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PLANT NAME:
Surry Units 1 & 2

RJL

ENCLOSURE

Consists of info. regarding the potential impact on the LOCA-ECCS and minimum DNBR analyses of the flow area reductions resulting from steam generator tube denting...

(6-P)

FOR ACTION/INFORMATION

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VIRGINIA ELECTRIC AND POWER COMPANY
RICHMOND, VIRGINIA 23261

March 31, 1977

Mr. Benard C. Rusche
Director of Nuclear Reactor Regulation
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

Attn: Mr. Robert W. Reid, Chief
Operating Reactors Branch 4

Serial No. 219A/082776
FRD: RWC/MLB/cjw
PO&M: ALH
Docket Nos. 50-280
50-281
License Nos. DPR-32
DPR-37

Dear Mr. Rusche:

As a result of the March 23, 1977 request from Mr. M. Fairtile of the NRC staff, the potential impact on the Surry Units No. 1 and 2 LOCA-ECCS and minimum DNBR analyses of the flow area reductions resulting from steam generator tube denting has been evaluated and is documented in Attachment 1. It is concluded from this evaluation that the impact of flow area reduction from the tube denting phenomenon is minimal and need not be explicitly considered in these analyses. Specifically, the results of the evaluation show that the flow area reduction resulting from the denting phenomenon, as characterized in the Surry Units No. 1 and 2 steam generators, is conservatively equivalent to less than a 0.2 percent increase in the tube plugging level and is, in reality, judged to be virtually a zero percent increase in the tube plugging level. Since this increase is small and the methodology used in the evaluation is very conservative, the results and conclusions of the LOCA-ECCS and minimum DNBR analyses provided in Vepco to NRC letters Serial No. 219/082776 dated March 4, 1977 and Serial No. 017/043073 dated May 14, 1976, are not impacted.

Should you have questions or comments, we would be most happy to meet with you at your earliest convenience.

Very truly yours,

C. M. Stallings
Vice President-Power Supply
and Production Operations

Attachment

cc: Mr. Norman C. Moseley, Director
Office of Inspection and Enforcement
Region II

ATTACHMENT 1

Analyses of the effect of steam generator tube plugging on the Surry Units 1 and 2 minimum DNBR and LOCA-ECCS Accident were provided in our letters of May 14, 1976 (Serial No. 017/043073) and March 4, 1977 (Serial No. 219/082776). These analyses indicated that (1) from a minimum DNBR standpoint, up to 25% of the steam generator tubes could be plugged without affecting the calculated minimum DNBR, and (2) from a LOCA-ECCS standpoint, the peak clad temperature limit would not be violated for up to 20% of the steam generator tubes plugged.

Recently, the NRC Staff raised the question of what the impact of the flow area reduction (in the unplugged tubes) resulting from the steam generator tube denting phenomenon is on the LOCA-ECCS and minimum DNBR accident analyses. An evaluation of this impact, given in terms of equivalent increase in the percent steam generator plugging level is provided below:

The basic approach used in the evaluation is as follows:

1. From the dented tubes that have been removed and inspected in the laboratory, a conservative dented tube profile model (see Figure 1) was developed which, on a worst case basis, represented the equivalent reduction in cross-sectional flow area associated with a given tube diameter (or probe size that could just be passed through the dented tube).

