

# CERTIFIED

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MINUTES OF THE  
ACRS SUBCOMMITTEE ON  
DECAY HEAT REMOVAL SYSTEMS  
MARCH 16, 1982  
WASHINGTON, DC

DATE ISSUED: 4/16/82



The ACRS Subcommittee Meeting on Decay Heat Removal Systems met on March 16, 1982, at 1717 H Street, N.W., Washington, D.C. The purpose of this meeting was to continue the Subcommittee discussions on decay heat removal requirements. Specifically: (1) a status report on Task Action Plan A-45, "Shut-down Decay Heat Removal Requirements," (2) the effectiveness of feed and bleed heat removal processes, (3) an assessment of plant designs without feed and bleed capabilities, and (4) Combustion Engineering's (CE) response to ACRS comments on the CESSAR System-80 Decay Heat Removal Systems. A notice of this meeting appeared in the Federal Register on March 1, 1982 (Attachment A). A copy of the detailed agenda is attached (Attachment B). The handouts for this meeting are included in the ACRS files. No oral statements were received from members of the public. The entire meeting was open to members of the public.

The ACRS members present were D. Ward (Chairman), J. Ebersole, H. Etherington, and J. Ray. ACRS consultants present were I. Catton, P. Davis, E. Epler and Z. Zudans. The principal NRC Staff present were C. Grimes, S. Hanauer, I. Israel, W. Jensen, F. Rowsome, B. Sheron, and A. Thadani. CE was represented by R. Turk. The NRC Federal Designated Employee was Dr. R. Savio, ACRS. Other members of the ACRS Staff included A. Cappucci.

DESIGNATED ORIGINAL

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INTRODUCTORY STATEMENT

Mr. David Ward, Subcommittee Chairman, introduced the members of the Subcommittee and stated the purpose of the meeting. He pointed out that the meeting was being conducted in accordance with the provisions of the Federal Advisory Committee Act and the Government in the Sunshine Act and that Dr. Richard Savio was the Designated Federal Employee for the meeting. He stated that Mr. Cappucci from the ACRS Staff was also present. He also gave recognition to guests from the senior nuclear engineering class at North Carolina State University.

Mr. Ward noted that the Subcommittee would consider two subjects: (1) Task Action Plan A-45 and, (2) the effectiveness of feed and bleed cooling of PWRs. In particular, the response of the NRC Staff and Combustion Engineering to the December ACRS letter concerning this subject. He also requested that the Subcommittee members and consultants express their opinions at the conclusion of the meeting.

NRC STAFF STATUS REPORT ON TAP A-45, A. MARCHESE, NRR

Mr. Marchese briefed the Subcommittee on the status of TAP A-45. He indicated that the Director of NRR disapproved the previous plan because of the large budget, long schedule and tasks in the original plan were more appropriate for industry.

He went on to explain that changes were made in four basic areas which allowed the NRC Staff to reduce the schedule. These areas included: (1) deleting most of the work on future plants except for the development of an acceptance criteria for Decay Heat Removal Systems; (2) quantitative acceptance criteria

based on core melt frequency instead of overall risk to reduce the uncertainty associated with overall risk; (3) relying more on the industry to perform plant specific evaluations to improve Decay Heat Removal Systems for those prime candidate plants which do not meet the NRC Staff's acceptance criteria; and (4) relying on one contractor for overall project management and coordination.

Members of the Subcommittee then questioned Mr. Marchese about the use of core melt frequency as an acceptance criteria. Mr. Marchese clarified certain points concerning the overall core melt frequency goal and its breakdown to establish reliabilities on various systems which are involved in the Decay Heat Removal System. Mr. Etherington raised the question of core melt as compared to the TMI-2 accident. Mr. Marchese stated that the core melt defined for Decay Heat Removal Systems would be worse than TMI-2. Dr. Hanauer of the NRC Staff stated Mr. Marchese's answer should be amended a little. He went on to explain that the analytical models for core melt would be indistinguishable from TMI-2 because of the lack of fine structure in the model.

