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STOLZ,J.F. Operating Reactors Branch 4

SUBJECT: Forwards response to 830509 request for addl info re natural circulation cooldown procedrues & supporting analytical bases.Natural circulation cooldown unlikely undertaking at facility.Procedures & training provide appropriate guidance.

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July 19, 1983

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attention: Mr. John F. Stolz, Chief
Operating Reactors Branch No. 4

Subject: Oconee Nuclear Station
Docket Nos. 50-269, -270, -287

Dear Sir:

By letter dated May 9, 1983, the NRC staff requested additional information regarding natural circulation cooldown procedures and supporting analytical bases. Duke Power Company has previously responded to the subject of natural circulation cooldown by letter dated November 5, 1981 (response to Generic Letter 81-21). The following is our response to the recent staff request.

Natural circulation cooldown mode of operation is not expected to be undertaken at Oconee Nuclear Station except for SBLOCA events which do not allow continued operation of or restart of reactor coolant pumps. In all other situations, procedures recommend that hot shutdown be maintained until those systems required for forced circulation are put back into service. This operating strategy constitutes good practice which takes advantage of two rather unique operating capabilities at Oconee. The first capability is the design feature which maintains main condenser circulating water flow by gravity following a loss of offsite power. This feature allows condenser vacuum to be maintained and thus allows closed loop recirculation of condensate which might normally be steamed to atmosphere at other nuclear stations. Thus, concerns regarding the adequacy of condensate inventory are not substantiated. Furthermore, if for some reason the condensate inventory were exhausted, there exist several additional feedwater sources for providing long term decay heat removal. The second capability is the large capacity of the Keowee hydro units, which are the emergency power sources at Oconee, and can be utilized for powering a reactor coolant pump as necessary, following a loss of all other offsite and onsite power sources. One transmission line from Keowee is underground and the other is above ground, thus reducing any vulnerability to natural phenomena. For the above reasons, the concerns outlined in the NRC letter regarding natural circulation cooldown at Oconee are not shared by Duke Power Company.

Regardless of the low likelihood of implementing a natural circulation cooldown, procedures are in place which address the relevant phenomena associated with natural circulation cooldown. "Planned Initiation of Natural Circulation and Natural Circulation Cooldown", OP/0/A/1102/16 (copy attached), provides the operator with the appropriate guidance and includes precautionary steps to avoid developing a vessel head void. This procedure interfaces with "Inadequate Core Cooling", OP/0/A/1106/35, if symptoms of a head void exist. These procedures,

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along with the training which has been implemented following the St. Lucie event, constitute a comprehensive treatment of the natural circulation cooldown mode.

The NRC letter has correctly noted that the version of the B&W Abnormal Transient Operating Guidelines (ATOG) which was reviewed by the NRC (Oconee 3 Draft ATOG) does not include guidance on vessel head voids. Duke Power Company has a program underway which will result in this identified deficiency, as well as all other known deficiencies in ATOG, being addressed fully in the upgraded station emergency procedures prior to implementation. NRC issuance of the SER on ATOG will greatly expedite completion of this effort.

Duke Power Company has stated and maintains the position that explicit analyses of natural circulation cooldown do not provide any benefit for improved operation of the station. This statement is based on the following considerations. We have reviewed existing analyses including the references in the NRC letter, and also analyses performed by other vendors and utilities. Based on our review of the analyses we have concluded that the analytical models and assumptions do not realistically simulate the physical phenomena. The results of the different analyses, in our estimate, either over-predict or under-predict the cooldown rate which would prevent drawing a vessel head void. These conclusions are based on the approaches taken (i.e., intentionally conservative) by the analysts, and by code and model limitations. In addition, the analyses are only valid for the scenario analyzed. The initial and boundary conditions for initiating a natural circulation cooldown can vary substantially from case to case.

It seems more appropriate to develop station operating procedures for natural circulation cooldown based on nominal cooldown rates (50°F/hr), and to provide contingencies in the event symptoms of a vessel head void are indicated. With this approach two situations will be avoided: 1) the operator will not be guided based on analyses which are potentially invalid, 2) the natural circulation cooldown will not be needlessly slowed in a situation where the symptoms of the concern can be readily detected and the appropriate response made at that time. A vessel head void is a condition which can be managed without undue difficulty.

