SURVEILLANCE REQUIREMENTS (Continued)

2. Tubes in those areas where experience has indicated potential problems, and

3. At least 3 percent of the total number of sleeved tubes in all three steam generators. A sample size less than 3 percent is acceptable provided all the sleeved tubes in the steam generator(s) examined during the refueling outage are inspected. These inspections will include both the tube and the sleeve, and

4. A tube inspection pursuant to Specification 4.4.5.4.a.8. If any selected tube does not permit the passage of the eddy current probe for a tube or sleeve inspection, this shall be recorded and an adjacent tube shall be selected and subjected to a tube inspection.

INSERT A →

c. The tubes selected as the second and third samples (if required by Table 4.4-2) during each inservice inspection may be subjected to a partial tube inspection provided:

1. The tubes selected for these samples include the tubes from those areas of the tube sheet array where tubes with imperfections were previously found, and

2. The inspections include those portions of the tubes where imperfections were previously found.

d. For Cycle 11, implementation of the tube support plate interim plugging criteria limit requires a 100 percent bobbin coil probe inspection for all hot leg tube support plate intersections and all cold leg intersections down to the lowest cold leg tube support plate with outer diameter stress corrosion cracking (ODSCC) indications. An inspection using a rotating pancake coil (RPC) probe is required in order to show OPERABILITY of tubes with flaw-like bobbin coil signal amplitudes greater than 1.0 volt but less than or equal to 3.6 volts. For tubes that will be administratively plugged or repaired, no RPC inspection is required. The RPC results are to be evaluated to establish that the principal indications can be characterized as ODSCC.

INSERT B →

The results of each sample inspection shall be classified into one of the following three categories:

INSERT A

5. Indications left in service as a result of application of the tube support plate voltage-based repair criteria (4.4.5.4.a.10) shall be inspected by bobbin coil probe during all future refueling outages.

INSERT B

Implementation of the steam generator tube-to-tube support plate repair criteria requires a 100-percent bobbin coil inspection for hot-leg and cold-leg tube support plate intersections down to the lowest cold-leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) indications. The determination of the lowest cold-leg tube support plate intersections having ODSCC indications shall be based on the performance of at least a 20-percent random sampling of tubes inspected over their full length.

(Proposed Wording)

SURVEILLANCE REQUIREMENTS (Continued)

6. Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving in the affected area because it may become unserviceable prior to the next inspection. The plugging or repair limit imperfection depths are specified in percentage of nominal wall thickness as follows:

   a. Original tube wall 40%

   b. Babcock & Wilcox kinetic welded sleeve wall 40%

   c. Westinghouse laser welded sleeve wall 25%

INSERT C

For Cycle 11, this definition does not apply to the region of the tube subject to the tube support plate interim plugging criteria limit, i.e., the tube support plate intersections. Specification 4.4.5.4.a.10 describes the repair limit for use within the tube support plate intersection of the tube.

7. Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steamline or feedwater line break as specified in 4.4.5.3.c, above.

8. Tube Inspection means an inspection of the steam generator tube from the point of entry (hot-leg side) completely around the U-bend to the top support to the cold-leg.

9. Tube Repair refers to sleeving which is used to maintain a tube in-service or return a tube to service. This includes the removal of plugs that were installed as a corrective or preventive measure. The following sleeve designs have been found acceptable:

   a. Babcock & Wilcox kinetic welded sleeves, BAW-2094P, Revision 1 including kinetic sleeve "tooling" and installation process parameter changes.

   b. Westinghouse laser welded sleeves, WCAP-13483, Revision 1.

INSERT C

This definition does not apply to tube support plate intersections for which the voltage-based repair criteria are being applied. Refer to 4.4.5.4.a.10 for the repair limit applicable to these intersections.