Manpower and funding were discussed briefly. Mr. Marchese indicated that the Director of NRR would authorize spending the budget allocated for TAP A-45 with the goal of October 1984 as the completion date. However, the Subcommittee expressed doubt as to meeting this reduced schedule. There was concern as to the manpower allocated by NRR and that NRR had "backburnered" this program in the past.

Mr. Marchese then presented the details of the revised TAP A-45. Mr. Ward noted that the intent of the presentation by Mr. Marchese had changed and

that the Subcommittee was expected to review the changed plan at the Subcommittee meeting. Following the presentation by Mr. Marchese and numerous questions by the Subcommittee members and the Consultants, Mr. Ward solicited summary comments from the same concerning TAP A-45.

Mr. Epler stated his concern that general purpose plant systems were required to be adequate for very sensitive applications and that the cost for modifications in most cases would be greater than the initial cost of the plant. He indicated that incentives exist for the industry to establish schemes for decay heat removal without being coerced into modifying existing systems.

Mr. Davis stated that he would like to see the draft plan. He indicated that the NRC Staff was moving in the right direction.

Mr. Zudans indicated that the industry should design the system and then determine what limits were acceptable. He also indicated that the NRC staff's approach was adequate in terms of the overall core melt frequency goal and associated system reliability.

Dr. Catton agreed with the basic criteria for core melt frequency. He also commented on the lack of NRC Staff manpower applied to the decay heat removal issue and agreed with Mr. Epler's arguments for dedicated Decay Heat Removal Systems. Dr. Catton finally stated that the single contractor approach was the only reasonable method of meeting schedules.

Mr. Ray stated that he had concerns about the minimal NRC Staff applied to TAP A-45 and delegating too much responsibility to contractor. He indicated that industry would rather deal with the NRC Staff.

Mr. Etherington voiced his concern over the  $10^{-4}$  core melt frequency goal. He indicated that the number should be reduced if possible.

Mr. Ebersole indicated that he would be suspicious of decay heat removal systems which were not dedicated.

Mr. Ward then discussed with the Subcommittee and the NRC Staff the feasibility of obtaining a copy of the TAP A-45 draft and a brief presentation to the full Committee in April.

GENERAL OVERVIEW OF FEED AND BLEED CAPABILITY FOR OPERATING PLANTS, W. JENSON,  
B. SHERON - NRR STAFF

Dr. Sheron gave a brief outline as to the content of the Reactor Systems Branch (NRR) presentation on feed and bleed capability. He was directly followed by Dr. Jensen of the same organization who presented a summary of the feed and bleed capabilities of operating plants and the analysis underway by industry to assess feed and bleed operation. He pointed out that the NRR Staff has divided all the operating plants into three categories. These categories included: (1) plants with High Pressure Injection (HPI) capable of feed and bleed while depressurizing, (2) plants which are required to depressurize with the PORVs prior to feed and bleed, and (3) plants without feed and bleed capability, i.e., PORVs have insufficient capability for feed and bleed operation.

Dr. Jensen continued by describing the core cooling requirements for the three types of plants. He pointed out that the ECCS (HPI) in flow must be greater than the primary coolant boil-off, approximately 40 lbs/hr. Mwt for

Type 1 plants. There was some discussion as to the validity of this number. It was pointed out by the Subcommittee that 40 lbs/hr. Mwt was in disagreement with the flow requirements presented in B. Sheron's memorandum, 7 gal/min. Mwt (~ 500 lbs/hr. Mwt). Following this discussion, Dr. Jensen discussed work performed by B&W concerning feed and bleed capability. The Subcommittee members also expressed some concerns as to the heat rejection rate out of the safety valves, specifically with reference to the pressurizer going solid and the safety valves passing only water. The NRC Staff stated that they would try to get more information concerning this matter, but pointed out that the analysis was not performed by the NRC Staff, but by Babcox and Wilcox.

Dr. Jensen indicated that most of the operating plants could perform primary system decay heat removal by feed and bleed. He summarized by stating that for feed and bleed operation, Type 1 plants would require an ECCS capability and PORV capacity of 40 lb/hr. Mwt. Type 2 plants would require a higher PORV capacity, 74 lb/hr. Mwt, and still be able to replace the same decay heat boil off with HPI. Type 3 plants would not be capable of feed and bleed operation. Davis-Besse was the only type 3 plant identified.

