WCAP-11908

CONTAINMENT INTEGRITY ANALYSIS
FOR
DONALD C. COOK NUCLEAR PLANT
UNITS 1 AND 2

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B. Radial Xenon Methodology

The insertion or withdrawal of control rods while changing power level can cause radial xenon redistribution as well as axial xenon redistribution. Since $F_Q(z)$ increases caused by radial xenon redistribution cannot be modeled in the axial model used to evaluate F_Q, this factor must be taken into account with separate calculations. $F_Q(z)$ increases due to radial xenon transients are explicitly included in W(z) through a height dependent radial xenon factor, Xe(z). Three-dimensional calculations are used to evaluate increases in elevation dependent radial peaking factors in a conservative manner by inducing a radial xenon oscillation. An equilibrium xenon case is perturbed by reducing power level and inserting control rods deeply enough to force the axial flux difference to the most negative allowed valve. The xenon distribution is allowed to change for sereral hours in this configuration, then the control rods are withdrawn and power is increased. The resulting xenon transient is followed in short time steps. The maximum value of F_{xy} at each elevation occuring during the transient is used to determine

Xe(z), where

$$Xe(z) = \frac{F_{xy}(z,t)^{\text{maximum, transient}}}{F_{xy}(z)_{\text{equilibrium}}}$$

The final form of Xe(z) is determined by conservatively bounding the results of the transient calculation.

ATTACHMENT 11 TO AEP:NRC:1071E

MAJOR ANALYTICAL ASSUMPTIONS
SECTION FROM WCAP-11908

1.2 MAJOR ANALYTICAL ASSUMPTIONS

The evaluation model for the long term mass and energy release calculations used was the March 1979 model described in reference 1. This evaluation model has been reviewed and approved by the NRC, and has been used in the analysis of other ice condenser plants.

For the long term mass and energy release calculations, operating temperatures for the highest average coolant temperature case were selected as the bounding analysis conditions. The use of higher temperatures is conservative because the initial fluid energy is based on coolant temperatures which are at the maximum levels attained in steady state operation. Additionally, an allowance of +5 °F is reflected in the temperatures in order to account for instrument error and deadband. The initial RCS pressure in this analysis is based on a nominal value of 2250 psi. Also included is an allowance of +30 psi, which accounts for the uncertainty on pressurizer pressure. The inclusion of an additional +5 psi uncertainty, such that the total uncertainty is +35 psi, would have an insignificant effect on the results. The selection of 2250 psi as the limiting pressure over 2100 psi is considered to affect the blowdown phase results only since this represents the initial pressure of the RCS. The RCS rapidly depressurizes from this value until the point at which it equilibrates with containment pressure.

The rate at which the RCS blows down is initially more severe for the 2250 psi case than for the 2100 psi case. Additionally the RCS has a higher fluid density for the higher pressure case (assuming a constant temperature) and subsequently has a higher RCS mass available for release. Thus, 2250 psi initial pressure was selected as the limiting case for the long term mass and energy release calculations. These assumptions conservatively maximize the mass and energy in the Reactor Coolant System.

It is the intent of this analytical effort to provide bounding calculations that will cover the fuel type used now and in the future for both Units 1 and 2. In order to justify this, the issue of fuel must be addressed since Unit 1 currently operates with Westinghouse fuel, and Unit 2 operates with ANF fuel.

The selection of fuel type for the long term mass and energy calculation and subsequent LOCA containment integrity calculation is based on the need to conservatively maximize the core stored energy. The fuel type in Unit 1, which is for 15x15 OFA fuel, was used in the analysis based on the fact that the larger diameter rods contain more core stored energy than the smaller diameter rods of a 17x17 assembly. Thus, the analysis very conservatively accounts for the stored energy in the core.

Regarding safety injection flow, the mass and energy calculation considers both minimum and maximum safety injection flowrates. For the case of minimum safety injection flow, the RHR crosstie valve is assumed to be closed, in conjunction with a 10% assumed degradation in pump head. Closure of the RHR crosstie was considered over the HHSI crosstie because this would have a more severe impact on the analysis (i.e., closure of the RHR crosstie would bound closure of the HHSI crosstie). This results in the conservative minimum safety injection flowrate used. For the case of maximum safety injection flow, the RHR crosstie valve is assumed to be open, and no degradation in pump head curves is considered. This results in the maximum permissible safety injection flowrate used. Further details about these assumptions are contained in section 2.4.

Thus, based on the above conditions and assumptions, a bounding analysis of Units 1 and 2 is made for the release of mass and energy from the RCS in the event of a LOCA.

In the case of the containment integrity peak pressure calculations, the analysis will utilize the LOTIC-1 evaluation model, which has been reviewed and approved by the NRC. This model has been successfully used for the other ice condenser plants in their FSAR analyses, as well as in ice weight reduction studies.

As input to the LOTIC-1 computer code, mass and energy release rates as described in Section 2 of this report will be used. Other major analysis assumptions will be that one diesel train will be assumed to fail, consistent with the requirements to analyze the worst single failure. Additionally, the

flow from the containment spray pump will be degraded by 10%, conservatively allowing for future system degradation.

The ice mass used in the analysis was 2.11 million pounds. This ice mass is consistent with the current technical specification ice mass basis.