(Proposed Wording)

SURVEILLANCE REQUIREMENTS (Continued)

INSERT D →

10. Tube Support Plate Interim Plugging Criteria Limit is used for the disposition of a steam generator tube for continued service that is experiencing ODSCC confined within the thickness of the tube support plates. For application of the tube support plate interim plugging criteria limit, the tube's disposition for continued service will be based upon standard bobbin coil probe signal amplitude of flaw-like indications. Pending incorporation of the voltage verification requirements in ASME standard verifications, an ASME standard calibrated against the laboratory standard will be utilized in steam generator inspections for consistent voltage normalization. The plant specific guidelines used for all inspections shall be consistent with the eddy current guidelines in Appendix A of WCAP-14122.

    a. A tube can remain in service with a flaw-like bobbin coil signal amplitude of less than or equal to 1.0 volt, regardless of the depth of the tube wall penetration, provided item c below is satisfied.

    b. A tube can remain in service with a flaw-like bobbin coil signal amplitude greater than 1.0 volt but less than or equal to 3.6 volts provided an RPC inspection does not detect degradation and item c below is satisfied.

    c. The projected distribution of crack indications is verified to result in total primary-to-secondary leakage less than 6.6 gpm in the most limiting loop during a postulated main steam line break event. The methodology for calculating expected leak rates from the projected crack distribution will be consistent with the latest EPRI recommended voltage-leak rate correlation described in WCAP-14122, using a probability of detection (POD) of 0.6.

    d. A tube with a flaw-like bobbin coil signal amplitude of greater than 3.6 volts shall be plugged or repaired.

b. The steam generator shall be determined OPERABLE after completing the corresponding actions (plug or repair all tubes exceeding the plugging or repair limit) required by Table 4.4-2.

INSERT D

10. Tube Support Plate Plugging Limit is used for the disposition of an alloy 600 steam generator tube for continued service that is experiencing predominantly axially oriented outside diameter stress corrosion cracking confined within the thickness of the tube support plates. At tube support plate intersections, the plugging (repair) limit is based on maintaining steam generator tube serviceability as described below:

    a. Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with bobbin voltages less than or equal to 2.0 volts will be allowed to remain in service.

    b. Steam generator tubes, whose degradation is attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than 2.0 volts will be repaired or plugged, except as noted in 4.4.5.4.a.10.c below.

    c. Steam generator tubes, with indications of potential degradation attributed to outside diameter stress corrosion cracking within the bounds of the tube support plate with a bobbin voltage greater than 2.0 volts but less than or equal to the upper voltage repair limit[1] may remain in service if a rotating pancake coil or acceptable alternative inspection does not detect degradation. Steam generator tubes, with indications of outside diameter stress corrosion cracking degradation with a bobbin voltage greater than the upper voltage repair limit[1] will be plugged or repaired.

    d. If an unscheduled mid-cycle inspection is performed, the following mid-cycle repair limits apply instead of the limits identified in 4.4.5.4.10.a, 4.4.5.4.10.b, and 4.4.5.4.10.c.

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(1) The upper voltage repair limit is calculated according to the methodology in Generic Letter 95-05 as supplemented.

INSERT D (continued)

The mid-cycle repair limits are determined from the following equations:

$$V_{MURL} = \frac{V_{SL}}{1.0 + NDE + Gr\left(\frac{CL - \Delta t}{CL}\right)}$$

$$V_{MLRL} = V_{MURL} - (V_{URL} - V_{LRL})\left(\frac{CL - \Delta t}{CL}\right)$$

where:

V_{URL}	=	upper voltage repair limit
V_{LRL}	=	lower voltage repair limit
V_{MURL}	=	mid-cycle upper voltage repair limit based on time into cycle
V_{MLRL}	=	mid-cycle lower voltage repair limit based on V_{MURL} and time into cycle
Δt	=	length of time since last scheduled inspection during which V_{URL} and V_{LRL} were implemented
CL	=	cycle length (the time between two scheduled steam generator inspections)
V_{SL}	=	structural limit voltage
Gr	=	average growth rate per cycle length
NDE	=	95-percent cumulative probability allowance for nondestructive examination uncertainty (i.e., a value of 20-percent has been approved by NRC)[2]

Implementation of these mid-cycle repair limits should follow the same approach as in TS 4.4.5.4.10.a, 4.4.5.4.10.b, and 4.4.5.4.10.c.

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(2) The NDE is the value provided by the NRC in GL 95-05 as supplemented.