Dr. Sheron discussed ongoing work the NRC Staff is performing with regard to feed and bleed, specifically focusing on the Combustion Engineering NSSS without PORVs. He explained the process by which the auxiliary pressurizer spray system could be utilized for primary system depressurization, further stating that this method was still under review by the NRC Staff.



The NRC Staff commented on PORV operation from the control room as being very plant specific. Dr. Sheron cited Calvert Cliff's procedures for pulling two control modules behind a control panel to open the PORVs. Dr. Sheron also discussed the instrument air operated PORVs at Ginna and how on an ECCS signal the instrument air is isolated. He further discussed other probable ways to operate the PORVs but pointed out that the operator would have to be familiar with the procedure.

ASSESSMENT OF PLANT DESIGNS WITHOUT FEED AND BLEED CAPABILITIES, S. ISRAEL, NRR; F. ROWSOME, RES, A. THADANI, NRR

F. Rowsome, RES, in response to the controversial nature of his memorandum, dated January 29, 1982, to R. Tedesco and T. Speis concerning feed and bleed capability put his "quick and dirty" analysis in perspective. He indicated that the recommendations were overstated and at most would warrant further study and consideration. He also stated that, the recommendations as to the worth of having PORVs or not were not a positive recommendation for a ratchet. He further apologized to CE plantowners, CE, NRR and to the Subcommittee members for the overstatements. He indicated that the analysis was correct, but was incomplete and bounded by broad uncertainties. The analysis looked at loss of main feedwater, loss of offsite power, very small LOCA (including stuck open PORV LOCA). The core melt frequency used was based on the first core ( $B.E = 10^{-3}$ ) for loss of all feedwater where the value at maturity ( $B.E. = 10^{-5}$ ) is a good deal lower. The fault tree analysis for auxiliary feedwater used industry averages for failures. He indicated that these numbers were suspect due to the spread, some very high failure rates and some very low. Other problem areas noted within the fault tree analysis were; finite test efficiency and ignoring

other common cause failures (only loss of AC power was considered) such as loss of instrument air. He made the point that the RES assessment indicated that providing feed and bleed capability was not necessary to mitigate the small break LOCAs, that the dependence on auxiliary feedwater did not appear to be limiting, and that inadvertent opening of an unblocked PORV was a sensitive function of the valve control reliability. Following these findings Mr. Rowsome made a brief statement concerning the value impact statement.

The NRC Staff recommended that PORVs not be made a licensing requirement for plants currently under review and the feed and bleed issue should be studied more thoroughly. Also discussed were the severe accident scenarios, such as Event V, and how depressurizing through PORVs could be beneficial.

S. Israel from the NRR Staff gave a brief presentation as to the analysis NRR performed concerning auxiliary feedwater reliability. He pointed out that the study performed was narrow and considered only simple loss of feedwater events such as loss of lube oil, loss of steam to FW pump, electrical disturbances (loss of power), and loss of condensate pumps. The Subcommittee members questioned Mr. Israel as to considering common mode failures and the interdependencies of support systems. The Staff stated that interdependencies were looked at for the AC systems, however support systems were not. Mr. Rowsome made some comments concerning WASH-1400 and support system interdependencies and concluded, after being asked by the Mr. Ebersole, that common cause failures and support system interdependencies need to be considered in these types of analysis.



A few comments were made by R. Lobell, NRR, concerning the reliability of the auxiliary feedwater system. He pointed out that although certain support systems interdependencies may not be included in all reliability studies, external events such as these are analyzed deterministically during the normal plant review process. Mr. Zudans also pointed out that the Subcommittee's interest was in the quantitative effects produced by including these events in the auxiliary feedwater system reliability determination.

