

Item 6

## Rebuttal to OIG Report

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I have reviewed the OIG report. The report is off base. The OIG report fails to point out that NRC requirements, policies, and process are not adequate for preventing the kind of situation that occurred at IP-2. The OIG report focuses in large measure on a red herring, the SE approving the operating interval extension. Although the SE has its shortcomings, I believe the conclusions reached in the safety evaluation were appropriate, given our process and what was and what should have been known about the condition of the IP-2 SGs.

The IP-2 SG tubes were operated with unacceptable safety margins since well before 1997. That IP-2 was in this condition without the knowledge of NRC staff is a direct reflection of the NRC process and policies. This situation was not the result of an inadequate safety evaluation performed years later (in 1999) of a proposed extension to the authorized operating interval. It was, instead, the result of an inadequate inspection in 1997.

NRC does not have an effective process for identifying plants with inadequate safety margins in their SG tubing. This is the fundamental issue that the IG report has failed to pickup on. The staff relies on leakage and rupture events and in-situ test failures to alert it to unacceptable conditions that may exist at PWRs. If we want to minimize the occurrence of tube ruptures, we need to adopt a regulatory process such as exists in Europe or Japan. If not, we should expect that the U.S. will continue to experience a very disproportional share of tube ruptures world wide. Eight or nine tube ruptures (depending on how you define tube rupture) have occurred in the U.S. Only two have occurred outside the U.S. We have justified our policy on the basis that SGs are not perceived to contribute unacceptably to risk. We are going to continue to experience tube ruptures. NRC's requirements, policies, and process allow this to be the case. We should be up front about this and not get so defensive when a rupture does happen. I resent the effort of the OIG to place blame for the IP-2 failure on the NRC working level staff.

The condition of the IP-2 steam generators since 1997 is now believed to have been highly risk significant. This was due in part to the very poor quality inspection in 1997 which allowed a tube with unacceptable safety margins to remain in service. This is also due in part to apparent low crack growth rates which allowed IP-2 to operate for an extended period of time with inadequate margins before the failure occurred. This calls the basis for our regulatory process into question, but this process issue is outside the scope of my discussion here.

Tube inspections performed in 1997 and before were inadequate to identify the flaw which led to the failure in February 2000. This inadequacy stemmed in large measure to excessive noise in the inspection data and failure of the licensee to exercise its Appendix B obligations (see NRC special inspection report dated August 31, 2000). NRR was not aware of the excessive noise nor of the licensee's failings with respect to Appendix B. The OIG report criticizes NRR for not reviewing the licensee's July 27, 1997 inspection report. That's an NRC process issue since there is nothing in the process or operating plan that obliges the tech staff to formally review these reports. The staff had no reason to believe that the 1997 inspection program was inadequate and no reason to conclude that review of this report was necessary to ensure the inspection was adequate. However, a careful review of that report would not allow anyone to conclude that an inadequate inspection had been performed. The only way the staff could have been aware that an inadequate inspection had been performed would have been to look at the actual eddy current raw data. That data was not provided with the report, not is it ever

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submitted with such a report. The tech specs don't require submittal of this data. The regions do not have a comprehensive program for evaluating the adequacy of licensee's eddy current inspection or the quality of the eddy current raw data.

Written inspection reports, such as the July 27, 1997 report for IP-2, are submitted after plant restart and are intended primarily to inform the staff of the scope and results of the steam generator inspections. These reports are important to the staff as reference material for tracking and trending the degradation status of the steam generators. The staff sometimes may refer to these reports when reviewing a license amendment request and when responding to questions from NRC management or external stakeholders concerning the status of the steam generators. The July 27, 1997 report proved to be an invaluable resource to the NRR staff following the February 15, 2000 failure event at IP-2 in terms of framing potential issues to be pursued with the licensee during the initial post-event followup. The written inspection reports do not provide, nor are they intended to provide, sufficient information to evaluate the adequacy of the inspections being performed or the quality of the inspection data.

OIG interviewed EMC's expert consultant on eddy current testing. Subsequent to the failure event, this consultant reviewed the licensee's raw eddy current data from 1997 and identified a number of issues as discussed in the OIG report. It is important to note that the contractor's observations were based on his review of the raw data and not the July 27, 1997 inspection report. OIG seems to be very confused on this point. OIG believes that the staff would have been able to make these finding on the basis of the July 27, 1997 letter. This is simply not true. Note, this contractor was only requested to review the 1997 raw data after the tube failure event. I don't believe anyone is performing similar reviews on raw data from other units at the present time. I don't believe that the regions have the expertise to perform such reviews. Such reviews are not part of their inspection program. But, if someone else ruptures a tube in the near future, I expect we will go through a similar exercise for them.

