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Secretary, U.S. Nuclear Regulatory Commission
ATTN: Rulemakings and Adjudication Staff
Washington, D.C. 20555-0001

Petition for Rulemaking (Docket No. PRM-50-73)

In the petition for rulemaking filed under Docket No. PRM-50-73 the petitioner requests that the NRC amend 10 CFR 50.46 and Appendix K to Part 50 to address the impact of crud on the core cooling capability during a fast moving, large break LOCA. The petitioner claims that during a large break LOCA a significant amount of crud could be dislodged, which would result in the blockage of flow channels leading to the inability to cool the fuel.

Framatome ANP disagrees that crud will collect within the core as described, nor would crud pose blockage problem. The typical crud formed on the surface of the cladding does not have the consistency to create a blockage during either operation or blowdown. Thermal transients in the cladding and resultant movement due strain will promote crud break off from the cladding. This break off of curd will produce small pieces, which will be further broken down by the turbulence and velocity of the blowdown forces.

The following comments are arranged by the referenced sections of Appendix K to Part 50 set forth in the petition.

I.B Swelling and Rupture: In NUREG-0630 it was hypothesized that the existence of an increased oxide layer and the associated oxygen incursion would strengthen and embrittle the material (zircaloy) at high temperatures (BETA range) and reduce the strain at rupture. Therefore, NUREG-0630 has very low pin strains for slow ramp rates above 1000 C. For fast ramp rates the peak temperatures are higher (and there is less time to build up oxide). Erbacker, in discussing the REBBECA tests in Germany, disagreed with this and shows only a minor, if any, effect of cladding oxidation on the cladding rupture strain. The EDGAR tests (M5 and Zr-4) indicate that there is only a small effect of oxidation. These tests show that crud will behave somewhat like an oxide layer but without significant oxygen incursion. As far as swelling and rupture is concerned, any crud will be a thin brittle layer with little strength and is essentially inconsequential.

I.C.2 Frictional Pressure Drops: Appendix K already requires the determination of appropriate pressure drops. It specifies that Reynolds Number effects and two-phase effects be accounted for. No further actions are necessary to account for the effects of crud.

I.C.4 Critical Heat Flux: In general, crud will have a rougher surface, which will enhance heat transfer and thus delay CHF. In some instances, crud is speculated to form a structure similar to a delamination of the corrosion layer and thereby allow trapped steam to blanket a small area of cladding and to reduce local heat transfer. The effect is similar to CHF only in that the affected local area reaches higher cladding temperatures. This phenomenon does not lead to

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CHF and does not propagate beyond the local blanketing. Examinations of the fuel pellets near these sites show that they operated at near normal temperatures. Thus, the only impact on LOCA results would be due to increased initial stored energy in scattered local areas. The initial cladding stored energy has only a limited effect on the LOCA PCT and even that would be mitigated by axial and azimuthal heat transfer within the cladding. The net effect lies within the conservative margins for the current calculational approaches and does not need to be included in the calculations.

I.C. 5 Post CHF Heat Transfer Correlations: Some sloughing off of the crud will occur and that will create an irregular surface that will experience better heat transfer. These correlations are primarily velocity dependant which allows them to compensate for any flow area restriction.

I.C.7 Core Flow Distribution During Blowdown: Crud dislodged during blowdown is broken into very small pieces and cannot become lodged within the fuel assemblies nor create significant blockage of core flow channels.

I.D.3 Reflood Rates: Reflood rates are generally dependent upon core wide conditions. The presence of crud on a limited amount of fuel will not have a significant effect on the core reflood rates.

I.D.6 Convective Heat Transfer Coefficients for Boiling Water Reactor Fuel Rods under Spray Cooling. The situation here will be similar to that under I.C.5.

I.D.7 The Boiling Water Reactor Channel Box Under Spray Cooling. The presence of crud on the fuel will not affect the heat transfer behavior of the channel.

Framatome ANP does not believe that 10 CFR 50.46 nor Appendix K to Part 50 should be revised to require that the specific effects of crud be accounted for. Experience demonstrates that crud effects are insignificant and do not warrant their inclusion in the regulation.

Framatome ANP appreciates the opportunity to comment on this petition for rulemaking.

Very truly yours,

James F. Mallay, Director
Regulatory Affairs

/lmk

cc: Project 693