Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

NOV 0 8 2001

10 CFR 50.90

WBN-TS-99-014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, D. C. 20555

Gentlemen:

In the Matter of	)	Docket No.50-390
Tennessee Valley Authority	)	

WATTS BAR NUCLEAR PLANT (WBN) UNIT 1 - TECHNICAL SPECIFICATION (TS) CHANGE NO. WBN-TS-99-014 - STEAM GENERATOR ALTERNATE REPAIR CRITERIA FOR AXIAL OUTSIDE DIAMETER STRESS CORROSION CRACKING (ODSCC) - RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION - (TAC NO. MA8635)

The purpose of this letter is to provide NRC a response to the request for additional information dated October 9, 2001. This letter also includes the responses to the additional questions which were received by electronic mail from NRC Project Manager, R. Heron on October 18, 2001.

TVA requested a license amendment for the steam generator alternate repair criteria on April 10, 2000. Additional information and clarification was provided to NRC concerning this request in letters dated September 18, 2000, and August 22, 2001.

Enclosure 1 provides TVA's response to NRC's questions dated October 9, 2001. These responses were discussed in a teleconference call between NRC, TVA, Westinghouse, and Foreline Associates, the Westinghouse contractor, on October 9, 2001.

Enclosure 2 provides the response to the electronic mail on October 18, 2001.

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No regulatory commitments are being tracked by this letter. If you have any questions concerning this response, please contact me at (423) 365-1824.

Sincerely,

P. L. Pace
Manager, Site Licensing
and Industry Affairs

Subscribed and sworn to before me
on this 8th day of November . 2001

E. Jeannette Long
Notary Public

My Commission Expires May 21, 2005

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ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
PROPOSED TECHNICAL SPECIFICATION CHANGE WBN-TS-99-014
ALTERNATE REPAIR CRITERIA (ARC) PRESSURIZATION RATE ISSUE
RESPONSE TO NRC REQUEST FOR ADDITIONAL INFORMATION

The following provides TVA's response to NRC's request for additional information concerning license amendment request WBN-TS-99-014 for the steam generator alternate repair criteria (ARC) for outside diameter stress corrosion cracking (ODSCC). These concerns are based on NRC's review of Enclosures 2, 3, and 4 of TVA's letter dated August 22, 2001. The enclosures of that letter which are associated with this request for additional information are listed below for ease of referencing the document which is being discussed.

Enclosure 2 - Steam Generator Alternate Repair Criteria Outside Diameter Stress Corrosion Cracking (ODSCC) Steam Generator Testing and Inspection Issues - Response to NRC's Request for Additional Information.

Enclosure 3 - Westinghouse Report SG-01-07-003 - "Pressurization Rate and Foil Strengthening Effects on the Burst Strength of Axially Degraded Steam Generator Tubing," dated July 2001.

Enclosure 4 - EPRI Report 1001441 - "Effects of Pressurization ate on Degraded Steam Generator Tubing Burst Pressure," dated April 2001.*

* EPRI Report 1001441 was revised in July 2001. That report was provided to NRC by EPRI. The revision contains changes made to reflect information learned from the conduct of the testing program documented in Enclosure 3 of TVA's August 22, 2001, letter listed above.

Based on NRC's review of Enclosures 2, 3, and 4 listed above, NRC had the following observations and questions.

DENT INSPECTION ISSUES

QUESTION 1

With respect to the dent inspection, TVA indicated that if circumferential cracking is identified at Watts Bar in a dented tube support plate intersection that is equal to 2 volts, the inspection plan expands to hot leg dented intersections greater than or equal to 1.0 volt. Please clarify the intent of this statement. Literally read, circumferential cracking could occur at a dent of magnitude 2.01 volts and no expansion would be necessary. Is it the intent of the statement that if a circumferential indication is observed in a dent whose magnitude is between 2.0 and 5.0 volts, then the inspection would be expanded?

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
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RESPONSE 1:

TVA plans to inspect hot leg dented intersections greater than or equal to 2 volts using a +Point probe. If circumferential cracking is identified at a dent of magnitude between 2.0 and 5.0 volts, then the +Point inspection is expanded to hot leg dented intersections greater than or equal to 1 volt.

PRESSURIZATION RATE ISSUE

The following questions and comments are related to the pressurization rate issue and focus on the burst pressure data base used in support of GL 95-05. Although the scope of some of the questions may appear to go beyond the scope of GL 95-05, the staff believes the information is necessary to ensure the licensee has properly identified when the effect will be observed, if at all.

The testing programs performed by TVA and by the industry resulted in several significant observations:

Observation a:

In certain circumstances, the Cochet equation (or partial through-wall equation) may overpredict the "burst pressure" for flaws whose crack tips do not end in full thickness material i.e., are not rectangular shaped). This phenomena occurs when a crack pops through the tube wall and then stops in less than full thickness material (i.e., stops along the original crack profile) until the pressure is elevated to a point where unstable crack tearing occurs (pages 2-5 and 7-6 of Enclosure 4). The term "stops in less than full thickness material" is used to indicate a crack/notch that starts to tear in the axial direction but stops before the length of the crack on the outside diameter of the wall is the same as the length of crack on the inside diameter of the wall (i.e., the crack profile is not rectangularly shaped).

