclear power industry that is relevant to application in the advanced nuclear plants. I believe that we can make a better effort to do so and to communicate RES findings on this point.

The Committee has also observed that the RES program is made up of a number of small projects that do not appear to be integrated.

I believe that RES can address all three of these interrelated comments by undertaking a more proactive role in integrating the work of the several projects and developing guidance for acceptance of advanced I&C technology. This could be done by a rule change, such as revision of the General Design Criteria, or by Regulatory Guide or other staff guidance documents for the digital I&C systems. We will look into this and other possibilities.

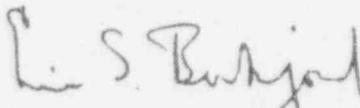
In considering our actions in response to the Committee's advice with regard to a "strategy of integrating the human with the plant through I&C," it is important to distinguish between what we can and cannot do in this regard.

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I sense the Committee's frustration over this question (advanced digital I&C), looking for an overall approach to the applications of this technology to such an important role in (advanced) NPPs. It is neither permissible nor appropriate for the Research Office to develop an acceptable overall approach, because the system designer has the responsibility. However, RES can do what I have suggested.

I believe that further dialog with the Committee on this issue could be useful. To that end, I suggest that RES arrange for the Committee to hear from I&C systems designers. I suggest a set of presentations and discussions at an NSRRC meeting later this year where (1) I&C systems designers describe their overall strategy, (2) regulatory reviewers describe their framework for reviewing I&C systems designs, and (3) RES describes the research activities in support of the regulatory reviews.

Sincerely,



Eric S. Beckjord, Director
Office of Nuclear Regulatory Research

Enclosures:

1. Response to NSRRC Comments
2. Letter, L. Shao, RES, to S. Bush, NSRRC, dated 11/3/93
3. Letter, W. Corwin, ORNL, to M. Mayfield, RES, dated 10/22/93
4. ALWR Code Development & Assessment Mission Statements

cc: Dr. David Morrison

RESPONSE TO NSRRC COMMENTS

(Letters, D. Morrison, NSRRC, to E. Beckjord, RES, dated January 14 and February 16, 1994)

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A. ADVANCED INSTRUMENTATION AND CONTROLS AND HUMAN FACTORS

1. Strategic Vision

Comments (pp. 3-4):

a) "The Subcommittee concluded from its review on November 29-30 that the fundamental need for an overarching strategy integrating the human with the plant through I&C has not been met."

b) "The RES program in these areas is made up almost entirely of small projects answering a large number of user needs, not themselves integrated as to basic objectives. As a result, the program is splintered and diffuse."

c) "Meanwhile, good work will continue to be done on individual questions without the synergism of a comprehensive strategic plan. For example, the development of an advanced control room design review guideline and the cognitive environment simulation investigation are efforts producing useful results in important areas. On the other hand, many projects are spending a significant effort in literature familiarization, while one project is entirely devoted to identifying and assessing human factors research facilities and capabilities. It was hoped by the Subcommittee that by this time such background information would be known by RES, so that it could be integrated into projects in a quicker and less costly manner, as would be typical of a more synergistic program."

d) ". . . there are opportunities available to HFB to work more effectively toward carrying out the ACRS recommendation in its letter to the Chairman of March 18, 1993, that a 'fresh start was called for in developing an effective approach to this new and difficult subject.' One possibility is to assemble a group of recognized outside experts in systems engineering of modern control systems with the specific goal of establishing a strategic vision of what is needed in a broad program of research in combining modern I&C hardware with reactor operators, with total improvement of safety as the objective. RES did conduct a meeting organized by the National Institute of Standards and Technology, but this meeting was more in the nature of a short technical society meeting than a goal oriented workshop."

Response:

- My response to the main thrust of this set of comments is included in the letter. Additional specific issues raised are addressed below.
- With respect to background information and literature research, it is important to view such Human Factors Branch activities as a continuing appropriate and necessary part of research work in this rapidly developing area. Nationally, extensive research is underway across a

wide spectrum of industries and applications, not just in the nuclear industry. We utilize the results of this research where applicable.

Also, research aimed at enhancement of personnel performance by nuclear industry organizations like the Electric Power Research Institute occasionally provides opportunities for coordinated and cooperative research that can use national research resources more efficiently.

Literature surveys help avoid duplication of previous efforts and assist in the effective use of the available information and resources. Literature surveys also keep the background information for regulatory actions current. Remaining current is especially important when addressing rapidly changing technologies such as digital I&C systems. A new generation of digital systems technology is thought to appear about every 5 years.