SURVEILLANCE REQUIREMENTS (Continued)

4.4.5.5 Reports

a. Within 15 days following the completion of each inservice inspection of steam generator tubes, the number of tubes plugged or repaired in each steam generator shall be reported to the Commission in a Special Report pursuant to Specification 6.9.2.

b. The complete results of the steam generator tube and sleeve inservice inspection shall be submitted to the Commission in a Special Report pursuant to Specification 6.9.2 within 12 months following the completion of the inspection. This Special Report shall include:

1. Number and extent of tubes and sleeves inspected.

2. Location and percent of wall-thickness penetration for each indication of an imperfection.

3. Identification of tubes plugged or repaired.

c. Results of steam generator tube inspections which fall into Category C-3 shall be reported to the Commission pursuant to Specification 6.6 prior to resumption of plant operation. The written report shall provide a description of investigations conducted to determine the cause of the tube degradation and corrective measures taken to prevent recurrence.

INSERT E →

d. For Cycle 11, the results of inspection for all tubes in which the tube support plate interim plugging criteria has been applied shall be reported to the Commission pursuant to Specification 6.9.2 within 15 days following completion of the steam generator tube inservice inspection. The report shall include:

1. Listing of the applicable tubes, and

2. Location (applicable intersections per tube) and extent of degradation (voltage).

e. Projected Steam Line Break (SLB) Leakage performed under 4.4.5.4.a.10 will be reported to the Commission prior to restart of Cycle 11 (Mode 1).

INSERT E

d. For implementation of the voltage-based repair criteria to tube support plate intersections, notify the Commission prior to returning the steam generators to service (MODE 4) should any of the following conditions arise:

1. If estimated leakage based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds the leak limit (determined from the licensing basis dose calculation for the postulated main steamline break) for the next operating cycle.

2. If circumferential crack-like indications are detected at the tube support plate intersections.

3. If indications are identified that extend beyond the confines of the tube support plate.

4. If indications are identified at the tube support plate elevations that are attributable to primary water stress corrosion cracking.

5. If the calculated conditional burst probability based on the projected end-of-cycle (or if not practical, using the actual measured end-of-cycle) voltage distribution exceeds 1×10^{-2}, notify the Commission and provide an assessment of the safety significance of the occurrence.

(Proposed Wording)

REACTOR COOLANT SYSTEM

OPERATIONAL LEAKAGE

LIMITING CONDITION FOR OPERATION

3.4.6.2 Reactor Coolant System operational LEAKAGE shall be limited to:

a. No pressure boundary LEAKAGE,

b. 1 gpm unidentified LEAKAGE,

~~c. 450 gallons per day total primary to secondary LEAKAGE through all steam generators,~~

c ~~d.~~ 150 gallons per day primary-to-secondary LEAKAGE through any one steam generator, and

d ~~e.~~ 10 gpm identified LEAKAGE.

APPLICABILITY: MODES 1, 2, 3, and 4.

ACTION:

a. With any pressure boundary LEAKAGE, be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the next 30 hours.

b. With any Reactor Coolant System LEAKAGE greater than any one of the above limits, excluding pressure boundary LEAKAGE, reduce the LEAKAGE rate to within limits within 4 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.4.6.2 Reactor Coolant System LEAKAGES shall be demonstrated to be within each of the above limits by:

a. Monitoring the following leakage detection instrumentation at least once per 12 hours:(1)

1. Containment atmosphere gaseous radioactivity monitor.

---

(1) Only on leakage detection instrumentation required by LCO 3.4.6.1.

3/4.4.5 STEAM GENERATORS (Continued)

operation would be limited by the limitation of steam generator tube leakage between the primary coolant system and the secondary coolant system (primary-to-secondary LEAKAGE = 150 gallons per day per steam generator). Axial cracks having a primary-to-secondary LEAKAGE less than this limit during operation will have an adequate margin of safety to withstand the loads imposed during normal operation and by postulated accidents. Operating plants have demonstrated that primary-to-secondary LEAKAGE of 150 gallons per day per steam generator can readily be detected. Leakage in excess of this limit will require plant shutdown and an unscheduled inspection, during which the leaking tubes will be located and plugged.