TVA Discussion

The Cochet equation is used to predict the tearing pressure of the remaining ligament of a part through-wall flaw. If the pressure to tear the remaining ligament is greater than the burst pressure of the tube after the ligament is torn, then the tearing pressure is also the burst pressure. The test results indicated that the measured burst pressure of a specimen in which the

tearing arrested had a subsequent retest pressure that was less than if the configuration had been machined in the specimen.

The small degree of over prediction and under prediction by both the Cochet or ANL equations does not depend on crack shape and whether or not a crack stops in less than full thickness material during a particular burst test. Both the Cochet and ANL equations agree equally well with systematic burst test data. ANL uses a slightly different flow strength than is typically used with the Cochet equation.

Observation b:

A flaw that is pressurized and tears to a given length and through-wall thickness will have a lower burst pressure (if retested) than a flaw initially of the same dimensions (i.e., one not previously pressure tested). This was attributed to the plastic strain field at the crack tip (page 18 of Enclosure 3). It is not clear from the description whether the flaw must tear into full thickness material for this to be true.

TVA Discussion

The previous tearing would be expected to reduce the pressure needed to reinitiate further tearing from a machined notch or untested crack of the same dimensions. If tearing had only occurred over some portion of the tapered thickness of material in the specimens and stopped, (for example, because of the loss of pressure from the testing equipment), the pressure required to resume the tearing would be expected to be less than the pressure required to tear a machined notch or untested crack of the same dimensions as the torn configuration.

Observation c:

The severity of the pressurization rate/foil effect appears to be more severe for longer flaws with a "deep section" (e.g., the Type 14 specimen). The foil effect is larger for larger flaws such as the 1.42-inch specimen and there is only a "possible very mild" strengthening effect for a 0.75-inch long slot.

TVA Discussion

There is no demonstrated foil strengthening effect on 0.75-inch long slot configurations. There is only the possibility that the scatter in test data could mask a possible mild foil strengthening of several percent at most. It is expected that

there would be a larger relative effect for the longer flaws of the Type 14 specimens. The foil can be thought of as a reinforcement of the ligament tearing pressure. For long flaws, once the ligament tears, the crack continues to run. The foil reinforces the burst pressure because tear and burst are the same for those specimens. Thus, the maximum effect would come for deep and long flaws.

Observation d:

There is a small amount of time dependent deformation apparent in tensile tests of Alloy 600 between room temperature and typical steam generator operating temperatures.

TVA Discussion

The observation is correct. This effect has been observed previously and has been known in the technical community for over a decade. As noted, the effect is small and should not be meaningful for the conditions of interest in analyzing the structural integrity of steam generator tubes.

QUESTION 2:

Please clarify the statement on page 7 of Enclosure 3 indicating that "crack extension into full thickness material is not a necessary condition to signify that the burst pressure has been reached, although it is a sufficient condition for steam generator tubing." For the specimens used in the fast rate tests without foil, four of the six specimens reached their maximum pressure during the initial pressurization tests performed without a bladder. For these tests, did the "crack" tear into full thickness material? Was the same true for the other two specimens? If the initial pressurization rate tests were performed with a facility of unlimited capacity would the "burst pressure" have been higher than reported? If so, would this alter the conclusion that the effect is only a "foil effect?"

RESPONSE 2

Depending on geometry and material toughness crack extension can occur before, at or after a plastic collapse limit load has been reached. The very high toughness of Alloy 600 and the small diameter and thickness dimensions of steam generator tubes makes tearing into full wall thickness material a sufficient condition for the inference that a plastic collapse burst pressure has been

exceeded. For somewhat shallow partial through-wall cracks, the maximum possible pressure supportable by the tube (burst pressure) is the pressure required to tear a crack through the wall thickness. In some, if not most, test systems, tearing through the wall thickness immediately drops the pressure and prevents continued tearing into full thickness material. That is, the burst pressure has been exceeded but tearing into full wall thickness material did not occur. Therefore, tearing into full wall thickness material is not a necessary condition to identify a burst pressure. However, tearing into full thickness material is a sufficient condition to make the statement that "at some prior point the burst pressure must have been exceeded."

Initial pressurization tests without a bladder lead to tearing through the wall thickness but with a minimal crack mouth opening. Retesting with a bladder, but no foil, led to very substantial "fish mouth" openings about 0.2 inches across by 1.42 inches long. The crack ends did not extend into the full thickness material but the burst pressure had been exceeded. Retest pressures were lower than the original no seal condition in 4 of 6 specimens. In the other two specimens the retest pressures were higher by 23 pounds per square inch (psi) and 133 psi.

In these specimens, the factor which controls the burst pressure is tearing through the wall thickness, not tearing into full thickness material at the ends of the slot. The burst pressure of a 1.42-inch long, 100 percent through-wall crack is below 2000 psi. No higher burst pressures would have been observed if an unlimited capacity system(maintain constant pressure regardless of flow rate) had been used. This is exactly the point of examining post test appearance, calculating the maximum possible retest pressure and performing retests where there is any chance that the burst pressure has not been definitively determined.