The literature surveys that are performed and the network of contacts that we have established are consistent with a previous NSRRC comment that "there should be a vigorous, focused effort in RES to obtain, assimilate and apply the large amount of experience and information available from these other sources. Certainly some of that is being done, but not enough." (Letter to E. S. Beckjord from D. L. Morrison, February 10, 1993). For example, we have contracted with one of the organizations (CSERIAC) identified by the NSRRC as having "... established reputations as centers of knowledge and competence in the field." The evaluation of existing human factors research facilities for use by the NRC is to be completed before the end of the fiscal year.

- The September 12-13, 1993 National Institute of Standards and Technology (NIST) Workshop on Digital Systems Reliability and Nuclear Safety and -- in a very significant way -- the study being initiated with the National Academies of Sciences and of Engineering are additional steps to enhance RES's knowledge and ability to apply current technologies in this field, as well as to contribute to a coherent research perspective. The report on the NIST workshop is now out and copies have been provided to the Committee.

2. Human Factors Branch Capability

Comment (p. 4):

"The responsible branch does not within itself possess the requisite technical and executive capability to develop and apply such a strategy [i.e., the strategy referred to in Comment 1]."

Response:

The current Human Factors Branch staff is qualified to carry out its assigned responsibilities for confirmatory research in the area of I&C and human factors, both in the specific technical disciplines and in the capability to

provide an integrated perspective for the work. However, due to staffing level limitations, HFB has not been able to respond to all user need requests and has had discussions with the user offices regarding priorities. In recognition of the growing importance of this area of nuclear safety research, we are attempting to increase the staff levels. However, in the face of staffing level limitations and recruiting difficulties due to the high demand for specialized talent in this growth area, this is expected to take some time.

We would welcome further discussion of HFB capabilities planning with the NSRRC.

3. National Academy Study

Comment (p. 5):

"The Committee recommends that the Charter for this National Academy study be broadened to include the entire system of human operations, I&C software and hardware, and their combined relationship to plant safety."

Response:

We have accepted the Committee's advice and have broadened the study's charter to include the important human-machine interface issues which could affect overall system safety and reliability.

4. Administrative and Financial Matters; Service Organizations

Comments (p. 6):

a) ". . . it would appear that an excessive amount of time and personnel resources are required to carry out the required formalisms of administrative and financial matters."

b) "It appears to us that the administrative services are not viewing themselves as 'service' organizations, but rather as offices which must themselves be 'serviced.'"

Response:

In my March 4, 1994, letter to the Committee, I explained that financial management and contract management are essential and important aspects of the management of research projects and responded to the Committee's previously stated concern about the amount of time RES project managers invest in the administrative end of project management. While it is true that commercial contracting takes considerable time and involves more staff effort than we would like, the time and effort is driven primarily by the requirements of the Federal procurement regulations. We have been working with the Division of Contracts and Property Management case-by-case to reduce lead time for contracting. Also, the Office of Administration following the lead of initiatives to reinvent government, is undertaking to revise NRC contracting

procedures in order to eliminate unnecessary paperwork and delays in the process. We are hopeful that these activities will improve performance and appearance of performance to the Committee.

The Committee will be interested to know that NRC's contracting office is taking three actions to improve customer service and reduce the time it takes to issue commercial contracts. First, the office is reorganizing in a way that should improve the interface between its staff and RES. There should be less turnover in staff supporting RES procurements and the same people will handle RES contracts from cradle to grave. Second, it has initiated a Business Process Reengineering (BPR) study of the current competitive procurement process which is aimed at streamlining that process where possible. RES is represented on the BPR working group. Finally, the NRC procurement function has been designated a Procurement Reinvention Laboratory as part of the Administration's National Performance Review. This designation is allowing the NRC to test some streamlined procurement practices not previously permitted. If the Committee is interested, I will request the Director of Procurement to brief you on these initiatives.

B. ADVANCED REACTORS

General Note About Thermal-Hydraulics

It should be noted that many of the issues you raise were addressed in the 1/3/94 report of the Thermal-Hydraulics Task Group, of which you have a copy. We are responding separately to the recommendations in that report and will transmit our response to you.

1. Engineering Materials and Components -- General

Comment (p. 2):

"... no additional topics for research applicable to advanced reactors in the areas of thermal hydraulics engineering, materials and components, and severe accidents were identified by the Subcommittee, and no additional research has been identified by NRR or by RES. However, in several cases cited within this report, particularly within the engineering materials and component area e.g., check valves, forged SA508 Class 2 steel, fatigue, aging and reactor internals, an NRC position and its technical basis needs to be prepared and subsequently examined by the Committee to confirm its tentative agreement with RES that no RES activity in these areas is necessary."