The OIG report cites a remark of a RES senior metallurgical engineer that if NRC staff had reviewed the report, they might have recognized "indicators of the tube which ruptured in February 2000." Thus, failure to review the report constituted missed opportunities, both in 1997 and when the licensee requested the extension to their operating interval. As previously discussed, such a review would not have revealed the excessive noise levels which masked the indication which eventually led to the failure.

One can speculate, however, that review of this report could have alerted the staff to conditions in the steam generator which ultimately lead to the February 2000 failure event. RES has the benefit of hindsight on this. The July 27, 1997 report makes a barest mention of a single u-bend indication found at the apex during the inspection. (Staff notes from two telephone conferences during the 1997 inspection outage make no mention of the licensee having informed the staff of this indication at that time.) U-bend crack indications are quite common in Westinghouse steam generators, with and without denting, and typically do not pose an unusual challenge to steam generator tube integrity. Apex cracks, however, are highly unusual and were associated with previous tube rupture events. Hourglass deformation of the upper support plate flow slots as a result of denting led to elevated stress levels at the apex of the small radius u-bends and ultimately a tube rupture event at Surry Unit 2 in 1976. Excessive tube ovality at the apex introduced during the tube bending process led to a tube rupture at a foreign unit in 1978. The significance of the apex location is a subtle point that would likely be

flagged by only a very experienced reviewer. The report stated that the upper support plates were visually inspected and that no significant hourglass deformation of the upper support plate flow slots was observed. With knowledge of the apex location of the indication found, the staff could have challenged the basis for the licensee's assertion. It is now reasonably established that hourglass deformation was in fact present in 1997, but that the licensee's inspections were inadequate to detect this hourglass deformation. Knowledge of the presence of hourglassing clearly would have heightened staff concerns about the safety significance of the u-bend indication found and led to further questions. Note, however, that the July 27, 1997 report was submitted after IP-2 had restarted from the 1997 inspection outage. Thus, it would have already been too late to resolve the issue of whether hourglass deformation was present. Further, the staff could not have developed sufficiently compelling safety case to justify ordering a plant shutdown to resolve the issue.

A detailed review of the July 27, 1997 report might also have caused the staff to inquire about the reported probe restrictions in some row 2, 3, and 4 u-bends. Such restrictions, if real, might be indicative of significant ovality in the u-bends. However, the response would have been (based upon more recent information from the licensee) that the tubes were actually restricted at the sixth support plate, not the u-bends. While this would be indicative of dent activity at the sixth support plate, this information by itself would not be sufficient to indicate that hourglass deformation of the sixth support plate flow slots was taking place.

The OIG report cites an NRC AIT inspector as saying that the quality of the (1997 inspection) data collected by IP-2 was not very robust, and IP-2 missed a defect which indicated a possible tube failure. This statement was made with the benefit of hindsight; not based on review of the July 27, 2000 letter, but based instead on review of the raw eddy current data which was not provided with the report. He added that NRR should have been more questioning of the 1997 inspection. Presumably, the AIT inspector is referring to the raw data since review of the letter would not have revealed the data quality problem as discussed previously. Why should we have been more questioning? What is the regulatory process under which NRR should be reviewing the raw eddy current data? This second-guessing is entirely misplaced. It is the Region's responsibility to see that the tube inspections are conducted in accordance with applicable regulations and requirements. A formal review by NRR of the July 27, 1997 letter could not possibly have revealed the data quality problems with the IP-2 inspection data that led to missed indications and ultimately the failure event in February 2000. The AIT inspector further stated that the NRC should be more vigilant and intrusive in the steam generator inspection processes. I'm biting my tongue on this statement to preserve a sense of diplomacy. But, I wish he might have expanded on this. Who should be more vigilant and intrusive? NRR? The regions? How so? How would this fit in with the current regulatory process and current resources? Do we have to change them? How does this square with the clear message from our management that we need to be less intrusive, not more intrusive in our dealings with licensees.