Wastage-type defects are unlikely with the all volatile treatment (AVT) of secondary coolant. However, even if a defect of similar type should develop in service, it will be found during scheduled inservice steam generator tube examinations. Plugging or repair will be required of all tubes with imperfections exceeding the plugging or repair limit. Degraded steam generator tubes may be repaired by the installation of sleeves which span the degraded tube section. A steam generator tube with a sleeve installed meets the structural requirements of tubes which are not degraded, therefore, the sleeve is considered a part of the tube. The surveillance requirements identify those sleeving methodologies approved for use. If an installed sleeve is found to have through wall penetration greater than or equal to the plugging limit, the tube must be plugged. The plugging limit for the sleeve is derived from R.G. 1.121 analysis which utilizes a 20 percent allowance for eddy current uncertainty in determining the depth of tube wall penetration and additional degradation growth. Steam generator tube inspections of operating plants have demonstrated the capability to reliably detect degradation that has penetrated 20 percent of the original tube wall thickness.

INSERT F

For Cycle 11, tubes experiencing outer diameter stress corrosion cracking at the tube support plates (TSPs) where such cracking is confined to the thickness of the TSPs will be dispositioned in accordance with Specification 4.4.5.4.a.10.

Whenever the results of any steam generator tubing inservice inspection fall into Category C-3, these results will be reported to the Commission pursuant to Specification 6.6 prior to resumption of plant operation. Such cases will be considered by the Commission on a case-by-case basis and may result in a requirement for analysis, laboratory examinations, tests, additional eddy-current inspection, and revision of the Technical Specifications, if necessary.

INSERT F

The voltage-based repair limits of these surveillance requirements (SR) implement the guidance in GL 95-05 and are applicable only to Westinghouse-designed steam generators (SGs) with outside diameter stress corrosion cracking (ODSCC) located at the tube-to-tube support plate intersections. The voltage-based repair limits are not applicable to other forms of SG tube degradation nor are they applicable to ODSCC that occurs at other locations within the SG. Additionally, the repair criteria apply only to indications where the degradation mechanism is dominantly axial ODSCC with no NDE detectable cracks extending outside the thickness of the support plate. Refer to GL 95-05 for additional description of the degradation morphology.

Implementation of these SRs requires a derivation of the voltage structural limit from the burst versus voltage empirical correlation and then the subsequent derivation of the voltage repair limit from the structural limit (which is then implemented by this surveillance).

The voltage structural limit is the voltage from the burst pressure/bobbin voltage correlation, at the 95-percent prediction interval curve reduced to account for the lower 95/95-percent tolerance bound for tubing material properties at 650°F (i.e., the 95-percent LTL curve). The voltage structural limit must be adjusted downward to account for potential degradation growth during an operating interval and to account for NDE uncertainty. The upper voltage repair limit; V_{URL}, is determined from the structural voltage limit by applying the following equation:

$$V_{URL} = V_{SL} - V_{Gr} - V_{NDE}$$

where V_{Gr} represents the allowance for degradation growth between inspections and V_{NDE} represents the allowance for potential sources of error in the measurement of the bobbin coil voltage. Further discussion of the assumptions necessary to determine the voltage repair limit are discussed in GL 95-05.

The mid-cycle equation in SR 4.4.5.4.10.d should only be used during unplanned inspections in which eddy current data is acquired for indications at the tube support plates.

SR 4.4.5.5 implements several reporting requirements recommended by GL 95-05 for situations which the NRC wants to be notified prior to returning the SGs to service. For the purposes of this reporting requirement, leakage and conditional burst probability can be calculated based on the as-found voltage distribution rather than the projected end-of-cycle (EOC) voltage distribution (refer to GL 95-05 for more information) when it is not practical to complete these calculations using the projected EOC voltage distributions prior to returning the SGs to service. Note that if leakage and conditional burst probability were calculated using the measured EOC voltage distribution for the purposes of addressing the GL section 6.a.1 and 6.a.3 reporting criteria, then the results of the projected EOC voltage distribution should be provided per the GL section 6.b (c) criteria.