Response

Based upon the available information, the materials that will be used in advanced reactors are the same as, or better than, the materials that are presently being used in operating plants. These materials are being investigated in the research program presently being conducted by RES in these areas, in particular, in the areas of forged SA508 Class 3 steel, fatigue, aging, and reactor internals. Therefore, the research results from these programs are applicable to advanced reactors. As these research programs

proceed, areas in which additional research may be necessary might be identified. In the component and seismic areas, we do have new research programs for advanced reactors because in certain areas the proposed design, construction, and technology are different.

2. Check Valves

Comment (p. 4):

"... the Subcommittee would like to be informed of the relevant regulatory criteria and the RES basis that data in these areas is sufficient for current licensing needs. These include:

- [a]. The reliability of check valves under their intended service conditions--particularly operation at low pressure differential."

Response:

The development of new criteria for advanced reactors is unnecessary since the existing criteria for operating reactors are generally applicable to advanced reactors. While there may be some exceptions, this is not the case with check valves. We have undertaken studies of passive system reliability and check valves are important components the performance of which can affect reliability. Check valves for advanced reactors must operate under smaller differential pressures and, for this reason we are conducting a research program in this area to evaluate check valve operation under these conditions. We will keep the Committee advised of the findings of this study and the research, and of any changes in regulatory criteria that should be considered for passive ECCS systems.

3. Forged SA508 Class 3 Steel

Comment (p. 4):

"... the Subcommittee would like to be informed of the relevant regulatory criteria and the RES basis that data in these areas is sufficient for current licensing needs. These include:

- [b]. The validation of forged SA 508 Class 3 steel for reactor pressure vessels and steam generator tube sheets. (The letter of Dr. Shao to Dr. Bush of November 3, 1993, subsequent to the meeting provides a response which should be made the basis of the formal RES response to this Subcommittee request.)"

Response:

We will present the relevant regulatory criteria and RES position on these data at the earliest appropriate opportunity. The letter from Lawrence C. Shao to Dr. Bush, dated November 3, 1993, is provided as an enclosure to this

response, as well as the letter of W. R. Corwin to M. E. Mayfield dated October 22, 1993. (Enclosures 2 and 3)

4. Fatigue for ALWRS

Comment (p. 4):

"... the Subcommittee would like to be informed of the relevant regulatory criteria and the RES basis that data in these areas is sufficient for current licensing needs. These include:

[c]. A uniform position on fatigue for all ALWR designs."

Response:

Recent data on carbon and low alloy steels indicate that environmental effects on fatigue lives can be significant. NRC believes that under certain operating conditions, these effects may use up or even exceed the design factors of the "two on stress" or "twenty in cycles" ASME Section III design curves.

Consequently, RES has undertaken a program of research to collect data on environmental effects on fatigue to provide the basis for updating the fatigue design curves. NRR has developed a fatigue action plan to evaluate the impact of the environmental effects on the fatigue life of these reactor components deemed to be most affected. NRC will use the results of the research program and the action plan to evaluate the appropriate actions to be taken with respect to operating plants. These findings will also apply to fatigue issues for ALWRs.

5. Sixty-Year Life

Comment (p. 4):

"... the Subcommittee would like to be informed of the relevant regulatory criteria and the RES basis that data in these areas is sufficient for current licensing needs. These include:

[d]. Criteria for aging for 60 year life for both passive and active components. RES stated that it had not identified unique aging requirements for the AP600 and SBWR."

Response:

The questions related to plant operations beyond 40 years are being examined in the context of the license renewal rule for operating plants and in the review process for future plants. With respect to license renewal, NRR is in the rulemaking process and will address the age-related degradation effects during the renewal license period. The rule is intended to cover aging effects in long-lived passive structures and will provide regulatory criteria

for active components with credits given to the implementation of the maintenance rule and the effectiveness of current requirements and licensee programs.

With respect to future plants, the review process is intended to include consideration of 60-year plant design life.

6. Reactor Internals

Comment (p. 4):

"... the Subcommittee would like to be informed of the relevant regulatory criteria and the RES basis that data in these areas is sufficient for current licensing needs. These include:

[e]. Criteria should be developed for reactor internals."

