



UNITED STATES
NUCLEAR REGULATORY COMMISSION

WASHINGTON, D.C. 20555-0001

May 20, 1994

Dr. Thomas S. Kress, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Dear Dr. Kress:

SUBJECT: DRAFT COMMISSION PAPER ON SOURCE-TERM RELATED TECHNICAL AND
LICENSING ISSUES PERTAINING TO EVOLUTIONARY AND PASSIVE LIGHT WATER
REACTOR DESIGNS

I am responding to the Advisory Committee on Reactor Safeguards' (ACRS') letter to the Chairman dated March 15, 1994, in which you commented on the staff's draft Commission paper pertaining to the application of the revised accident source terms to evolutionary and passive light water reactor (LWR) designs.

In the draft Commission paper, the staff discussed 12 source term-related technical and licensing issues pertaining to either evolutionary LWRs or passive LWRs or both. The staff had previously identified all of these issues in SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs," and notes the ACRS' general agreement with its positions on the issues. Although the ACRS' letter did not specifically address any of the 12 issues discussed in the draft Commission paper, you did offer two general comments associated with the use of the new physically based source term in ALWRs. In the enclosure, the staff responds in detail to each of your comments.

As stated in the enclosure, the staff recognizes the importance of thermal hydraulics and the production of nonradioactive aerosols in determining the behavior of radioactive aerosols in containment. The staff is working to resolve these details during its current review of the applications for final design approval/design certification.

With regard to the ACRS' comment concerning the design criteria for containment volume and strength, the staff recognizes the advantages which would be achieved by putting severe accidents on an equal regulatory footing with design basis accidents. This approach was included as one of the options in the Advanced Notice of Proposed Rulemaking, "Acceptability of Plant Performance for Severe Accidents; Scope of Consideration in Safety Regulations." Currently, the staff is following the Commission's guidance in this matter.



020045

9406070159 940520
PDR ACRS
GENERAL

PDR

O+M-6-Commission ---
X-MH+S-3-2-JB
X-RD-13
X-O+m-7-ACRS
003057

DFD/B
1/1

RETURN TO REGULATORY CENTRAL FILES

Dr. Thomas S. Kress

- 2 -

The staff believes that its positions, as described in the draft Commission paper, are an important first step in applying the new source term to future ALWRs.

Sincerely,

Original signed by
James M. Taylor

James M. Taylor
Executive Director
for Operations

Enclosure:
As stated

cc w/enclosure:
Chairman Selin
Commissioner Rogers
Commissioner Remick
Commissioner de Planque
SECY

DISTRIBUTION:

Central File(w/inc)	EDO#0009888	PDST R/F(w/inc)
PDR	EDO/RF	HThompson
JTaylor	JMilhoan	JBlaha, EDO
WRussell/FMiraglia	DCrutchfield	WTravers
RBorchardt	KCyr, OGC	JHWilson
MTaylor, EDO	RArchitzel	EBeckjord, RES
EJordan, AEOD	WDean, EDO	JMoore, 15B18
RBernero, NMSS	PShea	AThadani, 12G18
PMagnanelli	BSweeney	FGillespie, 12G18
FCongel	MVirgilio	

OFC	PM:PDST	LA:PDST	TECH ED*	SC:PDST*	D:PDST*	DRSS*
NAME	JHWilson:tz	PShea <i>PS</i>	MMejac	RArchitzel	RBorchardt	FCongel
DATE	05/ /94	05/ <i>PS</i> /94	04/07/94	04/12/94	04/12/94	04/19/94
OFC	DSSA*	ADAR:NRR*	ADT:NRR*	D:NRR*	EDG	
NAME	MVirgilio	DCrutchfield	AThadani	WRussell	JTaylor	
DATE	04/26/94	04/28/94	05/06/94	05/12/94	05/ <i>20</i> /94	

OFFICIAL RECORD COPY: GT09888.JHW

* SEE PREVIOUS CONCURRENCE

RESPONSE TO ACRS COMMENTS ON THE DRAFT COMMISSION PAPER ON
SOURCE TERM-RELATED TECHNICAL AND LICENSING ISSUES PERTAINING
TO EVOLUTIONARY AND PASSIVE LIGHT WATER REACTOR DESIGNS

1. **ACRS COMMENT:** We think the realistic specification of the thermal hydraulics and production of nonradioactive aerosols associated with the DBAs [design-basis accidents] is as important as the specification of the source term itself. These conditions can strongly influence the behavior of radioactive aerosols in containment. Additional consideration should be given to developing Commission guidance on the thermal hydraulic conditions and nonradioactive aerosol generation to be coupled with the source terms for the various DBAs.

STAFF RESPONSE: The staff agrees that thermal hydraulic conditions and production of nonradioactive aerosols can strongly influence the behavior of radioactive aerosols in the containment following a DBA. The thermal hydraulic conditions include the containment pressure, relative humidity, and steam condensation and heat removal rates to the containment structure. These thermal hydraulic parameters, as well as the amounts of nonradioactive aerosols produced, differ with the specific reactor accident sequences and with the accident mitigation features provided (e.g., isolation condensers and primary containment cooling system for the simplified boiling water reactor (SBWR) design, containment shell cooling for the AP600 design, and containment spray for the Combustion Engineering (CE) System 80+ design).