The OIG report cites the RES senior metallurgical engineer as saying that the licensee's operational assessment in support of its requested operating interval extension was very simple. As an example, the RES engineer states that the licensee's crack growth rate analysis for the 1997 u-bend indication was faulty. Agreed. However, there was no basis for making a realistic estimate. Comparative data between successive inspections was not available. PWSCC operating experience would suggest that growth rates may range from close to zero to 100% through wall in less than one cycle. Information cited by RES in their March 16, 2000

memo is not helpful for predicting crack growth rates in the field. The absence of reliable growth rate information is a common problem when performing operational assessments. Where condition monitoring indicates that tubes with indications retain adequate safety margins at the time the indications are found and the affected tubes are removed from service, then the best one can do for an operational assessment is to assume that the plant can operate for a similar length of time to its next inspection as it did during the previous operating interval assuming the quality of the inspection is as good or better than the previous inspection. If condition monitoring indicates that adequate safety margins are not present, then a mid-cycle inspection may be necessary during the next operating cycle to ensure that adequate margins are maintained. One can refine this approach as time goes on and as comparative information between successive inspections becomes available. This is not a rigorous approach and not necessarily conservative, but sometimes is all that can be done. The appropriateness of this approach, however, depends on being able to reliably detect flaws well before safety margins are unacceptably impaired. It also relies heavily on tube being likely to produce leakage leading to shutdown, before margins become unacceptably impaired.

At IP-2, the licensee's condition monitoring assessment indicated that the tube identified to contain the u-bend indication in 1997 retained adequate safety margin as indicated by the measured length of the flaw. The 1997 inspection involved the first use of the mid-range plus point probe in the u-bends which was thought to be an improvement relative to previous inspections. The requested extended operating interval represented a minimal increase in terms of operating months; from 24 to 26 operating months. Note, stress corrosion cracking is only active during periods of elevated temperature. Assuming adequate inspections were performed in 1997, the requested extension should have had minimal impact on the safety margins and risk. The March 16, 2000 RES memo acknowledges this point. The crack growth rate issue raised by RES is a total red herring. In fact, the crack growth rates in the IP-2 u-bends now appear to have been low (based on more recent information), although there is significant uncertainty associated with the estimates. The tube failure at IP-2 was the result of inadequate inspection in 1997, not high growth rates.

It is interesting to note that the tube failure occurred before 24 operating months had been accumulated since the 1997 inspection. Had IP-2 operated continuously from the time of restart from the 1997 inspection in accordance with its technical specifications and not requested an extension, it would have suffered the failure event anyway. Again, the fundamental problem was that the 1997 inspection was inadequate to support any term of operation whatsoever, extension or no extension. Thus, attributing blame to the 1999 safety evaluation for fact that the tubes had unacceptable safety margins dating back to at least 1997 is inappropriate. In this sense, the 1999 safety evaluation is another red herring.

EMCB had no reason to believe that the 1997 inspections were inadequate at the time it approved the requested extension to the operating interval. Even a detailed review of the July 27, 1997 inspection report would not have revealed the data quality problem which caused the flaw which eventually failed to be missed, as previously discussed. Such a detailed review might possibly have raised a concern about the involvement of hourglass deformation and follow up questions in this regard, but only if it had been reviewed by someone with more experience. It is highly speculative that this line of questioning would have raised concerns to a sufficient level to have caused the staff to reject the amendment. Even if one assumes that review of the 1997 report would have led to rejection of the amendment request, that should not suggest the staff erred in not reviewing the 1997 inspection report. Again, the material submitted with the license amendment request, including information in response to the RAI,

purportedly contained all information relevant to the amendment request. The NRR staff had no reason to believe from review of this material that the 1997 inspection was inadequate. I believe the depth of review and level of expertise applied to the extension request was entirely appropriate given these circumstances and the negligible delta in safety factors and risk associated with the request.

The one criticism of the safety evaluation that may be valid is that one might infer from the safety evaluation that the licensee's operational assessment was more rigorous than it actually was based on information presented in the licensee's submittals. The safety evaluation could have been more forthcoming about the shortcomings of the licensee's analysis. However, I believe the conclusions reached in the safety evaluation were entirely appropriate in the absence of information that the 1997 inspection was inadequate and in view of the limited safety factor and risk deltas associated with the request. We now know that one IP-2 tube had inadequate safety margins since at least 1997 and that the plant was operated at high risk since that time. Way too much attention has been focused on the SE rather than on the shortcomings in our regulatory process that allowed this situation to exist in the first place. The conclusions in the SE were properly focused on the safety factor and risk deltas associated with the request, not the baseline.

Finally, the OIG report takes me to task for not having reviewed the source material at the time I concurred with the SE. I am totally bewildered by this criticism. I was tasked with reviewing the SE, not performing an independent review of the source material. I did of course also provide assistance and guidance to the reviewer. I explained the technical issues that needed to be addressed in the SE. I learned from her that they had not submitted an operational assessment to support the extension request. I identified the specific information relating to the operational assessment that needed to be requested in an RAI. Once the SE was submitted for my review, I determined that the SE cited adequate technical justification to support the conclusions reached. I had no reason to suspect that the 1997 inspections were inadequate. Given that we were effectively extending the operating interval by only two months, I was confident the impact of this extension should have a minimal impact on safety margins and risk.