

ENCLOSURE 1

## WORKING PAPER ON RESIDUAL HEAT REMOVAL

I. Summary of Proposal

A revision to Standard Review Plant (SRP) 5.4.7 on the Residual Heat Removal (RHR) System is proposed to accomplish the following:

- (1) Approve a Branch Technical Position that documents the current NRR position on residual heat removal, from the reactor, and
- (2) Clearly delineate the review responsibilities of the Reactor Systems and Auxiliary and Power Conversion System Branches regarding residual heat removal.

II. Background

An overall staff position on residual heat removal has been evolving for several years. After a large number of ad hoc decisions on individual cases, a joint technical review - projects position was reached and documented in Reference 1, in February 1974. Although this position has been generally applied since that time, its application has not been consistent. Apparently this is because Reference 1 was never formalized as a branch position or regulatory guide. Some representative plants that have been required to satisfy many elements of the proposed position are CESSAR, WPPS 3 and 5, Floating Nuclear Power Plant.

The attempted imposition of the positions in Reference 1 to the Standard RESAR-41 and GESSAR plants led to appeals by General Electric and Westinghouse. At meetings the reactor manufacturer's position has been that the RHR system was not required to be designed as a safety system since:

- (1) The plant could remain at hot shutdown conditions indefinitely, and
- (2) There are alternate (other non-safety grade) means of reducing the reactor coolant system temperature and pressure.

However, the positions stated by the reactor manufacturer's are not completely consistent with GDC 34. General Design Criteria (GDC) 34 clearly states:

- (1) Removal of residual heat from the reactor is a safety function,

- (2) The safety function is to be accomplished with only on-site or off-site power available,
- (3) The safety function is to be accomplished using only safety grade equipment, and
- (4) The safety function is to be accomplished despite a single failure.

GDC 34 does not explicitly require that the plant be brought to a cold shutdown condition. However, there is an implied requirement (based on reasonable engineering design) that the plant be able to be brought to a cold, depressurized condition in a reasonable length of time. This step is necessary, if removal of fuel is to be accomplished.

The reactor manufacturer's position stated in the appeals meeting led, in turn, to a complete re-evaluation of all aspects of the position by the NRC staff. The major conclusions of this staff re-evaluation were:

- (1) The requirements imposed on the RHR system were generally supportable by the regulations, but in some cases were too inflexible.
- (2) The position considered only low pressure RHR systems that were located outside of the containment.
- (3) Definitive design criteria should be established for the systems and components needed to lower the reactor coolant temperature and pressure values that permit operation of the RHR system.

A revised position that corrected these deficiencies was developed by the staff. This position was documented in the response to the reactor manufacturers' appeals. (References 2 & 3).

### III. Proposed Position

The objective of the proposed Branch Technical Position is to establish definitive design requirements for all of the systems that are required to transfer residual heat from the reactor to the ultimate heat sink. In addition the position considers the possibility of high pressure RHR systems and low pressure RHR systems located inside of containment, as well as the more typical low pressure RHR system that is located outside of the containment.

The overall position is presented in Branch Technical Position RSB 5-1, "Design Requirements of the Residual Heat Removal System."

#### IV. Value Assessment

The proposed Branch Technical Position and revisions to SRP 5.4.7 define requirements for a safety grade system(s) to transfer fission product decay heat from the reactor to the environment. The entire range of reactor coolant system temperature and pressures, from normal operating values to cold shutdown are considered in the proposed position. Previous positions only treated the range of temperatures and pressures that occurred once the RHR system was placed into operation. As noted in the following paragraph, the transfer of fission product decay heat to the environment over this entire range is important to safety.