Because the AP600 and SBWR designs have been submitted and are under review, the staff does not intend to develop and promulgate specific guidance relative to the impact of thermal hydraulic conditions and production of nonradioactive aerosols on the behavior of radioactive aerosols in containment at this time. It will, however, communicate on these matters with Westinghouse and General Electric (GE) via requests for additional information (RAIs) or similar licensing communication vehicles during the development of the draft safety evaluation reports. In the discussion that follows, the staff has summarized the current status of the three ALWR design reviews that are based on the revised accident source terms.

GE proposed a group of reference accident sequences for the SBWR design that lead to core damage but terminate with the reactor pressure vessel still intact to determine the thermal hydraulic conditions in the containment following the DBA. GE, in turn, used these reference accident sequences to generate the thermal hydraulic conditions using an SBWR version of the MAAP code. The staff is reviewing the GE proposal and will either select its own representative group of accident sequences or, after appropriate review, use the GE-selected accident sequence for its independent determination of the thermal hydraulic conditions and nonradioactive aerosol generation. The staff will use

Enclosure

this information along with the following parameters for evaluating the fission-product behavior and determining the aerosol removal rates in the SBWR containment following a DBA:

- containment geometry
- aerosol characteristics
- aerosol removal by isolation condensers and primary containment cooling systems

Westinghouse has provided neither DBA sequences nor the thermal hydraulic conditions in the containment for the AP600 design. The staff is addressing this matter with Westinghouse by means of RAIs.

The CE System 80+ evolutionary plant design includes a safety-grade containment spray system; therefore, the thermal hydraulic conditions and the amounts of nonradioactive aerosol are less significant for determining the behavior of radioactive aerosol behavior and its removal rates in the containment. Nevertheless, in its evaluation of the System 80+ design, the staff used a steam condensation rate of 100 moles per second (typical value from NUREG-1150) and 350 kilograms (770 lbs) of nonradioactive aerosol (typical value from draft NUREG-1465).

2. **ACRS COMMENT:** We continue to recommend that the general design criteria (GDC) for containment volume and strength for future ALWRs incorporate the spectrum of severe accident challenges described in our report of May 17, 1991. The containment should represent a defense-in-depth feature that is not limited to design basis accidents.

STAFF RESPONSE: The staff included this approach as one of three options selected to be incorporated into the Advanced Notice of Proposed Rulemaking (ANPR) titled "Acceptability of Plant Performance for Severe Accidents; Scope of Consideration in Safety Regulations," which was published in the Federal Register on September 28, 1992.

In SECY-93-226, "Public Comments on 57 FR 44513 - Proposed Rule on ALWR Severe Accident Performance," the staff summarized and discussed the public comments on the ANPR and recommended a proposed approach for proceeding with the drafting of a generic rule. In its staff requirements memorandum dated September 14, 1993, the Commission approved the staff recommendation in SECY-93-226 to delay a decision on the need for generic rulemaking to address severe accidents at least until after the final safety evaluation reports are issued for the ABWR and the System 80+. Further, the Commission recommended that any such generic rulemaking follow completion of the revisions to 10 CFR Part 50 and Part 100. Therefore, the staff intends to follow the direction of the Commission in this matter and will continue further dialogue with the ACRS at an appropriate time in the future.

Borchardt
ACTION

EDO Principal Correspondence Control

FROM:

DUE: 04/14/94

*Assigned to 5/13/94
per memo - 4/6/94*

EDO CONTROL: 0009888

DOC DT: 03/15/94

FINAL REPLY:

J. Ernest Wilkins, Jr.
ACRS

TO:

Chairman Selin

Received 3/21/94

FOR SIGNATURE OF :

** GRN **

CRC NO:

Executive Director

DESC:

ROUTING:

DRAFT COMMISSION PAPER ON SOURCE TERM RELATED
TECHNICAL AND LICENSING ISSUES PERTAINING TO
EVOLUTIONARY AND PASSIVE LIGHT WATER REACTOR
DESIGNS

Taylor
Milhoan
Thompson
Blaha
Mat Taylor
Beckjord, RES
Bernero, NMSS
Jordan, AEOD
Cyr, OGC

DATE: 03/21/94

ASSIGNED TO:

CONTACT:

NRR

Russell

SPECIAL INSTRUCTIONS OR REMARKS:

PREPARE RESPONSE TO ACRS FOR EDO SIGNATURE.
PUT COMMISSIONERS AND SECY ON CC (SHOWN ON
ORIGINAL) FOR REPLY.

ACTION
DUE TO NRR DIRECTOR'S OFFICE
BY April 11

*Critchfield - action
Gody - coordination*



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

March 15, 1994

The Honorable Ivan Selin
Chairman
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Chairman Selin:

SUBJECT: DRAFT COMMISSION PAPER ON SOURCE TERM RELATED TECHNICAL
AND LICENSING ISSUES PERTAINING TO EVOLUTIONARY AND
PASSIVE LIGHT WATER REACTOR DESIGNS

During the 406th and 407th meetings of the Advisory Committee on Reactor Safeguards, February 10-11 and March 10-12, 1994, respectively, we discussed the draft Commission paper on source term related technical and licensing issues pertaining to evolutionary and passive light water reactor (LWR) designs. During these meetings, we had the benefit of discussions with representatives of the NRC staff and industry. We also had the benefit of the documents referenced.