Response:

The staff does not believe that it is necessary to develop new criteria for advanced reactors, since the existing criteria for operating reactors is generally applicable to advanced reactors. While there may be some exceptions, this is not the case in the area of reactor internals.

Based upon the available information, the materials that will be used for reactor internals in advanced reactors are the same as the materials that are presently being used in operating plants. These materials are being investigated in the research program concerning reactor internals presently being conducted by RES. The results of this research will be applicable to advanced reactor internals. Areas in which additional research may be necessary might be identified as this research proceeds.

The results of these efforts will also be applicable to reactor internals for ALWR's. Therefore, there is no need for research in addition to that currently underway.

7. RELAP5 Work Quality

Comment (p. 2):

"The Subcommittee is very interested in the technical quality of the development activity underway on RELAP5, the timeliness and completeness of the code documentation, the technical capabilities and interactions among the PWR and BWR oriented development teams at INEL, ORNL, and BNL, and the technical capabilities of the project management group within the DSR, RES which is directing this demanding technical task."

Response:

Regarding the "technical quality of the development activity underway on RELAP5," the INEL staff is, in general, composed of competent senior staff members. However, it would appear that this group lacks some high level of expertise needed to function as a "world class" organization.

Most of the detailed technical guidance at the lab appears to come from their line manager and not from their manager in charge of the RELAP5 development team. While it is gratifying that the INEL line management has enough technical expertise to attempt to fulfill this role, it is unfortunate that there is little technical leadership at the next level down. The staff's perception of this deficiency has been communicated to the lab and it is one of their high priority action items to find someone to provide senior technical leadership.

Over the years, a certain RELAP frame of mind appears to have developed within the INEL staff. Often lacking sufficient funding levels to "do the job right," an organizational culture arose in which finding "band-aid" solutions to get the code to calculate for the current problem became the norm. There was a reluctance to change the basic configuration of a code product that had been used successfully in the past, even when some of the individual modeling was suspect. The argument was that all models working together, and compared to data, should be the measure of code evaluation.

As described below, actions are underway to address these problems. When work started on the advanced reactors in 1991, NRC staff instituted a process to find the root-cause of the code problems rather than seeking simple fixes. This process is continuing with increasing strength as the staff is involved in more detailed technical review of code modeling. It is critical for RES to join in a long-term partnership with the lab to ensure capability is maintained in the long term and to provide leadership regarding long-term activities. This process has begun. A long-term code development plan is now in the process of being formulated. The intent is to produce a T/H capability that is truly world class and once again advances the state of the art. This effort does not require an enormous expenditure of resources, but it does require a commitment to a significant level of funding (on the order of 4-5 FTEs for development) that is stable and dedicated to resolving the problems of the future and not to maintenance of the status quo. Only through such an approach can quality researchers either be recruited into the RELAP5 program or be developed from junior staff.

In parallel with the long-term effort to improve the modeling capabilities of the code, a new comprehensive separate effects developmental assessment matrix will be undertaken. The objective of this task is to demonstrate quantitatively the capability of the code to simulate the phenomena judged to be important for reactor safety analyses. This matrix will include roughly 30 to 50 test facilities and encompass 300 or more individual tests, thereby bringing RELAP5 developmental assessment to a level roughly consistent with that used on the French T/H code CATHARE. The NRC T/H consultants will be used to help assemble the relevant test matrix.

Steps are being taken to improve coordination between the AP600 analysts at INEL, the SBWR analysts at BNL, and the INEL code development group. As a temporary measure, an NRC/RES staff member has taken an on-site assignment at INEL to facilitate the interactions between these groups.

The best working environments arise from situations in which the sponsor and the contractor work together as a team towards a shared goal and with a common sense of mission. During February 1994, a high level programmatic meeting between INEL and RES management was held to discuss further work to resolve these problem areas. The discourse was remarkably open and frank and agreement was reached on a number of short and long-term action items to improve the working relationship. This type of communication is important to our mutual success and will be continued. A similar exchange has now also taken place with BNL. Also, coordination meetings, between RES, INEL and BNL, are being held on a regular basis.

In addition, effective communication among the teams on the AP600 and SBWR projects is being improved. Examples of these recent interactions include the following: 1) Development of the PIRT concepts, that is, a single PIRT each for AP600 and SBWR with important phenomena defined by component and accident phase, was done at joint meetings with NRC staff, NRC T/H consultants and staff from the two contractors working on the PIRTs: INEL for AP600 and BNL for SBWR. This led to a common format for both PIRTs and cross fertilization of ideas on ranking of important phenomena; 2) At a review of the PUMA/SBWR scaling, staff from BNL found an error in the scaled power requirements for the test facility; and 3) a meeting on defining the conditions for AP600 counterpart tests between ROSA, SPES, and OSU was held with staff from NRC, INEL, JAERI, and Westinghouse.