The importance to safety of an operable method of transferring this heat is demonstrated by the results presented in the final draft of the Reactor Safety Study, WASH-1400. That report shows, for PWR's, that the inability to remove decay heat from the reactor following a normal shutdown has a higher probability of resulting in a core melt than does a large LOCA for all seven of the radioactive release categories associated with a core melt. For BWR's, the report shows that the inability to transfer decay heat from the reactor following a normal shutdown is the largest contributor to the core melt probability for the four highest radioactive release categories. Therefore, it is obvious that the ability to transfer heat from the reactor to the environment is an extremely important safety function, for both PWR's and BWR's.

The promulgation of a definitive Branch Technical Position will also increase the efficiency of the review process. Recently, a series of ad hoc decisions have been made regarding specific deviations from the proposed position. Each of these decisions have been preceded by a series of time consuming meetings with the applicant and with various levels of management. A definitive position should eliminate much of this effort.

#### V. Impact Assessment

The impact of the proposed position is anticipated to be relatively small. Since the proposed position is intended to be applied only to Standard Plants and future CP reviews, any required design change should be able to be accomplished as part of the normal plant design effort.

The anticipated design changes and analysis requirements are as follows:

- (1) For PWR's, the atmospheric dump valves would have to be designed to safety grade standards and would have to be provided with on-site and off-site power supplies. An analysis would have to be provided to show that the plant could be brought to a cold shutdown condition (200°F) within a reasonable period of time with only on-site or off-site power available, assuming the most limiting single failure. Since the RHR system, with no single failure, is designed to reduce the reactor coolant temperature to about 140°F in 24 hours, for the purpose of refueling, no significant difficulty is anticipated in satisfying this "reasonable period" requirement of bringing the plant to 200°F with a single failure. The proposed revision to SRP 5.4.7 specifies 36 hours as being a reasonable period.
- (2) For BWR's, the reactor manufacturer has verbally stated that their design satisfies all of the requirements of the proposed position. However, documentation is required to show that this is the case.

Since the design changes and additional efforts required are small, no schedule delays are anticipated. The NRC staff does not have specific cost information; however, any hardware costs resulting from the proposed position are thought to be small.

#### VI. Proposed Implementation Plans

Approval of the RRRC is requested to include the proposed position in the SRP as a Branch Technical Position and begin implementation in the review of custom CP applications docketed after March 1, 1976 and all standard plant applications. SD also will be requested to initiate development of a Regulatory Guide. When the Guide is issued, the SRP would be revised to delete the Branch Technical Position and reference the Guide, so that any changes in the position resulting from the development of the Guide would be incorporated.

#### VII. Backfitting Potential

The position of NRC regarding implementation of regulatory guides and branch positions is expressed in Reference 4. This letter, which received concurrence from Mr. Rusche and Dr. Knuth states that, "Branch technical positions...are used in the review of active applications. As with regulatory guides, only in rare cases where

essential matters are involved will they be backfitted by applying them to plants already reviewed and then in accordance with 10 CFR 50.109." Regarding Regulatory Guides, the letter states, "Only in rare cases where truly essential matters are involved do we plan to consider backfitting, and then based only on careful case-by-case reviews and in accordance with the requirements of 10 CFR Part 50.109."

Based on this stated NRC philosophy, the proposed position is not considered to be a subject of backfit requirements.

#### VIII. Coordination

The proposed Branch Technical Position has been extensively reviewed within NRR. The position incorporates the requirements stated in references 2 and 3. These letters had concurrence from the Director and appropriate Assistant Directors of Technical Review and Reactor Licensing.

#### References:

1. Memorandum to R. C. DeYoung, V. Stello, et. al., from John Angelo entitled "RP-TR Staff Meeting of February 13, 1974 Regarding the Requirements on Shutdown Cooling Systems," February 28, 1974.
2. Letter to Mr. Clement Eicheldinger, Westinghouse Electric Corporation from Roger Boyd, November 12, 1975.
3. Letter to Mr. Ivan Stuart, General Electric Company, from Roger Boyd, November 12, 1975.
4. Letter to Mr. J. D. Geier, Illinois Power Company, from Robert Minogue, July 8, 1975.