Separate source terms are provided for BWRs and PWRs. The source terms consist of the fraction of the equilibrium core inventory of fission products released into containment, the timing of this release, and the chemical form of the fission product iodine. In the past, such source terms have been specified in Regulatory Guides 1.3 and 1.4 to provide guidance on appropriate values to use in the site suitability analyses that are required by 10 CFR Part 100, and in conjunction with the other design basis accidents (DBAs) in Chapter 15 of the Standard Review Plan. The DBA source terms should not be confused with the plant and sequence specific source terms that are mechanistically derived and used in PRAs and other severe accident analyses. The specifications that are presently in Regulatory Guides 1.3 and 1.4 consist of 100 percent of the noble gases and 25 percent of the iodine (91 percent as elemental iodine, 5 percent as particulate iodine, and 4 percent as organic iodine). For site suitability analyses, these specifications have been used along with a thermal hydraulic specification. These analyses require that a peak containment pressure be calculated for a double-ended break of the largest primary system piping and be applied for 24 hours after which it is to be reduced to half that value.

~~94032 5022~~ 3pp

The 10 CFR Part 100 specifications of the source term have always been viewed as being somewhat arbitrary, but conservative. The proposed revised source terms are intended to remove some of the arbitrariness of the present values and to make them more realistic. As part of the overall process of decoupling site suitability decisions from reactor design, the revised source term and the dose criteria provisions are to be removed from 10 CFR Part 100 and put into 10 CFR Part 50 where they would apply only to design features. The revised source terms are based on values developed in NUREG-1150 for the "in-vessel" release phase associated with severe accidents.

In the draft Commission paper, the staff describes the proposed revised source terms and proposed uses for reviews and assessments of evolutionary and passive LWR designs. The paper discusses positions taken by the staff on source term issues for evolutionary and passive LWR designs (identified in SECY-90-016 and SECY-93-087). The staff believes these positions will provide a basis for closing these issues with respect to design certification reviews and the EPRI Utility Requirements Documents.

We generally agree with the positions taken by the staff on the issues and agree with the principle that the source terms for DBAs should be made more realistic. Realistic source terms should result in more appropriate designs (e.g., engineered safety features, source term mitigation features, sampling and measurement devices, and containment integrity). We believe the changes can lead to increased coherence in the associated regulations and their application. As in all responses to the accumulation of new knowledge, such proposed changes in the regulations, whether toward enhancement or relaxation, or whether applied to existing plants or to future plants, should be assessed for their overall effect on risk. We also have the following concern about the revised source term specifications.

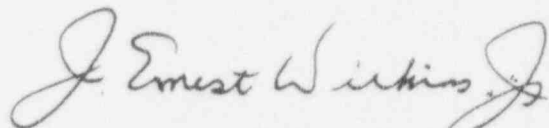
We think the realistic specification of the thermal hydraulics and production of nonradioactive aerosols associated with the DBAs is as important as the specification of the source term itself. These conditions can strongly influence the behavior of radioactive aerosols in containment. Additional consideration should be given to developing Commission guidance on the thermal hydraulic conditions and nonradioactive aerosol generation to be coupled with the source terms for the various DBAs.

We continue to recommend that the General Design Criteria for containment volume and strength for future ALWRs incorporate the spectrum of severe accident challenges described in our report of

March 15, 1994

May 17, 1991. The containment should represent a defense-in-depth feature that is not limited to design basis accidents.

Sincerely,



J. Ernest Wilkins, Jr.
Chairman

References:

1. Memorandum dated January 6, 1994, from Dennis M. Crutchfield, NRC Office of Nuclear Reactor Regulation, for John T. Larkins, Executive Director, ACRS, Subject: ACRS Review of Commission Paper on Source Term-Related Technical and Licensing Issues Pertaining to Evolutionary and Passive Light-Water-Reactor Designs
2. Memorandum dated February 10, 1994, from James M. Taylor, NRC Executive Director for Operations, for the Commissioners, Subject: Draft Commission Paper, "Source Term Related Technical and Licensing Issues Pertaining to Evolutionary and Passive Light-Water-Reactor Designs"
3. SECY-93-087, Memorandum dated April 2, 1993, from James M. Taylor, Executive Director for Operations, for the Commissioners, Subject: Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs
4. SECY-90-016, Memorandum dated January 12, 1990, from James M. Taylor, Executive Director for Operations, for the Commissioners, Subject: Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements
5. NUREG-1150, Volumes 1 and 2, "Severe Accident Risks: An Assessment for Five U.S. Nuclear Power plants," December 1990
6. Report dated May 17, 1991, from David A. Ward, ACRS Chairman, to Kenneth M. Carr, NRC Chairman, Subject: Proposed Criteria to Accommodate Severe Accidents in Containment Design