QUESTION 3

For Figure 2.6 in Enclosure 3: For each data point (fast and slow rate tests), provide the following information showing how the "measured tearing pressure" was arrived at (preferably in one table):

a. sequence of testing
b. conduct of test - with bladder, with bladder and foil, no bladder or foil
c. post test appearance

For example, was specimen WAT-14-001, first tested "fast" without bladder and foil and then tested with a bladder. If so, what was the pressurization rate and the "burst pressure" for each of these two tests (recognizing that only two of six had higher burst pressures in the second test)? At the completion of each of these two tests, describe whether a Figure 2.4 or Figure 2.5 post test appearance was observed. In addition, describe whether the axial tearing stopped in full thickness material, extended beyond the original notch length (typically 1.42 inches for Type 14 specimens), or whether it stopped in less than full thickness material.

The staff is requesting this information to assess whether any of the information learned from the series of tests (discussed above) is affecting the data, thereby affecting the comparisons among the various tests (in particular, retesting of specimens that started to tear and/or didn't tear into full thickness material).

Address whether this includes all Type 14 specimen data reported in Enclosures 3 and 4. The staff notes that the data reported in Table 2-2 of Enclosure 4 does not match the text in Enclosure 4 regarding the average burst pressures and standard deviations.

RESPONSE 3

The total amount of information requested at the start of this question was effectively modified based on the telephone discussion of October 9, 2001, with members of the NRC staff (K. Karwoski, et al.). The test duration data for the slow-rate without foil and fast-rate with foil specimens are listed in Table 2-1 of EPRI Report 1001441, Enclosure 4 of the TVA submittal dated August 22, 2001. The fast-rate without foil tests were intended to be pressurized at a rate of 1000 to 2000 psi per second (psi/s). The rates for the Type 14 specimens tested for TVA are further discussed in the following paragraph. Based on the telephone discussion, it was understood that the staff concurred with the conclusion that once the radial ligament had torn, the burst pressure had been reached and that further information on the post-test appearance of the specimens would not be required.

Regarding the specific example requested, the WAT-14-001 specimen was first tested "fast" without any reinforced bladder. The fast pressurization rate was intended to be on the order of 1000 to 2000 psi/s. The details of the rates achieved are discussed below in the response to Question 6. It was subsequently tested

again with a reinforced bladder to see if the burst pressure was any higher. The crack opened to the extent that the foil and bladder were ejected at essentially the same pressure. The purpose of the bladder is to retain the water in the tube to effect a test. The purpose of the foil is to delay the rupture of the bladder until the burst pressure of the tube has been reached. When a foil is used, it is 0.5 inches wide and typically extends beyond the ends of the flaw by about 0.25 inches at each end. Centering of the foil on the flaw is not perfect, so once the flaw starts to open up significantly, both the foil and the bladder may tear.

When the bladder is not used, pressure is lost as soon as the radial ligament tears. When a retest takes place the pressure is lost as soon as the bladder is no longer shielded by the foil. This occurs if the foil tears or if it slips to the side or if the flaw opens enough to expose the bladder. The results from the Type 14 specimen tests are summarized in the attached Table 1. Testing subsequent to the onset of leak did not show any meaningful change, i.e., tearing of the remaining ligament in the depth direction is synonymous with burst of the tube at the location of the indication.

Pressurization rates for the tests are listed in the attached Table 2, and discussed in detail in the response to Question 6.

Whether Figure 2.4 or Figure 2.5 more closely matches the post-test appearance, is not meaningful regarding whether or not the burst pressure had been reached. Once the tearing pressure had been reached, the burst pressure had also been reached. This means that the comparisons are not being affected by whether or not the crack stopped in less than full thickness material.

The text for the mean and standard deviation values for the results from the slow and fast rate tests reflects the effect of categorizing the test result for specimen ANO-00-091 as being from a fast-rate test. This specimen was originally slated to be destructively examined without testing to evaluate the performance of the profile machining. Instead, it was later tested at a separate facility and initially categorized incorrectly as a fast-rate test. It was subsequently, categorized as a slow-rate test. The correct values for the means and standard deviations for the two categories of testing are in Table 2-2 of EPRI Report 1001441.

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QUESTION 4:

The results provided in Section 2 of Enclosure 3 were performed for 3 conditions: fast with foil, fast without foil and slow without foil. Were any tests performed at slow pressurization rates with foil for the Type 14 specimens? Would the effect be of the same magnitude?

RESPONSE 4

There were no slow-rate tests performed using a foil reinforced bladder in the specimen within the TVA scope of work. Nor was there any test of this type in the previous Arkansas Nuclear One (ANO) scope of work. If a series of slow-rate tests were to be performed employing foil reinforced bladders, the results would be expected to be similar to the fast-rate tests with foil. It is possible for there to be an interaction effect between the rate of testing and the effect of the foil reinforcement, e.g., it could be postulated that the friction shear force between the foil and the inside surface of the tube is subject to a rate effect. However, the results of the tests run on the specimens with ¾-inch long machined flaws indicate that such an effect would not have meaningfully affected the ODSCC database.

