August 29, 2002

Dr. George E. Apostolakis
Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

SUBJECT: DRAFT ADVANCED REACTOR RESEARCH PLAN

Dear Dr. Apostolakis:

On behalf of the staff, I would like to thank you for your letter of July 18, 2002, and comments on our latest version of the Draft Advanced Reactor Research Plan. We appreciate the considerable amount of time and effort the Committee has invested in its review. As you know, the plan is expected to be provided to the Commission in the fall of 2002, and the Committee's input will help us achieve that goal.

The purpose of this letter is to provide a brief response to the ACRS' recommendations on the plan as presented in your July letter. As described, the plan is essentially a technology assessment and gap analysis of our advanced reactor infrastructure, primarily with respect to non-light-water reactors (non-LWRs). Exelon's withdrawal of their pre-application review for the PBMR, however, has impacted our budget and shifted our priorities. Accordingly, we have scaled back but not eliminated long-lead research activities on non-LWRs. We have also shifted some of our focus to reactor designs that have been submitted since we prepared the plan (e.g., ESBWR, SWR-1000, and ACR-700). These new activities will be added to the plan. Nevertheless, within our budget constraints, most of the ACRS' recommendations will either be integrated into the plan or otherwise addressed by other ongoing activities. We hope to continue to interact with the ACRS on the Committee's recommendations and on new reactor designs as they enter into the plan.

RESPONSE TO ACRS COMMENTS

1. We agree with the Committee's recommendation that research continue on High-Temperature Gas-Cooled Reactors (HTGRs), but remain focused at a generic level, and on the Gas Turbine-Modular Helium Reactor (GT-MHR) design. In addition, many of the key technical issues identified in the plan (e.g., high-temperature materials, graphite, and TRISO fuel particle performance), are generic to all HTGRs, and as such, will receive a higher priority over those considered to be associated with a particular plant design.

2. We agree with the Committee's comment that the development of fission product release models for TRISO fuels is a key research area for gas-cooled reactors. The models currently implemented in the MELCOR code are empirical and are based on

experimental data obtained for LWR fuel at burnup levels less than 45 GWd/MTU. These models will be extended to gas-cooled reactors and, as part of this effort, decisions will be made as to how best to model the difference in the mechanism of fission products release between LWR fuel pellets and TRISO fuels. In addition, experimental data on fission product release and transport from irradiated TRISO fuels under prototypic conditions (e.g., burnup, environment) in HTGRs will be generated, or obtained through research collaborations, to validate fission product release models.

3. We agree that the development of the regulatory structure to be used for licensing reactors with advanced designs is a high priority. The staff has initiated work on the development of a framework for advanced reactors. These activities include developing a systematic program plan for the development of the framework and identification of the policy and technical issues for advanced reactors (i.e., SECY-02-0139, dated July 22, 2002 (ML021790610) and a memorandum dated July 22, 2002 (ML021820009), respectively). In addition, the framework will need to consider the Commission's decision on legal and financial issues associated with licensing new nuclear power plants, as requested by the staff, which includes issues related to modular plant licensing, merchant plant licensing, and HTGR licensing.

4. Research to investigate degradation and fission product release characteristics of the LWR core with high burnup fuel is an important research area for operating reactors. We agree with the Committee's comment that the plan as written will need to be extended to capture very high burnup fuel. NRC is assessing its participation in the PHEBUS-2K program that will investigate core degradation and fission product release for high burnup UO_2 fuel. We are also pursuing with the Institute de Radioprotection et de Sûrete Nucléire of France to obtain VERCORS fission product release data from high burnup fuel. Both PHEBUS-2K and VERCORS data will be useful to validate our severe accident code.

5. We agree that the approach for selecting design-basis events and choosing acceptance criteria for the new designs needs to be risk-informed. This approach was already under way for the PBMR when Exelon withdrew from the pre-application review process.

6. We are planning to use the Planning, Budgeting, and Performance Management (PBPM) process for allocating program funds, and Phenomena Identification and Ranking Tables (PIRTs) up-front to prioritize research within technical areas. Additionally, workshops on advanced reactors and meetings with stakeholders provide feedback from the broad perspective. We believe this approach is consistent with the Committee's comments. To streamline the process, the PIRT exercises for current advanced reactors will be performed in a manner similar to that previously used for the AP600.

7. The advanced reactor research plan has been revised to include research to determine the relationship between radioactivity in the coolant system during the operating phase of HTGRs and fuel quality. An important research issue is whether monitoring systems would be capable of detecting significant "latent" fuel particle failure conditions, or conditions that could lead to higher than expected fuel particle failure rates at elevated temperatures. The research plan will be expanded to investigate the capability of such systems to detect latent failures.

8. The staff will remain cognizant of the near-term deployment and Generation IV activities by continuing to observe and being made aware of research and development initiatives that stem from the associated roadmap activity. In addition, RES will maintain representation on the Nuclear Energy Research Advisory Committee and remain cognizant of technical issues that could have regulatory implications.