In summation, the Oconee Nuclear Station has rather unique operating capabilities which justify the position that a natural circulation cooldown is a very unlikely undertaking. Procedures and training address the relevant phenomena and provide appropriate guidance and precautions. Analyses of vessel head cooling have not resulted in any technical guidance of a realistic nature on which Duke Power Company would base station operating procedures. Reactor vessel head voids and natural circulation cooldown are processes which have been sufficiently addressed.

Attachment 1 is an item-by-item response to the enclosure of the May 9, 1983 letter.

Very truly yours,

Hal B. Tucker

Hal B. Tucker

RLG/GBS/php

Attachments

cc: Mr. James P. O'Reilly, Regional Administrator
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Region II
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Mr. J. C. Bryant
NRC Resident Inspector
Oconee Nuclear Station

Mr. John F. Suermann
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Washington, D. C. 20555

HRD/RLG
July 19, 1983

Duke Power Company
Oconee Nuclear Station

Attachment 1
Response to NRC Request for Information
Natural Circulation Cooldown

1. Provide a detailed description of your plant operation during natural circulation cooldown. Discuss the basis for procedures used during this type of operation. Include guidance provided on prevention and mitigation of upper head voiding.

   Response:

   "Planned Initiation of Natural Circulation and Natural Circulation Cooldown" (OP/0/A/1102/16) is provided as Attachment 2. This procedure is the governing procedure, along with other procedures which are referenced. Operator training following the St. Lucie event, which incorporated guidance from B&W, along with Duke Operating experience constitute the basis for the procedure.

2. Document any demonstration (analysis or test) that shows the use of natural circulation cooldown procedures will not result in upper head voiding.

   Response:

   Duke Power Company has reviewed analyses of natural circulation cooldown from all available industry sources. We do not consider these analyses to be sufficiently realistic, such that we would not consider utilization of such analysis results as a basis for operating procedures. A better approach is to utilize a nominal cooldown rate of 50°F/hr and allow the cooldown to proceed until a vessel head void, if any, were to develop. At that time the operator would promptly terminate depressurization until no symptoms of the void remained. This symptom-oriented approach is consistent with current industry philosophy, and would result in the optimum recovery.

3. If voiding were to occur during natural circulation cooldown, what procedural steps will be taken to assure that no void would form in the hot-leg, thus blocking natural circulation.

   Response:

   In order for a reactor vessel void to enter the hot leg, the void volume would have to increase in size to approximately 1100 ft^3. Since the operator would be closely monitoring the pressurizer level for an indication of a vessel head void, it is not credible that a void of this size would go unnoticed. Considering a minimum pressurizer level of 100 inches, a void of 1100 ft^3 would require the pressurizer level to increase to a water solid condition. The operator would stop any RCS depressurization upon indication of a vessel head void, and thereby terminate void growth. Pressurizer heaters would then be utilized to restore pressure control. Furthermore, once the vessel mixture level due to a head void decreased to near the subcooled coolant interface maintained by natural circulation, it is not mechanistic to consider further void growth. The steam would condense on the subcooled liquid. Provided that subcooled natural circulation was maintained, the growth of a vessel head void is a self-limiting process.

4. Provide an analysis that shows the Oconee units have sufficient condensate supply to support a conservative estimate of the time to cool down and depressurize for transfer to the decay heat cooling system. Note that Reference 3 concludes:

   o A natural cooldown without voiding will take a minimum of 84-130 hours.
   o 30 hours are required to collapse a 458 ft^3 steam bubble at 200 psig during an isobaric process, and
   o Raising RCS pressure to accelerate bubble condensation is an ineffective mechanism because the RV head is essentially adiabatic.

   Response

   The Oconee Nuclear Station has the capability to recirculate condensate in a closed loop during natural circulation. This rather unique design feature justifies the position that condensate inventory is of no concern. Furthermore, several additional feedwater sources are available to provide decay heat removal as necessary.