QUESTION 5

For the GL 95-05 database, provide the conditions under which the tests were performed including pressurization rate, temperature, bladder, foil, and whether one pressure test was followed by another. For the French data, address whether a foil effect was observed given the French data are consistently higher than the mean correlation and foil "reinforcement" was used for these slow pressurization rate tests. Do the results imply these geometries exhibited a foil effect at slow pressurization rates? How do the flaw profiles of the French tubes compare to the flaw profiles of the tubes in the 3/4" database? Does the method of attaching the foil affect the results?

RESPONSE 5

The tests conducted in the United States were performed at room temperature. The intent was to achieve pressurization rates on the order of a 1500 to 2000 psi/s. For expected depths greater than about 80 percent, a foil reinforcement was used to prevent ejection of the bladder if ligament tearing occurred. For the other specimens, no liner of any type was used. Not all of the

pressure tests were conducted at the same time. Tests were conducted as specimens became available.

The French tests were conducted with foil reinforcement of the specimens. The rate of pressurization was on the order of 60 to 120 psi/s. This is discussed in detail in Section 3.2.4 of the EPRI report. The reported burst pressures are 85 percent of the values measured during the testing. The reduction in burst pressure was applied to account for the strengthening effect of the foil. French tests of through-wall specimens were conducted by a different investigator using different equipment (and likely at a different laboratory). That investigator reported that there was no foil effect using his system with lubricated foil. Westinghouse is uncertain whether profiling of the specimens was performed in France, when those tests were done. Westinghouse knows of no specimen profile information from the French specimens. It is possible that the method of attaching the foil, affects the results when the foil is attached to the tube instead of to the bladder. The French considered all effects accounted for when the measured pressure was reduced by 15 percent to calculate the reported pressure.

QUESTION 6

For Figure 3.8 of Enclosure 3, which was derived from Table 3-1, please address the following:

a. For the indications with maximum depths between approximately 65% and 85%, the predictive model underpredicted the burst pressures for specimens tested without foil. In Enclosures 3 and 4, it was indicated that the Cochet equation may overpredict the burst pressure of partial through-wall cracks that do not end in full thickness material. In addition, it was indicated that the Cochet equation provides a conservative prediction of the burst pressure. Please address whether the underprediction for the 65% to 85% through-wall specimens tested without the foil is attributed to the limitations of the Cochet equation (related to cracks that do not end in full thickness material) or some other mechanism. If the underprediction is due to this effect, wouldn't it be more appropriate to compare the mean of the data for a specific depth (or a small depth range) for those specimens tested without a foil to the mean of the data for the same depth for those specimens tested with a foil to assess the effect of a foil for this specific geometry? If this were done, would it

alter the conclusion that a foil effect is being observed and/or its magnitude?

Response 6a:

A copy of Figure 3.8 is included as Figure 1 of this document. A review of the figure does effect a comparison of the means of the foil and no foil tests across the full range of depths. It is also apparent that there is a trend for the model to over estimate the burst pressure for the deeper specimens regardless of the presence of a foil reinforced bladder during the test, i.e., the data trend downward from left to right on the figure. A clearer comparison is apparent from an examination of Figure 3.7 of the report, which is included herein as Figure 2 for your convenience. Figure 2 illustrates the results from both models against an ideal prediction line and shows the results of performing a linear, 1st order regression analysis of the measured burst pressures on the predicted burst pressures. It is apparent from the figure that neither the slopes nor the intercepts are significantly different when separate regression analyses are performed for the no-foil and foil data.

The use of any normalizing equation leads to the conclusion that "the systematic deviation from the prediction model (Cochet or ANL) is the same for foil and no foil specimens." In other words, there is no detectable foil effect in the TVA specimens, and that finding extends to the ODSCC database because of the length of degradation involved.

It must be stressed that a comparison of the relative merits and or limitations of the normalizing equations, Cochet or ANL, is not relevant to this discussion, only that any systematic deviations of test data from the model used do not depend on whether or not the cracks or slots end in full thickness material. Because the trend of the data is consistent, it is not considered necessary to segregate the data into depth bands for comparison of foil and no-foil effects. This is supported by the information presented on the attached Figure 2.

b. Given the scatter in the burst pressure data for any given depth (approximately 5 to 10% in the burst pressure), discuss whether normalization of the data (to a mean curve) is appropriate and/or whether more testing needs to be performed to reach the conclusions drawn in the report.

Response 6b:

The results of the tests were normalized using standard industry models, and thus could be concluded to have been normalized appropriately. The scatter of the data is not more pronounced than for other strength models employed, hence, more testing does not need to be performed to reach the conclusions expressed in the report.

c. The staff notes that the tests depicted in Figure 3.8 were performed at slow pressurization rates and the tests indicating a foil effect were done at fast pressurization rates. These latter tests compared "fast-foil" tests to "slow-no-foil" and "fast-no-foil" tests. See Question 4.

Response 6c:

The response to this issue is provided following Question 3 above. The important consideration here is with regard to the ODSCC ARC database, which consists of steam generator and laboratory tube cracked specimens with axial lengths and depths that in the extreme are comparable to the TVA test specimens. Results from "slow-foil" tests are not considered necessary to the resolution of the pressurization rate effect. Moreover, the test results for the TVA specimens demonstrate that any foil effect that might be implied by the results of the tests of the Type 14 specimens is not meaningful to the results of tube support plate ODSCC structural integrity tests.

