

crud control incentives and methods are effective.

5. In PRM-50-73A, the petitioner contended that if the deposits continued to build during normal reactor operation, a severe crud buildup might form. Blockage of the flow within the fuel bundles would likely develop and overheating of the cladding would trigger an autocatalytic [*i.e.*, self-propagative] zirconium-water reaction. Subsequently, the petitioner stated that buildup could initiate substantial and rapid localized core melting while the reactor is at (full) power. Further, the petitioner contended that a reactor may be operated within its licensing basis and the technical specifications during the transition from unusually heavy crud to severe crud. The petitioner made a hypothesis that the increase of the off-gas system activity would not be regarded as an indicator of a possible heavy crud deposition and, therefore, the plant would continue to operate until the transition from heavy crud deposition to a severe level occurs.

Crud build-up is generally a very slow process. With water chemistry control, the transition time from heavy crud to severe crud deposition will be on the order of weeks. Even before the formation of a heavy crud layer, the elevated cladding temperature due to crud can cause crud-assisted corrosion which usually results in pin-hole type fuel cladding damage. The longer the rod experiences the elevated temperature caused by the crud, the more damage to the fuel rod cladding would occur. With only a few fuel rods damaged, the off-gas activity would increase. Abnormally high activity readings in the off-gas system require operators to take action to mitigate fuel cladding damage. In several cases at different operating reactors, the operators were able to adjust the control rod pattern to lower the local power peaking factor around the damaged fuel bundles after the high off-gas system activity reading was observed even though the activity levels were below the technical specifications limit. Therefore, observed practice shows that fuel cladding damage due to excess crud formation is readily detectable during normal operation, and effective mitigation measures have been taken by operators.

Under conditions where heavy crud deposition occurs, fuel damage could eventually lead to cladding cracks or ballooning effects. The crud layer may then break off and fuel pellets may be cooled directly by the water, thus lowering the cladding temperature. Although the elevated cladding temperature could theoretically trigger a

metal-water reaction in a very limited area of the fuel cladding, the crud also shields the cladding from the water and causes significant resistance to the metal-water reaction. Therefore, the NRC has concluded that the petitioner's concern about autocatalytic zirconium-water reactions is not valid.

Furthermore, the NRC has not found any evidence to support the petitioner's view that the off-gas activity would stay below the technical specification limit while the heavy crud deposition continues. Operating experience has shown that if a reactor operates continuously under heavy crud conditions, the cladding damage will result in higher off-gas activity readings that are quickly noted by the plant operators. It is highly unlikely that the off-gas activity would remain undetected by plant operators. Recent operating experience at plants with leaking fuel demonstrates that plant operators quickly take action to suppress fuel leaks, and in many cases, shut down the reactor to inspect and replace leaking fuel.

Finally, crud formation is one of many items which are required to be considered for both LOCA and transient safety analyses, and existing regulations and the NRC Standard Review Plan already provide adequate guidance on addressing the impact of crud on plant safety.

NRC Strategic Performance Goals

The NRC has evaluated the advantages and disadvantages of the rulemaking requested by the petitioner with respect to the four NRC Strategic Performance Goals as follows:

1. *Maintaining Safety:* The NRC believes that the requested rulemaking would not make a significant contribution to maintaining safety because current regulations and regulatory guidance already address the effect of crud-related parameters on core cooling, because no existing data suggests that the amount of crud normally deposited on reactor fuel can significantly interfere with coolant flow, and because the probable cause of the single event at River Bend Station noted by the petitioner, namely a transient coolant chemistry excursion with high iron and copper levels, is known and has been corrected. The NRC believes that existing regulations, guidance and practices provide for monitoring, detecting and correcting any possible crud effects on core cooling before any significant safety problems could occur.

2. *Enhancing Public Confidence:* The NRC believes that the proposed revisions would not enhance public confidence. First, the NRC has

concluded that the petitioner's contentions lack an adequate technical basis. Second, current regulations and guidance already address the effects of normal crud accumulation on core cooling. The petitioner's request in effect would require that substantial, additional consideration be given to abnormally heavy accumulations of crud as a potential source of coolant flow obstruction, which is a condition that has never been observed. Taking such an unnecessary action may actually detract from public confidence in the NRC as an effective regulator.

3. *Improving Efficiency, Effectiveness, and Realism:* The proposed revisions would not improve efficiency, effectiveness, and realism because licensees would be required to generate unnecessary additional information as part of the development of their ECCS evaluation models and the NRC would need to evaluate the licensee's data and analysis. The NRC staff believes that this additional consideration is unnecessary because the petitioner's scenarios are not supported by a technical basis. The additional NRC staff and licensee effort would not improve efficiency or effectiveness. In addition, the NRC resources expended to promulgate the rule and supporting regulatory guidance would be significant and is unnecessary.

4. *Reducing Unnecessary Regulatory Burden:* The requested rule would increase licensee burden by unnecessarily requiring significant additional testing and analysis of ECCS effectiveness.

Reasons for Denial

The Commission is denying the petitions for rulemaking. Section 50.46 currently requires a nuclear power plant applicant/licensee to address the impacts of the core geometry change on cooling in ECCS analyses. An acceptable implementation of this requirement has been documented in the Commission's Standard Review Plan, which specifically addresses the potential buildup of crud and its effects for ECCS analyses and transient analyses. The petitioner's hypothetical discussion of fuel clad performance with severe levels of crud buildup was not supported by modeling, experimental results or operational data sufficient to demonstrate that fuel with high crud levels will actually behave in the manner postulated by the petitioner. The NRC believes that there are other phenomena the petitioner failed to consider that would tend to reduce metal-water reactions and counteract autocatalytic reactions even if the extreme conditions postulated by the