UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SEP 24 1979

MEMORANDUM FOR: H. Berkow, Acting Chief
Management & Administrative Support Branch

FROM: Domenic B. Vassallo, Acting Director
Division of Project Management

SUBJECT: LONG-RANGE RESEARCH PLANS

This memo is in response to Mr. Crutchfield's request of August 10, 1979 for DPM's long-range research objectives.

DPM's long-range needs cover three broad research areas. It is possible that these areas of concern are more properly the responsibility of others in NRR, and that they are now DPM concerns/responsibilities merely because DPM had historical technical responsibility. Specifically, DPM had major technical responsibilities in the area of LMFBRs and gas-cooled reactors, and DPM also had a lead role in the core melt accident evaluations on the FNP. We have covered these areas to ensure that they are covered in NRR.

The first area of concern relates to low probability-high consequence core degradation/melt accidents in LWRs. The objective of the efforts is to understand the course of such accidents, the effects on materials and structures, the consequences in terms of containment contents and loading, and the potential of devices for mitigation.

I. We see the following long-range research objectives for LWR core melt accidents.

A. To understand the phenomenology of the high temperature material interactions associated with a postulated core meltdown accident.

The reason this research is needed is to provide a thorough understanding of core-melt accident progressions and the mitigating potential of various core retention system materials and configurations. (Priority Rating = 1)

B. To understand the phenomenology of hydrogen generation, migration, burning, and exploding under reactor accident environment conditions.

The reason this research is needed is to provide a thorough understanding of the potential thermal and mechanical loadings which are imposed on the containment from hydrogen producing reactions. (Priority Rating = 1)

C. To understand the potential for and phenomenology of steam explosions, to determine the extent of mechanical loads which steam explosions impose on the reactor vessel, the PHTS, and/or the containment.

The reason this research is needed is to provide a thorough understanding of the extent to which steam explosions degrade the integrity of reactor vessel and containment barriers to the release of radiation. (Priority Rating = 1)

D. To understand the behavior of core meltdown accidents in LWRs up to and including the analysis of the temperature, pressure, and hydrogen-evolution history in the containment. This will be used as a "damage source term" for the activity in E, below.

The reason this research is needed is to provide a thorough understanding of the mechanical and thermal loadings of the containment for selected accident scenarios. (Priority Rating = 1)

E. To understand the structural response capability of LWR vessels, PHTSs and containments.

This research is needed to enable the licensing staff to establish containment and venting requirements and criteria for future LWRs. (Priority Rating = 1)

F. To understand radioactive aerosol behavior, as well as clean-up systems, proposed to mitigate related problems.

This research is needed to enable the establishment of licensing requirements for aerosol mitigating features and to estimate in-containment source terms. (Priority Rating = 1)

The area of LMFBR long-range needs is difficult and complex, technically and otherwise. We do not presently have an LMFBR under review, nor do we presently project that an LMFBR will be submitted for licensing during the next few years. This whole area is dependent on international agreements and national policy. Under these circumstances, we are unable to assign a significant priority to LMFBR confirmatory research activities. It is appropriate, however, for the NRC to give high priority to monitoring and interaction with DOE to ensure that NRC staff views are male known, and to ensure that the NRC staff is informed about DOE programs. This interaction effort is a priority 1 activity.

II. The following activities deal with LMFBRs, and should be undertaken as long-term research for an LMFBR program; because of the national policy situation and the lack of applications in NRC, they cannot be assigned any priority.

A. The same objective as stated in I.A., but properly extended to include materials unique to fast reactors, such as sodium.

B. The same objective as in I.B., properly extended to include hydrogen generation sources unique to fast reactors, such as sodium-water reactions.

C. The same objective as in I.D., properly extended to include meltdown progression phenomenology unique to fast reactors.

D. The same objective as in I.E., properly extended to include the energetics potential unique to fast reactors from fuel vapor and sodium vapor generation (FCI).

In addition to the above objectives which overlap to a certain degree LWR research objectives, we list the following objectives:

E. To understand the "transition phase" of an LMFBR whole-core accident progression, recriticality potential in particular.

This research is needed to determine the roles that recriticality prevention and mitigation play in reactor design and licensing.

F. To understand both inherent and engineered features of fast reactors which could potentially prevent or considerably limit core damage for low probability initiators.

This research is needed to enable licensing to judge the effectiveness of cost-effective safety approaches or inherent characteristics in order to give proper credit in licensing deliberations.

G. To understand system interdependency and the probability of accident initiating events and of accident sequences in order to conduct quantitative risk analyses.

This research is needed to enable the licensing staff, through proper quantitative risk analysis, to properly weigh risk contributors in licensing evaluations.

H. To understand fuel behavior under the unique operating and accident conditions of fast reactors.

This research is needed to enable the staff, independent of DOE fuels programs, to judge fuel performance under normal and abnormal conditions.

III. In the area of HTGR safety/licensing matters we see the following long-range research objectives:

Continued technical assistance and research supporting Fort St. Vrain operations is foreseen in areas of (1) fuel transient behavior, (2) heat transfer and fluid flow, (3) structural graphite oxidation, (4) structural analysis, (5) inservice inspection techniques, (6) refractory metals behavior, (7) accident analysis confirmations, and (8) low probability accidents. While it is possible that research pertaining to heat transfer, fluid flow and structural analysis would be substantially completed prior to the FY 1982-86 period, the other tasks have long-term requirements. (Priority Rating = 1)

Depending on the outcome of the NASAP study, there may be alternative reactor types under serious consideration by DOE in the 1982-86 time frame which have unique features and safety issues not covered under the three broad categories mentioned above. We view this to be unlikely and therefore have not listed any long range user needs for these alternatives. However, major redirection of DOE nuclear development policy could change this.

D. B. Vassallo, Acting Director
Division of Project Management

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AUG 01 1979

MEMORANDUM FOR: Walt Paulson, Program Support Staff, NRR

FROM: D. Muller, Acting Director, DSE

SUBJECT: LONG RANGE RESEARCH PLANS

The enclosed list of long range research plans has been compiled in response to your request of August 10, 1979 to comply with the EDO request for user offices to provide RES with their broad long-range research objectives for the period FY 82-86. The programs identified in this list may contain one or more program elements that need not be closely defined for long-range planning purposes at this time. The programs are sufficiently detailed to support formulation of significant research policy issues.

Perhaps the most important of these issues is the general expansion of information needs associated with the heightened appreciation of accident occurences and the need to be able to monitor their characteristics and environmental effects. Other major areas of research needs result from the increased appreciation of the role that simulation modeling and socio-economic factors play in the overall licensing process and hence in staff responsibilities. Another important consideration in formulating research needs is reducing lessons learned to staff practice by using the large body of experience to initiate generic assessments of certain environmental issues.

These long range research needs assume completion of research programs already underway or continuation of them until their stated objectives are achieved.

Daniel R. Muller, Acting Director
Division of Site Safety and
Environmental Analysis
Office of Nuclear Reactor Regulation

Enclosure: As stated

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