Additional coordination meetings are being planned to discuss remaining issues on the methodology for completing the RELAP5 CSAU for both AP600 and SBWR.

A T/H Task Group appointed by the director, RES, has recommended that NRC/DSR/RPSB staff have adequate expertise in four areas:

1. Experimental facilities
2. Code use and analysis
3. Code Development
4. Code Assessment

The recent hiring of a T/H modeling expert has given staff expertise in the second and third areas. In addition, two staff have been assigned to do in-house analyses using NRC computer codes. They are receiving technical support from the local INEL office and one is involved in an extended assignment at INEL. Rotational assignments with INEL staff are also being implemented. The staff has existing expertise in the first area, and is in the process of hiring a university professor, who is experienced in running a test facility, for a one-year sabbatical, beginning June 30, 1994.

In the fourth area, code assessment, many of the RPSB staff will gain experience over the next two years as vendor and NRC test data for AP600 and SBWR become available and the codes are assessed against it.

8. RELAP5 Documentation

Comment (pp. 2-3):

"The availability of scrutable documentation has not kept pace with the improvements reported as being made in RELAP5 and this contributed to misunderstandings."

Response:

Updating code documentation is now a high priority task for us. The current focus of the RELAP5 documentation effort is to produce documentation for MOD3.1.2 using easily updatable software (Framemaker). To the extent that they are known, documentation errors that affect use of the code have been corrected. Such documentation error corrections are regularly reported in the RELAP5 News. At the time of internal code release to selected users (e.g., NRR, RES, BNL, etc.), documentation of changes, corrections, or descriptions of new models as may be needed to use the code are provided. As noted above, internal release of MOD3.1.2 will be in July 1994; MOD3.1.2 documentation release will follow in September 1994 for internal review. We believe that the documentation at that time will reflect a more complete and comprehensive state of code development and assessment. All of the RELAP5 documentation will be on Framemaker. Documentation configuration control will be established. Comments from the ACRS, the 1992 documentation peer review, NRC staff, and code users will be included. Documentation will undergo a thorough review by INEL management, technical editors, technical peers, and NRC T/H consultants and staff. The RELAP5 documentation will be updated, reviewed and released by February 1995. TRAC-PWR documentation was updated last year and the update of RAMONA documentation will be completed by the end of CY 1994.

9. RELAP5 Process

Comment (p. 3):

"The Subcommittee knows that RES has a PROCESS in place for evolving responses, but suggests that this PROCESS needs to be improved. The Subcommittee is concerned that the overall net effect of outside input be a constructive process and not an open loop for recycling criticisms and enhancing polarization. Further, the Subcommittee believes that improved communications between advisory committees already in place may prove to be more effective than generating new ad hoc consultant and additional research."

Response:

The primary source of input having the largest influence on definition and implementation of T/H research programs is internal to the NRC staff. The main customer for our research products (computer codes and test data) is NRR and we work closely with them to assure our research results meet NRC regulatory needs. To improve this interaction we have formed an internal NRC code users group which will recommend and prioritize improvements to our

computer codes. As part of this internal process we use contractors and T/H expert consultants to implement effective research programs. It should be made clear that the T/H expert consultants are used primarily as participants in our research programs, rather than critical reviewers. On occasion they do review and comment on documentation of codes and research results.

We run the CAMP (Code Applications and Maintenance Program) program in which over a dozen countries contribute resources of about \$380K per year to improve and maintain our computer codes. These requirements for code improvements are prioritized by a CAMP Program Committee. NRC then includes these requests in its own prioritized list of improvements.

The primary external review groups are the ACRS and the NSRRC. The ACRS T/H subcommittee performs in-depth reviews of code modeling, test facility design, scaling and instrumentation, and code uncertainty. The NSRRC performs a more global assessment of the research, focussing on the process followed and the personnel involved. To improve our interactions with ACRS, we plan to only send them material to review that has been thoroughly reviewed by contractor and staff; in lieu of the draft material sometimes sent in the past. We also plan to be better prepared in the future, having the benefit of experience of the scope and depth to which ACRS plans to review the T/H program.