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Table 1
Test Results for Type 14
EDM Notch Specimens

Specimen Identification	No Bladder		Lubricated Burst (psig)
	Leak (psig)	Maximum (psig)	
WAT-14-001	4044	4049	4074
WAT-14-002	4177	4260	4172
WAT-14-003	4049	4113	4030
WAT-14-004	3946	4025	3980
WAT-14-005	4624	4683	4541
WAT-14-006	3627	3759	3892

Table 2
Leak Onset Results for Type 14
EDM Notch Specimens

Specimen Identification	Start Time	End Time	Start Pressure	End Pressure	Average Rate	Ratio to Model
WAT-14-001	1.8	4.9	353	4044	1191	94.8%
WAT-14-002	1.7	3.5	122	4157	2242	98.5%
WAT-14-003	1.4	2.4	250	4049	4259	97.0%
WAT-14-004	1.0	1.6	63	3946	6472	91.4%
WAT-14-005	1.6	3.8	78	4624	2066	104.1%
WAT-14-006	1.5	2.2	157	3627	4957	93.8%

Note: Start and end times represent the range over which the average was calculated. The information listed here is also graphed on Figure .

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
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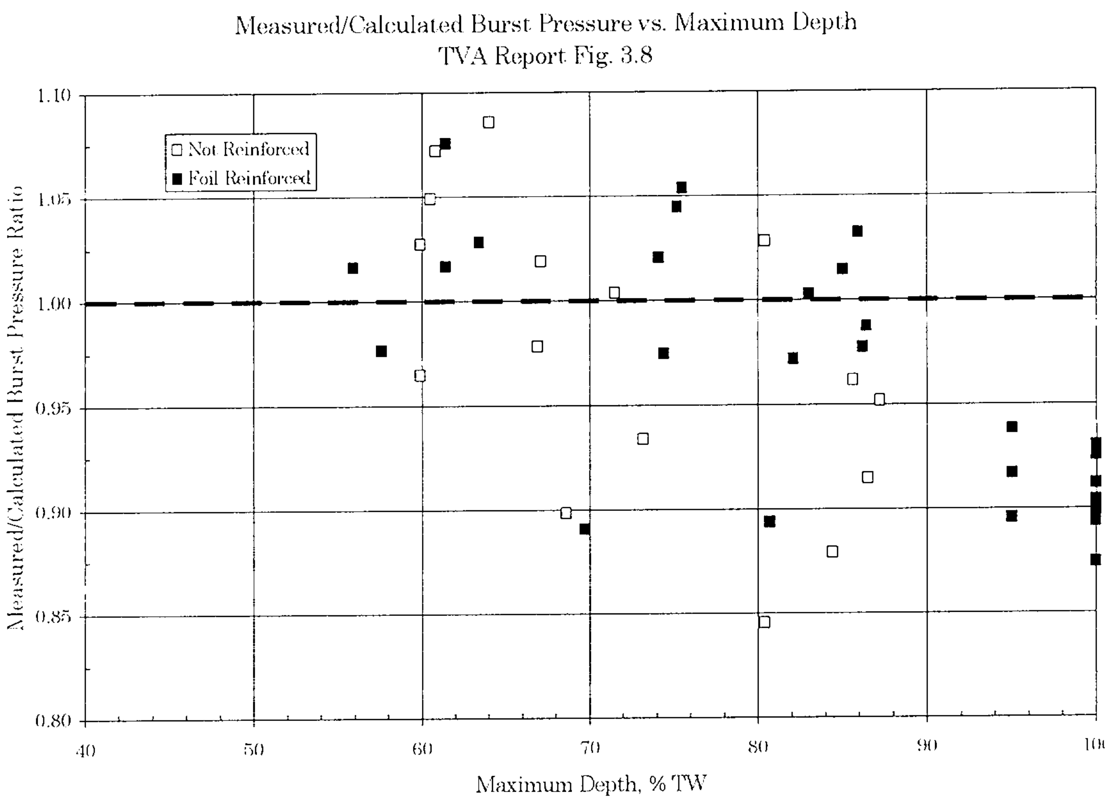

Figure 1: Repeat of Figure 3.8 of the TVA report.