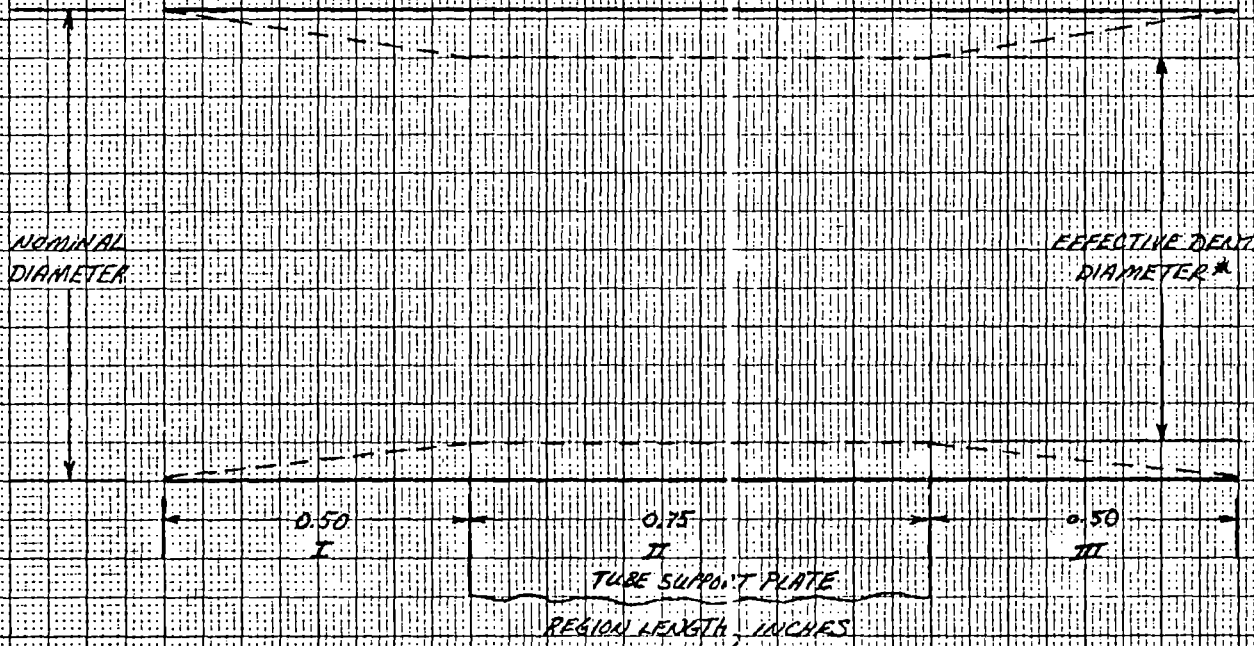
2. The dented tube profile model was then used to determine the change in the form loss coefficient (reference Idel'Chik, AEC-TR-6630) between various sizes of dented tubes and an undented tube in order to determine the increase in flow resistance. In turn, this increase in flow resistance for each dent size was then represented in terms of an equivalent increase in tube plugging level as a function of dented tube diameter (or probe size that could just be passed through the dented tube). See Figure 2.

3. A conservative distribution of the number of steam generator tubes as a function of tube diameter (or probe size that could just be passed through the dented tube) at the end of four continuous months of operation was then developed. (See Figure 3.) This distribution was based on the

tube probing data obtined to date from the Surry Units. This data indicates, even when assuming a very conservative rate of denting during the operational period, that most of the tubes will not undergo significant denting during the operational period. This conclusion is also in agreement with the analyses and data provided in the Vepco to NRC letter (Serial No. 0318/011977, dated March 25, 1977) which shows that significant tube denting occurs in the regions of high strain and, in turn, forms the basis for the development of the tube plugging criteria.

4. The equivalent increase in the percent plugging level as a function of tube diameter (or probe size) from Figure 2 was then combined with the tube denting distribution (corresponding to the full range of denting assumed to have occurred after four continuous months of operation) from Figure 3 to determine the total equivalent increase in the percent tube plugging level for all steam generators due to the denting phenomenon.

The results of the above analyses indicates that on a very conservative, worst case basis, the total equivalent increase in the percent of tube plugging level due to the flow area reduction associated with the denting phenonmena is less than 0.2%. However, when considering the conservatisms inherent in the above bounding analyses (see Table 1), the total equivalent increase in the percent tube plugging level resulting from the denting phenomena is in reality judged to be virtually zero. Therefore, the impact of the flow area reduction in the unplugged steam generator tubes resulting from the denting phenomenon on the minimum DNBR and LOCA-ECCS analyses is negligible.