10. Code Processes

Comment (p. 3):

"Specifically, it is suggested that RES work to achieve a proper balance in how experts at National Laboratories are used for code developments and code assessments to ensure that codes are developed, assessed, and maintained in environments that generate technical staff growth and competence in cost effective ways."

Response:

Quality researchers, and in particular code developers - who must have a good understanding of the physical processes and of the numerical methods, neither alone is sufficient - are relatively scarce. To ensure that the talents of these individuals are available to the NRC, the agency must fund a long-term code development effort at a level that is sufficient to cover a significant fraction of these individuals' time and also allow for the mentoring of junior staff.

As discussed earlier such a program is now being developed for the INEL. The long-term code development goals will be ambitious in that they will attempt to extend the present state of the art, and consequently will not be risk free. As mentioned above, this effort will not require a large expenditure of resources, but it will require a continuous expenditure. The policies of sudden growth and contraction of research efforts that have been practiced in the past, in the name of economy, have proven to be a false economy. A few talented individuals working in a stimulating environment can, over a period of time, accomplish much more than large "teams" hastily thrown together for the crisis of the day.

11. Peer Reviews

Comment (p. 3):

"While the NSRRC has endorsed the use of peer reviews, the Subcommittee cautions that complete reliance on peers to achieve resolution of technical issues is not appropriate. In-house technical expertise, leadership, and effective communications are vital aspects of the process to achieve resolutions."

Response:

It is not the staff's intent to rely on peers to achieve resolution of technical issues at all, much less completely. Peer reviews will be relied upon to:

- provide recommendations regarding these research efforts most likely to result in resolution of the issues;
- help us to judge the adequacy of solutions proposed;
- help us to avoid the pitfalls of working within one closed organizational culture without the benefits of external ideas.

We agree that in-house technical leadership, expertise, and communication are vital and are working on improving all three both at our contractors and on our staff.

12. Responses to Commenting Sources

Comment (p. 3):

"Finally, the Subcommittee would like to be informed as soon as practical of the process that RES plans to utilize to generate effective responses to the range of sources commenting on this overall research activity."

Response:

We plan to continue our written responses to formal letters from the full ACRS and NSRRC. Our intent is to encourage such communications and commentary. However, as stated previously, we plan in the future to only go for review before the ACRS when we are ready with research that is adequately documented and sufficiently reviewed. This should reduce the number of comments and reduce inefficiencies on both sides caused by reacting to draft (e.g., with the potential to be incomplete, inconsistent, unclear) material.

13. Code Mission Statements

Comment (p. 3):

"A specific mission statement for each NRC ALWR thermal-hydraulic code application (i.e...., each code applied to each reactor design to be certified) would be useful in assessing the adequacy of the RES development program. RES agreed to provide the appropriate statement."

Response:

The set of statements provided to the Advanced Reactor Subcommittee on January 26, 1994 is attached. (Enclosure 4)

14. Passive Systems

Comment (p. 4):

"We further note that identification of practical approaches for evaluating passive systems and areas for methods improvement is to be assessed at a forthcoming workshop prior to reinstating research activity. The Subcommittee would like to be promptly informed of the schedule and program for this workshop."

Response

On March 1 and 2, 1994 the NRC's Office of Research held a two-day workshop to discuss methods for assessing the reliability of reactor designs having passive safety features. The workshop was held in Harper's Ferry, West Virginia and was attended by 55 participants including Neil Todreas of the NSRRC, NRC staff, academia, NRC consultants, National Laboratories, DOE, the NRC's Advisory Committee for Reactor Safeguards and the nuclear industry. Industry representatives included staff members from Westinghouse, General Electric, Combustion Engineering, B&W, EPRI, NUMARC, NUS, TENERA and Southern Electric. One representative from the United Kingdom attended.

During the workshop there was general agreement regarding the assessment approach envisioned for advanced reactor designs having passive safety features. It was widely agreed that the development of a good understanding of the physical systems and physical phenomena associated with the behavior of the passive systems under severe accident conditions will be the most important aspect of doing these assessments. In particular, it is important to ensure that the initial conditions for operation of passive systems, stemming from reactor transients just prior to initiation, are well understood and that these conditions are addressed in the passive system test programs. It is believed that existing analysis methods that have been used in past reactor safety studies, e.g., containment evaluations under severe accident conditions, provide a suitable framework for analyzing passive systems but that experience in applying these methods is now needed. Certain data will also need to be acquired for this application.

A summary report on the workshop is being prepared. Discussions of follow-up activities between NRR and RES, focusing on AP600 and SBWR issues, are in progress.