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT UNIT 1
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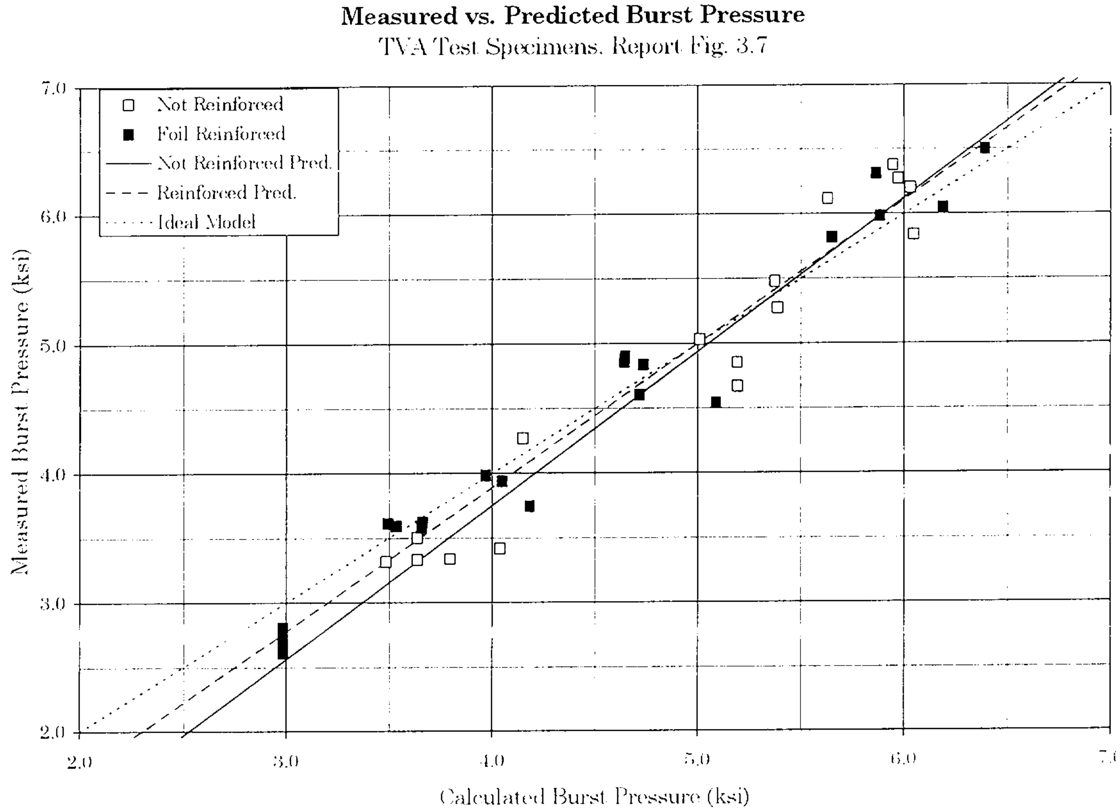

Figure 2: Repeat of Figure 3.7 of the TVA report.

ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNIT 1
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ENCLOSURE 2

WATTS BAR NUCLEAR PLANT UNIT 1
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RESPONSE TO NRC QUESTION ON OCTOBER 18, 2001

The following additional questions were received from the NRC Project Manager R. Heron by electronic mail on October 18, 2001.

QUESTION 1

Figure 2.3 of Enclosure 3 represents a typical pressurization rate curve for the fast pressurization tests performed without the foil (this figure is actually a pressurization rate curve for a leak test). A review of this figure indicates that the pressurization rate prior to leakage was only on the order of 300 psi/sec rather than 2000 psi/sec. As a result, it appears to draw into question the conclusion that there is no pressurization rate effect. The subsequent test of this tube would have been performed with a bladder and a different flaw geometry.

If the plot in Figure 2.3 is typical, it is not apparent that the results truly represent "fast pressurization rate tests without a foil" rather they may represent slow tests without a foil.

In light of the above, discuss the need to conduct slow pressurization rate tests with a foil so that a direct comparison of pressurization rates can be performed.

RESPONSE 1

The inclusion of the pressurization rate figure for specimen WAT-14-001 as typical was not intended to imply that the rates for the specimens were identical. In fact, the figure illustrates the rate for the slowest tested specimen. The data on the figure show that the overall average pressurization rate for the specimen was about 1191 pounds per square inch per second (psi/s), i.e., the pressure started to increase at 1.8 seconds and reached 4044 psi at 4.9 seconds. For the pressure range from 3500 to 4044 psi the rate was about 454 psi/s, the lowest pressurization rate of any of the Type 14 models tested. Table 2 in Enclosure 1 of this letter, provides a listing of the salient pressure and time information from the records for each of the Type 14 specimens. The average rate ranged from a low of 1191 psi/s to a high of 6472 psi/s. Also listed in Table 2 are the ratios of the measured maximum pressure to the predicted maximum pressure for each model, which demonstrates that the ratios were not dependent on the rate of the test, e.g., the fastest test had the lowest ratio. Figure 1 of this enclosure illustrates the pressure versus time history for a specimen that had an effective pressurization rate in excess of 4000 psi/s. Figure 2 of this enclosure illustrates the pressure versus time history for the

specimen tested at the fasted rate. For the specimens shown in these figures it should be noted that the rate near the end of the test was similar to the average rate during the whole test. Finally Figure 3 of this enclosure illustrates a chart of the onset-of-leak pressure as a function of the pressurization rate, convincingly showing that the pressurization rate did not influence the ligament tearing pressure of the specimens. The implication is that slow pressurization rate tests of specimens with a foil reinforced bladder liner are not needed.

QUESTION 2

The data in Enclosure 4 for the burst pressures of the Type 14 specimens does not match the data provided to the NRC in 2000. For example, last year ANO-00-068 was reported to have a burst pressure of 2.965 ksi whereas in the present report the burst pressure was reported as 3.230 ksi. Discuss the reasons for the inconsistency.