Following this discussion Mr. R. Lobell, NRR, answered questions previously asked by the Subcommittee members. These questions concerned loss of AC power and cooling capability for the auxiliary feedwater pump room and protection against steam supply failure for Palo Verde. Also of concern was the failure of filters which affect multiple auxiliary feedwater pumps (common mode failure). He indicated that the steam driven auxiliary feedwater pump could run for approximately two hours without room cooling and the steam driven pumps were only used 2% of the time, therefore a steam line break was not credible. Mr. Lobell also stated that the NRC Staff did consider common mode failures from filters in their reliability studies.

STATUS REPORT - CESSAR SYSTEM 80 STANDARD PLANT REVIEW, C. GRIMES, NRR,  
R. TURK, CE, G. DAVIS, CE

Mr. Grimes, NRR, presented a very brief summary of the CE System 80 Standard Plant Review. Some concern was expressed by the Subcommittee consultants concerning the review of the System 80 Standard Plant in terms of BOP support systems, specifically the bearing lubrication supply for the pumps.

Mr. George Davis, CE, explained the intent of the CE presentation concerning adding PORVs to allow feed and bleed type operations. Disregarding steam generator integrity he stated that CE sees no significant increase in safety for adding motor operated valves to the pressurizer. This conclusion was based upon feed and bleed being beyond the design basis, and if the capability for feed and bleed was required, secondary depressurization would be an alternative.

Mr. R. Turk, CE, stated that CE reached the conclusion that the auxiliary feedwater system adequately protects the health and safety of the public. This is based on CE's opinion as the high reliability of the emergency feedwater system. He went on to explain that this meant three safety related pumping sources, power supplies, and circuitry. Mr. Ebersole asked what CE plans to do about Palo Verde (one train of auxiliary feedwater is not safety-related). Mr. Turk replied that modifications had been made to third pump which satisfy CE's interface requirements.

Mr. Turk explained some advantages to not pursuing feed and bleed operation. These consisted of maintaining the integrity of reactor coolant pressure boundary, accessibility enhancement when using secondary side for heat removal, including containment, would allow other feed and bleed strategies. He went on to explain that the normal PORV function was carried out by using pressurizer spray with low temperature overpressure protection carried out by the Shutdown Cooling System Relief Valve.

There were some questions by the Subcommittee members concerning low temperature overpressure protection. Following these questions, Mr. Turk

addressed the reliability of the emergency feedwater system. He stated that interface requirement would specify that the auxiliary feedwater system would have an unavailability of  $10^{-4}$  to  $10^{-5}$  per demand. The Subcommittee indicated that this number was a little optimistic. Further discussion followed concerning the basis for this number and the NUREG-0635 analysis methodology used. Concern was expressed by Subcommittee members with regard to the inclusion of all common cause failures and the caveat expressed for justifying larger unavailabilities.

CE continued their presentation by describing other systems involved in decay heat removal and their safety related classification. Also, they discussed the reason for the difference between RES core melt frequency ( $10^{-3}$ ) and the CE core melt frequency ( $5 \times 10^{-6}$ ). It was explained that the analysis in the Rowsome memo used only first core data instead of mature plant data. CE also used auxiliary feedwater system unreliability data generated by Bechtel for the Palo Verde Plant.

Mr. Turk presented an alternative decay heat removal scheme upon loss of feedwater. It consisted of depressurizing the steam generators using an atmospheric dump valve and some surrogate pump to maintain steam generator flow at some low pressure.

NRR COMMENTS, B. SHERON, NRR

B. Sheron, NRR, indicated that the NRC Staff feels that PORVs are not necessary on the System 80. This conclusion was based upon previous discussions by the NRC Staff and CE concerning auxiliary feedwater

reliability. He also stated that in order to perform a reasonable cost-benefit analysis the analysis should go beyond auxiliary feedwater reliability.

Dr. Sheron also stated that the CE report on depressurization and decay heat removal capabilities for the System-80 NSSS was still under review by the Staff. The Staff has many questions concerning decay heat removal for System-80. A few of these are given below:

- ° Probability of tube rupture in more than one steam generator.
- ° Can PORVs manage a tube rupture better than pressurizer auxiliary spray?
- ° Detailed information concerning CE proposed low pressure systems used for emergency water to the steam generators.