15. Modular Construction

Comment (p. 4):

"The Subcommittee was not informed of the resolution of its comments from the December 2-3, 1992 meeting on the research underway in the modular construction area."

Response:

The Subcommittee's comment from the December 2-3, 1992 meeting, under the heading Reliability of Modular Construction was:

"An interesting program on the subject topic was described. The Subcommittee had no questions on the suitability of the technical topics being pursued, but did question whether the process of placing this work at BNL versus conducting a competitive placement compromised the overall RES objective of having the most competent investigators conduct their research. The staff responded that user time pressures to obtain the needed results led to the selected contracting procedure.

The Subcommittee understands that special circumstances can justify a limited number of such placements, but that such placements must not be allowed to become the rule. In this case, RES should investigate the benefits of engaging other more competent investigators, should they exist, to assist or direct subsequent phases of this modular construction project."

It has always been our intent to utilize the "most competent investigators" for any experimental efforts or analytical efforts that extend the state-of-the-art. Phases I and II of this project concentrate on the identification of safety issues and the determination of what independent confirmation must be performed by the NRC and are well suited to a competent national laboratory. A major issue has to do with the adequacy of modular designs under seismic loading. This issue is under investigation in Japan. BNL was chosen as the most suitable laboratory based on expertise in seismic design of buildings and understanding of Japanese seismic design practice. We intend that any Phase III experimental effort, if identified as necessary in Phase II, will be performed by institutions or firms with the appropriate facilities and expertise.

16. Sufficiency of CONTAIN for Buoyant Effects

Comment (p. 5):

"The adequacy of CONTAIN for containment assessments will be assessed against data and the COMMIX code. This plan is proper but should emphasize evaluating how the lumped parameter representation of CONTAIN will suffice in presence of strong buoyant effects."

Response:

Data collected from the Westinghouse scaled facility will be used to assess the performance of the CONTAIN code and the COMMIX code, strong buoyant effects will be created by the release of steam or helium. Based on the outcome of this activity, the lumped parameter versus the finite difference approach would certainly be assessed. We anticipate the CONTAIN code along with ample code sensitivities to be an acceptable approach.

We are confident that the use of the CONTAIN code will suffice in evaluating the AP600 Passive Containment Cooling System (PCCS) design, particularly in relation to containment thermal-hydraulics. We may not achieve similar success in the area of "worst case" hydrogen stratification and transport, in part because there are larger inherent uncertainties. However, since hydrogen igniters are used in the AP600 design, this issue would not be a major concern provided the igniters are available during dominant severe accident sequences. Moreover, if the Westinghouse large scale facility covers a broad range of conditions and the scaling aspects are technically sound, we may be able to quantify the uncertainties surrounding either code and use engineering judgment to predict a reasonable bounding range of conditions for the full size AP600.

C. HIGH-LEVEL WASTE

1. Correction of Budget Figures

Comment (p. 2):

"Total [FY94] expenditures are \$4747K for the CNWRA, \$5700K for NRC/RES and \$500K for the projects at other locations, for an FY94 grand total of \$10,947,000.00."

Response:

The figures quoted are in error. Actual totals for FY94 allocations are \$5.6M at the CNWRA and \$0.767M at other contractors for a total of \$6.367M in budgeted FY94 resources. Corrected figures submitted by the staff were apparently not clear and resulted in a double counting in the Subcommittee's report of most of the CNWRA funding.

2. Probabilistic Approach to Volcanic Hazards

Comment (p. 2):

"The HLW Subcommittee endorses the use of a probabilistic approach in evaluating volcanic hazards."

Response:

Volcanic hazards are to be assessed as possible disruptive scenarios for the HLW repository performance assessment. The NRC volcanism research program has been developed to provide an independent technical basis to evaluate regional

information and DOE site characterization data and analyses so that both probabilities for volcanic events and the associated consequences can be treated in the context of the performance assessment calculations.

3. Interpretation of "Uncertainties"

Comment (p. 5):

"This is the time to avoid any possible future semantic difficulties in interpreting what is meant by 'uncertainties' and lack of knowledge in describing the processes for model and code assessments. [Currently, the term 'validation' is used.]"