RESPONSE 2

There is no inconsistency in the reported values in light of the context in which the numbers were presented. The measured test pressure was 3.230 ksi for tube material with a strength of 155.8 ksi (the sum of the yield and ultimate strengths) while the R72C72 tube at Arkansas Nuclear One (ANO) Unit 2 was reported to have a material strength of 143.0 ksi. The value of 2.965 ksi is calculated by multiplying the test result of 3.230 ksi by the ratio of the material strengths, i.e., 91.78 percent. The value of 2.965 ksi was recorded in a report to NRC from Entergy dated June 6, 2000, as representative of a result that would have been obtained had actual R72C72 material been used for the test.

The information reported in the EPRI and TVA documents for the Type 14 specimens are from tests using the same heat of tube material. The results tabulated in the EPRI document are the test measured values. For the TVA trapezoid profile tests, ¾-inch diameter tubes with a wall thickness of 0.043 inch were used because that is what the ODSCC ARC is for (the ANO tubing had a wall thickness of 0.048 inches). The same heat of material was used for all of the specimens. In summary, the Type 14 tests are an "apples-to-apples" comparison and the trapezoid tests are an "oranges-to-oranges" comparison.

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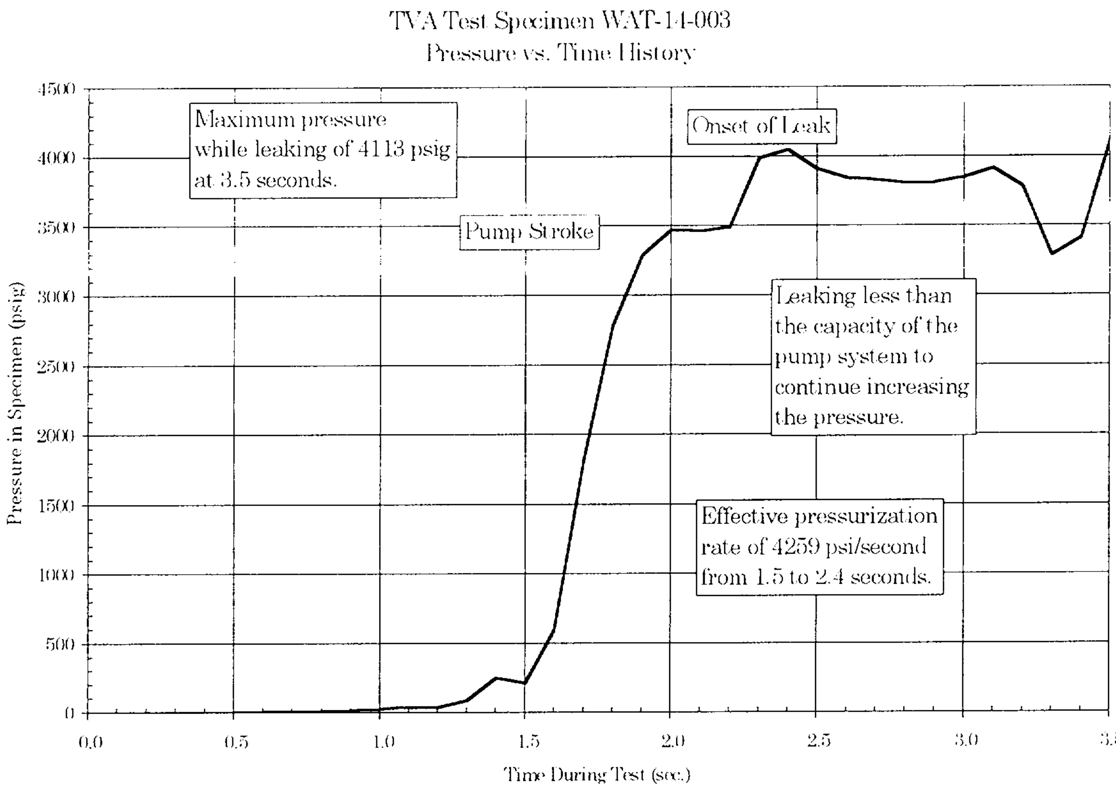

Figure1: Pressure vs. time history for a different specimen.

WATTS BAR NUCLEAR PLANT UNIT 1
PROPOSED TECHNICAL SPECIFICATION CHANGE WBN-TS-99-014
ALTERNATE REPAIR CRITERIA (ARC) PRESSURIZATION RATE ISSUE
RESPONSE TO NRC QUESTION ON OCTOBER 18, 2001

