Regulatory Assessment: Title 10, Section 50.46 of the *Code of Federal Regulations* (10 CFR 50.46) requires that licensees design their ECCS systems to meet five criteria, one of which is to provide the capability for long-term cooling. Following a successful system initiation, the ECCS shall be able to provide cooling for a sufficient duration that the core temperature is maintained at an acceptably low value. In addition, the ECCS shall be able to continue decay heat removal for the extended period of time required by the long-lived radioactivity remaining in the core. The ECCS is designed to meet this criterion, assuming the worst single failure.

However, for BWRs, experience gained from operating events and detailed analyses (including a detailed risk assessment) demonstrated that excessive buildup of debris from thermal insulation, corrosion products, and other particulates on ECCS pump strainers could occur during a LOCA. This created the potential for a common-cause failure of the ECCS, which could prevent the ECCS from providing long-term cooling following a LOCA. This led to the issuance of NRCB 96-03, and the subsequent installation of new larger strainers by BWR licensees.

The staff believes that there is sufficient new information and concerns raised relative to the potential for debris clogging in PWRs that part of this action plan has been prepared to address PWR sump blockage concerns. However, it is not clear whether a significant threat to PWR ECCS operation exists. The staff believes that continued operation of PWRs is justified because of PWR design features which would tend to prevent blockage of the ECCS sumps during a LOCA. These features would tend to be effective for insulation and coating debris. For instance, the containments in PWRs tend to be very compartmentalized making the transport of debris to the sump screens difficult. In addition, PWRs typically do not need to switchover to recirculation from the sump during a LOCA until 20-30 minutes after the accident initiation allowing time for much of the debris to settle in other places within the containment. Coating debris, in particular, would have plenty of time to settle. Clearly, the results of the staff's research program are needed before a final conclusion regarding the potential to clog the ECCS sump can be reached. In addition to these design considerations, the staff considers continued operation of PWRs to be justified because the probability of the initiating event (i.e., large break LOCA) is extremely low. More probable (although still low probability) LOCAs (small, intermediate) will require less ECCS flow, take more time to use up the water inventory in the refueling water storage tank (RWST), and in some cases may not even require the use of recirculation from the ECCS sump because the flow through the break would be small enough that the operator will have sufficient time to safely shut the plant down. In addition, all PWRs have received approval by the staff for leak-before-break (LBB) credit on their largest RCS primary coolant piping. While LBB is not acceptable for demonstrating compliance with 10 CFR 50.46, it does demonstrate that LBB-qualified piping is of sufficient toughness that it will most likely leak (even under safe shutdown earthquake conditions) rather than rupture. This, in turn, would allow operators adequate opportunity to shut the plant down safely (although debris generation and transport for an LBB size through-wall flow will still be investigated). Additionally, the staff notes that there are sources of margin in PWR designs which may not be credited in the licensing basis for each plant. For instance, NPSH analyses for most PWRs do not credit containment overpressure (which would likely be present during a LOCA). Any containment pressure greater than assumed in the NPSH analysis provides additional margin for ECCS operability during an accident. Another example of margin would be that it has been shown, in many cases, that ECCS pumps would be able to continue operating for some period of time under cavitation conditions. Some licensees have vendor data demonstrating this. Design margins such as these examples may prevent complete loss of ECCS recirculation flow or increase the time available for operator action (e.g., refilling the RWST) prior to loss of flow.

GL 97-04 is a review of NPSH calculations. No specific generic concerns were identified in the review of licensee responses.

The Probabilistic Safety Assessment Branch of NRR recently completed a preliminary assessment of the risk associated with the potential clogging of the ECCS sump in PWRs during a LOCA. In a memo from Richard J. Barrett to John N. Hannon dated March 26, 1999, it was concluded that "(d)ue to the unavailability of probabilistic models for debris-induced loss of ECCS NPSH and the plant-specific

nature of the sump screen clogging issue, the scope of this risk assessment was limited to assessing the frequency of accident sequences requiring ECCS recirculation to prevent core damage for an average PWR plant. Because the probability and timing of sump screen clogging depends on LOCA size and location, among other parameters, an effort was made to present the results, for each LOCA category, separately.

The following major conclusions were reached by performing this preliminary risk assessment.

1. Results presented in this analysis strongly justify research to re-evaluate the potential for clogging of PWR sump screens by taking into account new information, thus enabling more realistic evaluation and management of associated risks.

2. Continued operation of PWRs is justified because, based on available current information, there is no evidence that the risk associated with the sump clogging issue is high enough to compromise public health and safety."

These conclusions clearly support this action plan as outlined herein.