Response:

The use of the term "validation" to describe the process of building confidence in model simulations of future disposal system performance has drawn a great deal of attention over the last few years. The basic issue is that while complete knowledge is not possible, it is necessary to identify and apply those key elements of known information that will warrant confidence in the technical assessments that must be made, even in the absence of complete information, to satisfy the safety objectives, laws, and regulations for the disposal of the radioactive wastes. The NRC is focusing on this problem by trying to build an understanding of the important processes and an independent technical basis of data and models that can be used to assess the envelope of possible interpretations of the data DOE will use to support its assessment of repository performance contained in its license application. In fact, this approach is fundamental to the NRC HLW regulation (10 CFR 60) governing high-level waste disposal and the research program has been developed to support its implementation. A joint effort between NRC (the offices of NMSS and RES) and the Swedish Nuclear Power Inspectorate (SKI) is being undertaken to develop a strategy to build confidence in models and their use for HLW performance assessment.

4. Peer Reviews

Comment (p. 5):

"The Subcommittee recommends that RES provide guidance on when and how peer reviews are to be made."

Response:

The CNWRA has an official policy on peer reviews that has been endorsed by the RES Division of Regulatory Applications. In addition, the Office of Research has a policy that not only encourages the publication of research results in peer review journals, but also requires peer review of research projects at appropriate stages in their conduct. In particular, beginning this fiscal year, new CNWRA project plans will contain a specific task for a separate, focused peer review of the work in their fiscal year and will provide for an intermediate review during project implementation when appropriate. (RES

Office Letter No. 13, "RES Policy on Publication and Peer Review," was provided to the Committee with my March 4, 1994 letter to Chairman Morrison.)

5. Radionuclide Transport

Comment (p. 6):

"The Subcommittee requests a written response to the concern that the study of radionuclide transport from a potential repository is weighed too heavily toward uranium."

Response:

The CNWRA is developing an analysis of the applicability of the uranium studies to the repository program. This analysis will be reviewed by the staff and forwarded to the Committee with the staff's views as soon as the review is completed.

6. Natural Analogs

Comment (pp. 6-7):

"The Subcommittee had the benefit of discussions which focused on the difficulties of using natural analogs for assessing models used in PA's. However, limited objectives might be achievable at selected sites."

"The Subcommittee now agrees that it will be extremely difficult and perhaps essentially impossible to use natural analog information to truly validate complex mathematical models of radionuclide transport."

"It is probable that the major value of natural analog studies will be an evaluation of the 'big picture' that results and the implications for repository behavior, rather than the collection of data sets specifically for model validation."

Response:

The RES staff has long recognized both the benefits and limitations of the use of natural analogs in the waste management area. RES has actively participated in the activities of the Commission of the European Communities' Natural Analog Working Group (NAWG), which has been studying and discussing natural analogs as sources of data to understand radioactive waste disposal systems since 1984. Specific criteria were developed by the NAWG to be used in selecting sites for analog work. It was recognized that the utility of an analog was directly related to the ability to constrain the system and focus the scientific investigations. It was also recognized that analog data and models which are unique to a given site are seldom directly transferable to any disposal site. However, some kinds and types of data as well as approaches to site investigation and the construction and limitation of conceptual models will aid insight into what additional data should be collected at the proposed disposal site. Moreover, all of the data will aid in understanding the processes operating at the disposal site and the

interpretation and analysis of data taken at the disposal site. Analog studies offer a way of providing some understanding of some questions that cannot be answered or tested at a proposed disposal site because: (1) there is insufficient time to examine processes which may occur on geologic time scales; (2) it may be impractical to study processes on repository spatial scales at the repository site; (3) it is undesirable to undertake substantial destructive testing programs in the rock formation which will be relied upon for waste isolation. The object is to use as many sources of information as possible to construct an envelope of conditions, parameters, and models to explore the future state of the repository system.

7. Disruptive Scenarios: Lessons from SARP

Comment (p. 8):

"The Subcommittee called attention to RES's high priority severe accident research plan (SARP) and the strategies and methodologies being used to resolve high consequence but low probability issues. Experience acquired in these activities may be useful in developing rational approaches for treatment of disruptive scenarios."

Response:

The staff acknowledges the Committee's comment, and is looking into the suggestion.

8. High-Temperature Storage

Comment (p. 8):

"The Committee notes that DOE's tentative long-term, high-temperature storage concept has possible implications for seismic rock mechanics research. Thus developments in the high temperature area should be followed closely."

Response:

The design and performance implications of DOE waste package and drift designs and the thermal loading inherent in those designs are subjects being closely watched by NMSS, RES, and CNWRA staff. Also, test and analysis results from RES's thermohydrologics project at the CNWRA have been used to provide comments on the heater tests that DOE has done (G-tunnel) and is doing (Fran Ridge).