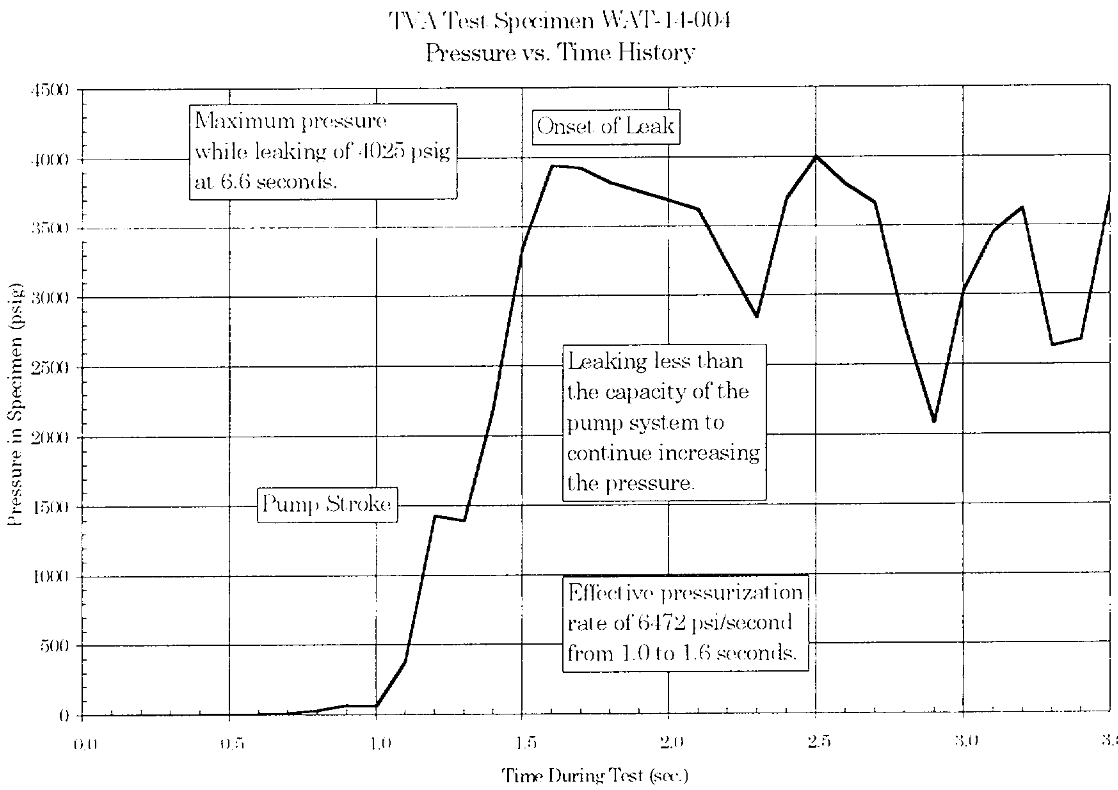

Figure 2: Pressure vs. time history for the specimen with the maximum rate.

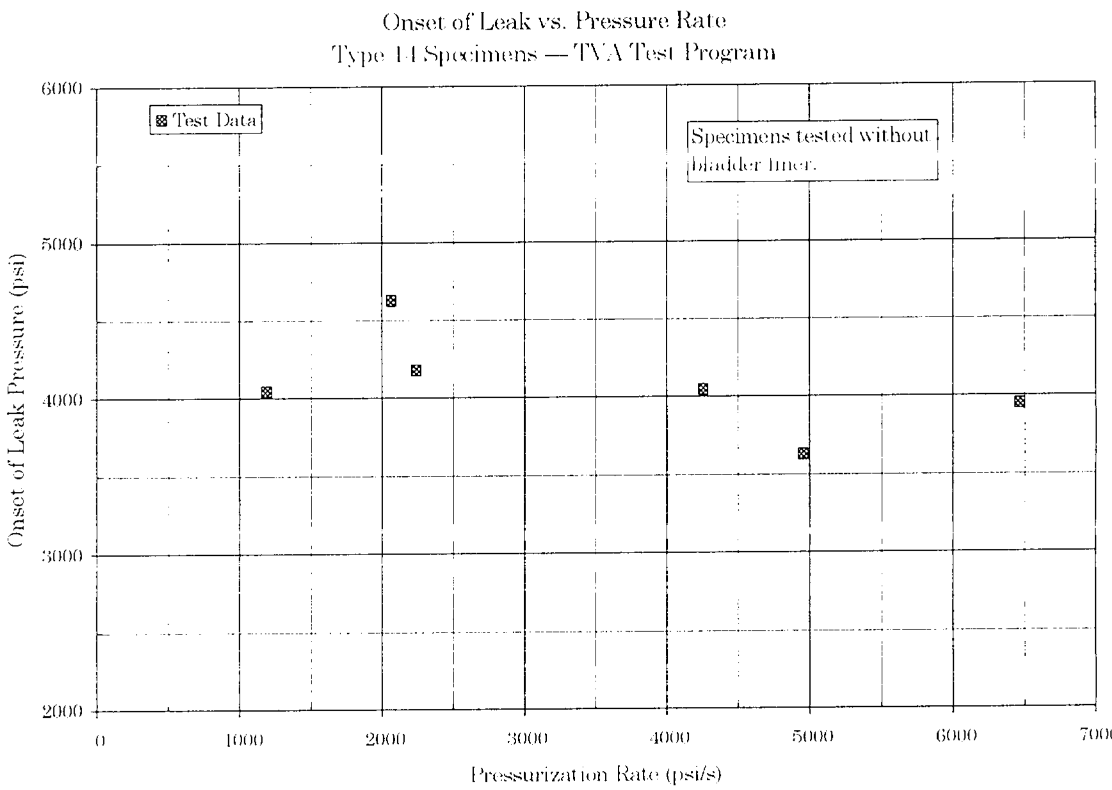

Figure 3: Comparison of the onset of leak pressure to the pressurization rate.