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TO: Professor Paul Shewmon

FROM: W. J. Shack WJS

SUBJECT: Comments on SECY-83-267C: Reinspection and Repair of BWR Piping

The reinspection plan described in the Commission paper appears to represent a reasonable compromise between thoroughness and the necessity to minimize exposure of inspections personnel. In some cases (e.g., the Duane Arnold safeends or the thermal fatigue problems in steam generator feedwater lines) it is possible that large cracks could occur in a relatively few joints with few observable indications in other joints so that inspections with the proposed initial 20% sample size would have a low probability of detecting the cracks. However, because IGSC cracking in BWR piping systems does not require any particular special circumstances such as crevices or fluctuating thermal stresses and because IGSCC growth is a relatively slow process, I think it is very unlikely that dangerous isolated cracks will occur without a correspondingly large number of indications throughout the piping system. Thus the sampling approach combined with the requirements for additional inspections if indications are found should offer a high probablility for the detection of large cracks, while minimizing the radiation exposure of inspection personnel.

The technical presentations at the Subcommittee hearing generally agreed that cracking with a total length less than ~25% of the circumference did not represent a serious safety concern. Even if the throughwall depths and growth rates of these cracks were grossly underestimated, the worse consequences appear to be leakage at a relatively low rate (<100gpm) with ample time for detection and a safe shutdown of the reactor. For cracks with total lengths greater than 50% of the circumference, additional assumptions (e.g., a significant degree of asymmetry in throughwall crack growth or adequate resistance to stable crack growth so that the piping does not become unstable at the plastic limit load) need to be invoked to assure leak-before-break behavior. Although these assumptions are plausible, there are clearly different degrees of uncertainty and conservatism associated with long and short cracks.

The criteria proposed by the staff for run-without-repair decisions follows the ASME code and uses a uniform factor of safety for both long and short cracks. Although a set of criteria which take into account the differences in risk posed by

cracks of different length when the uncertainties in depth measurement and the prediction of throughwall crack growth are considered would be preferable, I feel that the criteria proposed by the staff are acceptable when risk is assessed on a probabilistic basis. Significant risk would only occur if a large crack develops, and it is inadequately evaluated by the staff criteria, and it fails without leak-before-break. There are theoretical reasons (based on residual stresses, the assymmetric nature of most piping loads, and the nature of IGSCC growth) to expect that long, deep, circumferential cracks have a reasonably low probability of occurance, and experience seems consistent with this. The criteria will generally require repair for long cracks with reported depths >~25%. The factor of safety on reported crack depth using the criteria is >~2.5. This should account for much of the uncertainty in the measurement of crack depths and the calculation of throughwall crack growth. Also, as noted in my discussion of the inspection criteria, I think it is unlikely that a single isolated serious crack will exist, and thus if a significant crack exists, fairly extensive cracking will also be found in the remainder of the recirculation system. In these circumstances, I think the psychology of the inspection teams, the utility, and the regulatory staff will be conservative in sizing and evaluating the cracks. Finally as noted previously, leak-before-break behavior is certainly the most likely mode of failure.

No formal probabilistic assessment of these risks is available, but my judgment is that the joint probability is low enough to be acceptable on an interim basis.

I support that apparent staff position that the weld overlay is a temporary repair, which can be used to buy time while the utilities and the staff develop long term solutions. I think that the analytical results which suggest that for cracks less than 50% throughwall the residual stresses induced by the overlay will prevent further crack growth are probably valid, but the overlay cannot be considered as a permanent solution unless the inspection problem can be solved, and this seems unlikely. Even if the inspection problem can be solved, I think we should recognize that net-section-stress analysis used in the code and hence the staff criteria is intended to show that the flawed pipes maintain the nominal margins intended by the code design, but the actual margins have been reduced, and hence the capability of the piping system to withstand unanticipated loads (water hammers, etc.) is reduced. Thus in the long term I think that replacement is needed for piping systems which are already severely cracked, although other solutions can be considered for plants with less severe cracking problems. This also seems consistent with the staff position as outlined by Dick Vollmer.

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