B. Sheron, NRR, also indicated that whatever questions are asked CE concerning exclusion of PORVs from System-80 plant design will be asked of SONGS-2 and 3 and Waterford. Based on information to date, the Staff has concluded that PORVs are not necessary to compensate for AFW unreliability for System-80 plants.

SUBCOMMITTEE MEMBERS' AND CONSULTANTS' COMMENTS, D. WARD, J. EBERSOLE, H. ETHERINGTON, J. RAY, I. CATTON, Z. ZUDANS, P. DAVIS, AND E. EPLER

D. Ward, Subcommittee Chairman, summarized the requests of the full Committee in their December letter. He indicated that the full Committee had expressed concerns about: (1) independence and reliability for System-80 auxiliary feedwater system, (2) the integrity of the steam generators for decay heat removal, and (3) the potential for adding valves to allow rapid depressurization of the System-80 primary system. Mr. Ward went on to say that the

the Subcommittee would report at the April full Committee. The report would take approximately two hours and include: (1) an assessment of today's meeting, (2) the NRC Staff requirements for System-80 Decay Heat Removal, (3) Problems concerning the CESSAR interface in the BOP, and (4) a status report associated with TAP A-45.

Mr. Epler indicated that full resolution of this issue (feed and bleed) and the pressurized thermal shock issue should be accomplished in order to continue on with new plants. He also voiced concern for partial solutions such as installing PORVs which could preclude full resolution of these issues.

Mr. Davis expressed concerns for the burden feed and bleed type operations would put on the operator. He indicated that not very much was said as to the problems the operator might face. He further stated that any conclusions drawn as to the effectiveness of feed and bleed operations should include what tools the operator has at his disposal, i.e. procedures, training, etc.

Mr. Zudans expressed significant confidence in the CE steam generator design and felt that the thermal shock question had been well answered. The probabilistic numbers for auxiliary feedwater unavailability were probably adequate but the qualifiers should be removed and the interface requirements be better defined. He also stated concerns for using the PORVs during feed and bleed operation and the effects on pressurized thermal shock.

Dr. Catton stated that Combustion Engineering was probably not the group the Subcommittee should be talking to concerning auxiliary feedwater reliability. He indicated that interface requirements were one thing and meeting them was another. He suggested discussing this with a responsible design organization such as Bechtel. Dr. Catton made certain comments about steam generator design and chemistry. He indicated that he would like to see the studies which form the basis for the CE design. Finally, Dr. Catton expressed his feeling that not enough was known about depressurization to express a positive opinion and that the burden on the operator would be tremendous.

Mr. Ray also expressed concerns as to the burden on the operator and that the NSSS suppliers must recognize this problem in writing procedures and providing training.

Mr. Etherington stated Combustion Engineering had made a persuasive presentation as to PORVs not being required. However, he felt it would be a nice thing to have. He further stated that the full Committee asked the NRC Staff to consider additional valves and the Staff is continuing in this direction. He indicated that a final report is in the future and not at this time. Mr. Etherington was asked by Mr. Ward if restrictions should be placed on operating licenses at this time. He replied in the negative.

Mr. Ebersole indicated that CE should include interface systems in another expression of integral auxiliary feedwater reliability. On obtaining that, the fraction of its contribution to core melt on a non-PORV design should be determined.



Before adjourning the meeting, Mr. George Davis of Combustion Engineering question Mr. Ward as to the Subcommittee's recommendation concerning delaying licensing. Mr. Ward indicated that the Subcommittee consensus recommendation would include not delaying operating licenses for CE plants.

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NOTE: Additional details can be obtained from the transcript located in the Public Document Room, 1717 H Street, N.W., Washington, D.C. 20555 or from Alderson Reporting, Inc., 400 Virginia Avenue, S.W. Washington, D.C. (202) 554-2345.