SCHEMATIC OF DENTING MODEL

FIGURE 1

* NOT TO SCALE

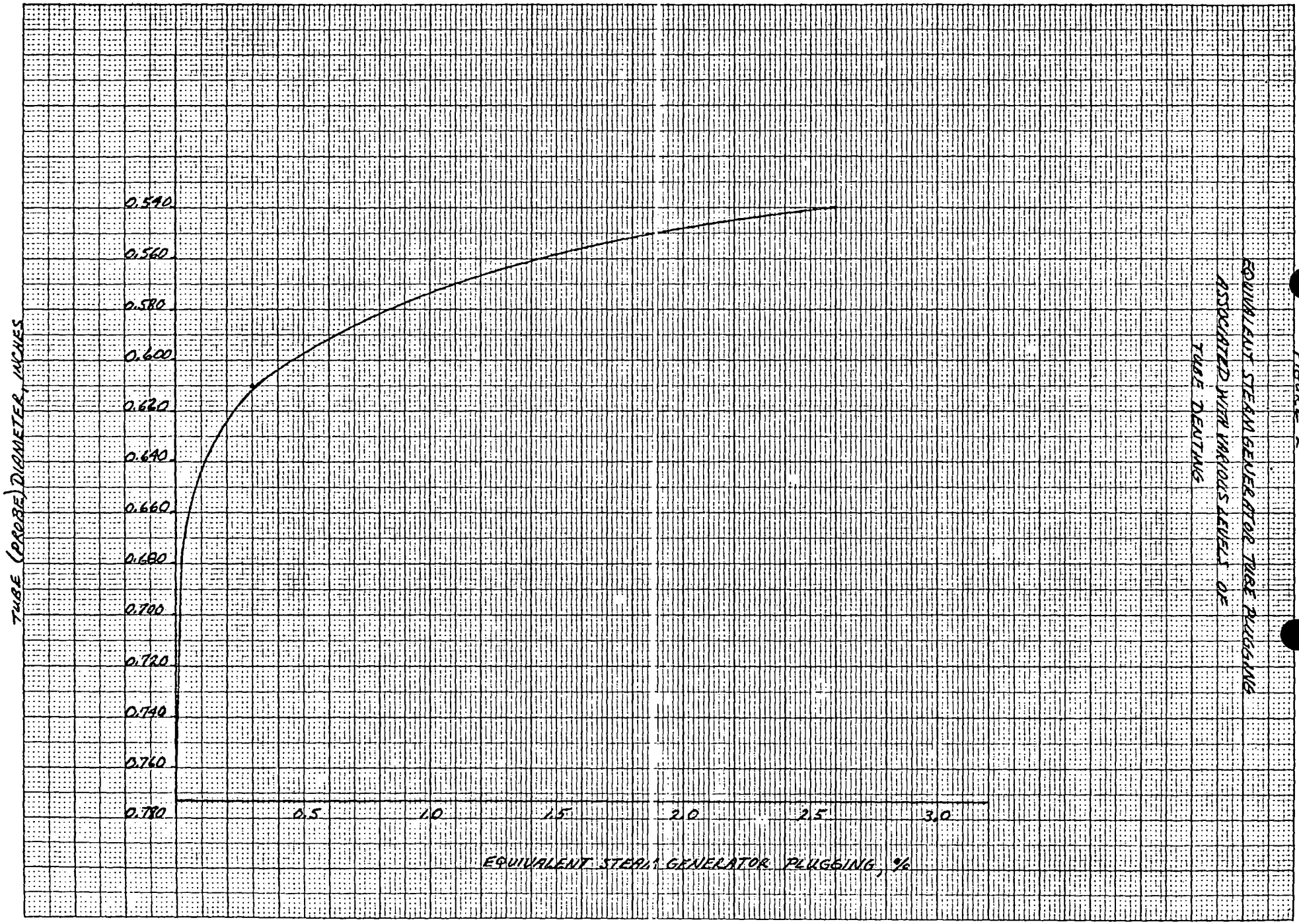


FIGURE 2

EQUIVALENT STEAM GENERATOR TUBE PLUGGING ASSOCIATED WITH VARIOUS LEVELS OF TUBE DEUTING

FIGURE 3

STEAM GENERATOR TUBE DENTING DISTRIBUTION

AFTER 4 MONTHS OF CONTINUOUS OPERATION

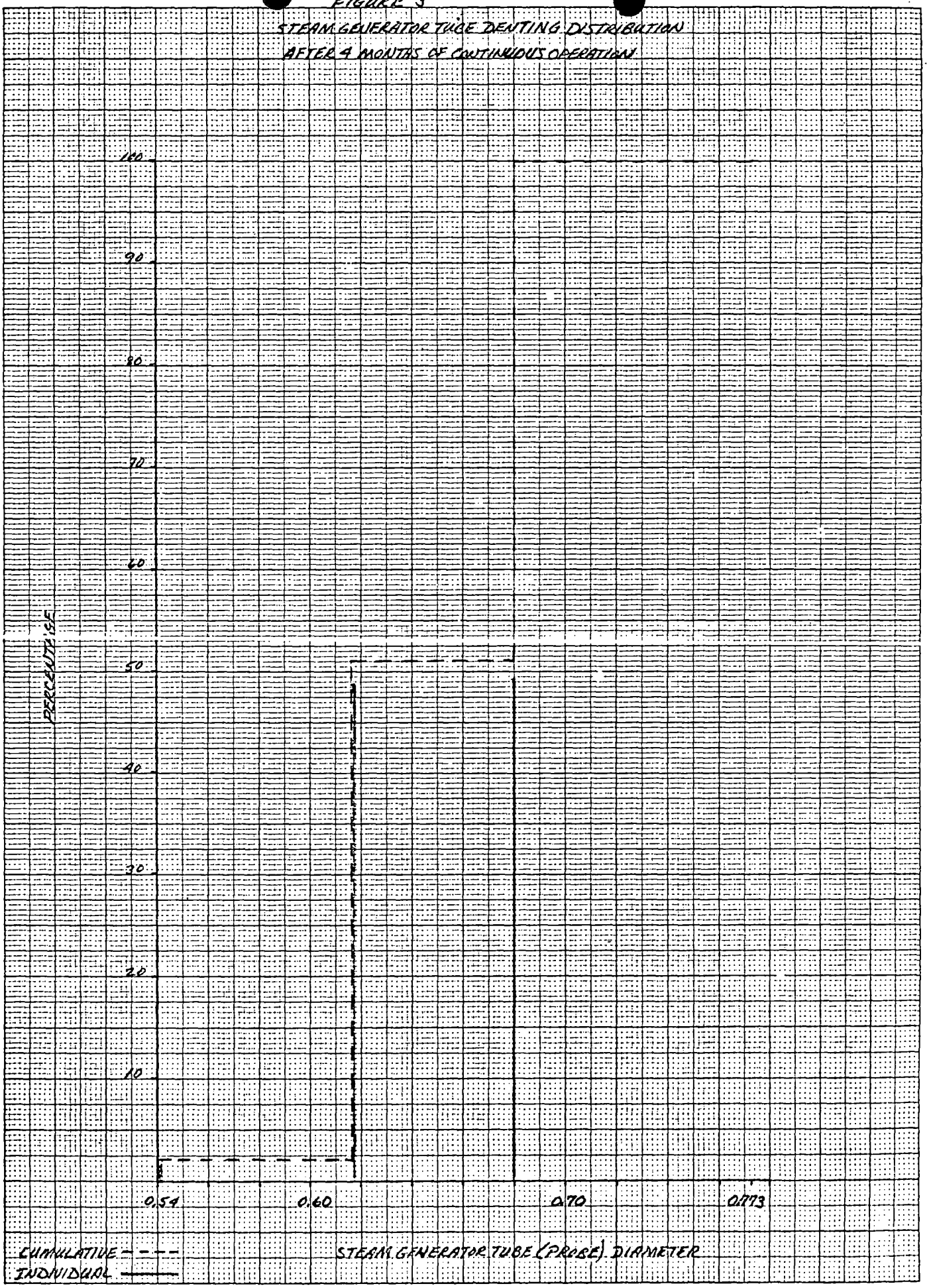


Table 1

Conservatisms Inherent In The Analysis To
Determine Impact Of Denting On Tube Flow Area Reduction

1. The same degree of denting was assumed to occur on the cold side of the steam generator tube as on the hot side, whereas surveillance has indicated much less denting on the cold side.

2. Area reduction used to characterize a dent was determined from the worst case area reduction found in the tubes actually removed and inspected in the laboratory.

3. The distribution of denting (as a function of tube diameter) and rate of denting during operation developed from probing data is very conservative with respect to the distributions and denting rates as indicated by the steam generator inspection program.

4. The analysis does not take credit (in the development of the equivalent increase in percent tube plugging as a function of tube diameter) for the fact that a significant percentage (approximately 17%) of the tubes have already been plugged.