9. In response to the Committee's comments on the need for additional consideration of fuel-coolant interaction (steam explosion), it should be noted that the in-vessel retention via external flooding of the reactor vessel is anticipated as an accident management strategy for AP1000. NRC intends to assess a whole range of ex-vessel severe accident phenomena, including fuel-coolant interactions (FCI), core concrete interactions, and hydrogen combustion for AP1000. For assessing these ex-vessel severe accident phenomena, state-of-the-art treatment of these phenomena will be employed. With respect to FCI, we recognize that the state-of-the-art treatment may not be sophisticated enough to predict the occurrence and energetics of steam explosions. Hence, an expert's view and analysis to explore a range of conditions and parameters important for the determination of FCI will be carried out.

10. The so-called "licensing by test" concept has not been formally proposed for NRC evaluation. The Commission's licensing process in 10 CFR Part 52 requires qualification testing for design certification applications (10 CFR 52.47(b)(2)). This requirement implements the Commission's policy on proof-of-performance testing for advanced reactors (51 FR 24643; July 8, 1986) and the Commission's goal of resolving all design issues before authorizing construction. This process will be used by the NRC staff to determine whether large-scale integral testing is needed to demonstrate the performance of safety features in advanced reactor designs. Also, in the draft *Federal Register* notice that is attached to SECY-02-0077, "Proposed Rule to Update 10 CFR Part 52," the staff is proposing to amend 10 CFR 52.79(b) (proposed § 52.211(b)) to require an applicant for a combined license that references a custom advanced reactor design to also perform the design qualification testing required by the current § 52.47(b)(2) for design certification applicants (see Section III.A.9 of SECY-02-0077). Therefore, the current and proposed regulations could accommodate a request that is supported by testing conducted on a demonstration or prototype plant. However, detailed design descriptions and appropriate safety analyses would also need to be submitted and reviewed by the staff to ensure that the demonstration or prototype plant is sufficiently similar in design to the plant for which a license is requested, and that the test results can be applied to the safety areas of interest. In addition, the instrumentation and proposed test program would have to be reviewed to ensure adequate data are obtained to form the basis for the NRC staff's licensing decision.

In closing, and in response to comments by ACRS Members Dana A. Powers, Stephen L. Rosen, and Graham B. Wallis, the staff's approach to addressing design-basis accidents for advanced reactors will involve two initiatives: (1) framework research to provide the rationale and technical basis for regulatory decision-making regarding accident selection and (2) activities that follow from SECY-02-0139, activities that will seek Commission guidance on resolving issues associated with event selection and safety classification.

Once again, we would like to thank the ACRS for their review and comment on the Draft Advanced Reactor Research Plan.

Sincerely,

/RA by Patricia G. Norry Acting For/

William D. Travers
Executive Director
for Operations

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
SECY

Once again, we would like to thank the ACRS for their review and comment on the Draft Advanced Reactor Research Plan.

Sincerely,

/RA by Patricia G. Norry Acting For/

William D. Travers
Executive Director
for Operations

cc: Chairman Meserve
Commissioner Dicus
Commissioner Diaz
Commissioner McGaffigan
Commissioner Merrifield
SECY

Distribution:

REAHFB R/F	NChokshi, RES	RTripathi, RES
DSARE R/F	MCunningham, RES	JMitchell, RES
EDO G20020446	ARubin, RES	PKadambi, RES
RES2001421	JRosenthal, RES	MVirgilio, NMSS
DSARE 2002-37	CTrottier, RES	SSteele, NMSS
ACRS File	JMuscara, RES	SCollins, NRR
WKane, DEDR	JPersensky, RES	MGamberoni, NRR
JCraig, AO	RLee, RES	SKoenick, NRR
SCollins, NRR	MSrinivasan, RES	ACubbage, NRR
ISchoenfeld, OEDO	JRidgely, RES	JWilson, NRR
PNorry, OEDO	SArndt, RES	SBurns/KCyr, OGC
DPowers, ACRS	MDrouin, RES	
SRosen, ACRS	ETrager, RES	
GWallis, ACRS	SRubin, RES	
TKress, ACRS	SAli, RES	
CAder, RES	JIbarra, RES	

C:\ORPCheckout\FileNET\ML022310097.wpd
*See previous concurrence
OAR in ADAMS? (Y or N) Y ADAMS ACCESSION NO.: ML022310097 TEMPLATE NO. EDO-004
Publicly Available? (Y or N) Y DATE OF RELEASE TO PUBLIC _____ SENSITIVE? N
To receive a copy of this document, indicate in the box: "C" = Copy without enclosures **"E"** = Copy with enclosures **"N"** = No copy

OFFICE	C:REAHFB	C	D:DSARE		D:DET		D:DRAA	
NAME	JFlack:mtb		FEltawila w/comment		MMayfield w/comment		SNewberry	
DATE	08/19/02*		08/19/02*		08/19/02*		08/19/02*	

OFFICE	NRR		D:RES		DEDMRS		EDO	
NAME	JLyons		AThadani by JStrosnider		CPaperiello		WDTravers	
DATE	08/20/02*		08/20/02*		08/28/02		08/29/02	