**NUCLEAR REGULATORY  
COMMISSION****Advisory Committee on Reactor  
Safeguards; Subcommittee on Decay  
Heat Removal Systems; Meeting**

The ACRS Subcommittee on Decay Heat Removal Systems will hold a meeting on March 16, 1982 in Room 1046, 1717 H Street, NW., Washington, DC. The Subcommittee will review the status of task Action Plan A-45, "Shutdown Decay Heat Removal Requirements" and the effectiveness of PWR Decay Heat Removal Systems with the emphasis on the CESSAR System 80 standard design. Notice of this meeting was published February 17.

In accordance with the procedures outlined in the Federal Register on September 30, 1981 (46 FR 47903), oral or written statements may be presented by members of the public; recordings will be permitted only during those portions of the meeting when a transcript is being

kept, and questions may be asked only by members of the Subcommittee, its consultants, and Staff. Persons desiring to make oral statements should notify the Designated Federal Employee as far in advance as practicable so that appropriate arrangements can be made to allow the necessary time during the meeting for such statements.

The entire meeting will be open to public attendance except for those sessions which will be closed to protect proprietary information (Sunshine Act Exemption 4). One or more closed sessions may be necessary to discuss such information. To the extent practicable, these closed sessions will be held so as to minimize inconvenience to members of the public in attendance.

The agenda for subject meeting shall be as follows:

**Tuesday, March 16, 1982**

*8:30 a.m. until the conclusion of business.*

During the initial portion of the meeting, the Subcommittee, along with any of its consultants who may be present, will exchange preliminary views regarding matters to be considered during the balance of the meeting.

The Subcommittee will then hear presentations by and hold discussions with representatives of the NRC Staff, their consultants, and other interested persons regarding this review.

Further information regarding topics to be discussed, whether the meeting has been cancelled or rescheduled, the Chairman's ruling on requests for the opportunity to present oral statements and the time allotted therefor can be obtained by a prepaid telephone call to the cognizant Designated Federal Employee, Dr. Richard Savio (telephone 202/634-3267) between 8:15 a.m. and 5:00 p.m., EST.

I have determined, in accordance with Subsection 10(d) of the Federal Advisory Committee Act, that it may be necessary to close portions of this meeting to public attendance to protect proprietary information. The authority for such closure is Exemption (4) to the Sunshine Act, 5 U.S.C. 552b(c)(4).

Dated: February 24, 1982.

John C. Hoyle,

Advisory Committee Management Officer.

[FR Doc. 82-3418 Filed 2-25-82; 8:45 a.m.]

BELLING CODE 7590-01-8

3/15/82

ATTACHMENT B

\*\*\* AGENDA \*\*\*

DECAY HEAT REMOVAL SYSTEMS  
SUBCOMMITTEE MEETING  
MARCH 16, 1982

- |  |                  |                  |
|--|------------------|------------------|
| 1. Executive Session   |                  | 9:00 - 9:15 am   |
| 2. Status Report on Task Action Plan A-45 -<br>A. Marchese, NRR  | 1-1/2 hr         | 9:15 - 10:45 am  |
| *** BREAK ***  | 15 min           |                  |
| 3. Summary of Feed and Bleed Capability for<br>Existing Plants - NRR   | 1 hr             | 11:00 - 12:00 am |
| a. Summary of Existing Designs/Envrionmental<br>Qualification  | 30 min           |                  |
| b. Summary of Existing Analysis for Feed and<br>Bleed Processes  | 15 min           |                  |
| c. ACRS Subcommittee Comments  | 15 min           |                  |
| *** LUNCH ***  |                  | 12:00 - 1:00 pm  |
| 4. Assessment of Plant Designs Without Feed and<br>Bleed Capabilities - F. Rowsome, RES<br>and A. Thadani, NRR | 1 hr &<br>45 min | 1:00 - 2:45 pm   |
| *** BREAK ***  | 15 min           |                  |
| 5. Status - CESSAR System 80 Standard Plant<br>Review - NRR/CE/  |                  | 3:00 - 6:15 pm   |
| a. NRR Status Report - NRR   | 30 min           |                  |
| b. CESSAR System 80 Evaluation - CE  | 2 hrs            |                  |
| c. RES/NRR Comments  | 15 min           |                  |
| d. ACRS Subcommittee Comments  | 30 min           |                  |