(Proposed Wording)

3/4.4.6.2 OPERATIONAL LEAKAGE (Continued)

LCO (Continued)

b. Unidentified LEAKAGE

requirements and that control room habitability continues to meet GDC-19

One gallon per minute (gpm) of unidentified LEAKAGE is allowed as a reasonable minimum detectable amount that the containment air monitoring and containment sump level monitoring equipment can detect within a reasonable time period. Violation of this LCO could result in continued degradation of the RCPB, if the LEAKAGE is from the pressure boundary.

postulated

4.5

NOTE 1

Maintaining an operating LEAKAGE limit of 150 gpd per steam generator ~~(450 gpd total) for Cycle 11~~ will minimize the potential for a large LEAKAGE event during a main steam line break. Based on the non-destructive examination uncertainties, bobbin coil voltage distribution, and crack growth rate from the previous inspection, the expected leak rate following a steam line rupture is limited to below 4.5 ~~6.6~~ gpm in the faulted loop. Maintaining LEAKAGE within the ~~6.6~~ gpm limit will ensure that offsite doses will remain within the 10 CFR 100 ~~guidelines~~. LEAKAGE in the intact loops will be limited to the operating limit of 150 gpd. If the projected end-of-cycle distribution of crack indications results in primary-to-secondary LEAKAGE greater than ~~6.6~~ 4.5 gpm in the faulted loop during a postulated steam line break event, additional tubes must be removed from service or repaired in order to reduce the postulated steam line break LEAKAGE to below ~~6.6~~ 4.5 gpm.

~~(1) c. Primary to Secondary LEAKAGE through All Steam Generators (SGs)~~

~~Total primary to secondary LEAKAGE amounting to 450 gallons per day through all SGs produces acceptable offsite doses in the SLB accident analysis. Violation of this LCO could exceed the offsite dose limits for this accident. Primary to secondary LEAKAGE must be included in the total allowable limit for identified LEAKAGE.~~

~~(2)~~ C. Primary-to-Secondary LEAKAGE through Any One SG

~~The 150 gallons per day limit on one SG is based on the assumption that a single crack leaking this amount would not propagate to a SGTR under the stress conditions of a LOCA or a main steam line rupture. If leaked through many cracks, the cracks are very small, and the above assumption is conservative.~~

INSERT G

(Proposed Wording)

INSERT G

Also, the 150 gallons per day leakage limit incorporated into this specification is more restrictive than the standard operating leakage limit and is intended to provide an additional margin to accommodate a crack which might grow at a greater than expected rate or unexpectedly extend outside the thickness of the tube support plate. Hence, the reduced leakage limit, when combined with an effective leak rate monitoring program, provides additional assurance that should a significant leak be experienced in service, it will be detected, and the plant shut down in a timely manner.

(Proposed Wording)

3/4.4.6.2 OPERATIONAL LEAKAGE (Continued)

~~d~~ c. Identified LEAKAGE

Up to 10 gpm of identified LEAKAGE is considered allowable because LEAKAGE is from known sources that do not interfere with detection of identified LEAKAGE and is well within the capability of the RCS Makeup System. Identified LEAKAGE includes LEAKAGE to the containment from specifically known and located sources, but does not include pressure boundary LEAKAGE or controlled reactor coolant pump (RCP) seal leakoff (a normal function not considered LEAKAGE). Violation of this LCO could result in continued degradation of a component or system.

APPLICABILITY

In MODES 1, 2, 3, and 4, the potential for RCPB LEAKAGE is greatest when the RCS is pressurized.

In MODES 5 and 6, LEAKAGE limits are not required because the reactor coolant pressure is far lower, resulting in lower stresses and reduced potentials for LEAKAGE.

LCO 3.4.6.3, "RCS Pressure Isolation Valve (PIV)," measures leakage through each individual PIV and can impact this LCO. Of the two PIVs in series in each isolated line, leakage measured through one PIV does not result in RCS LEAKAGE when the other is leak tight. If both valves leak and result in a loss of mass from the RCS, the loss must be included in the allowable identified LEAKAGE.

ACTIONS

a. If any pressure boundary LEAKAGE exists, the reactor must be brought to lower pressure conditions to reduce the severity of the LEAKAGE and its potential consequences. It should be noted that LEAKAGE past seals and gaskets is not pressure boundary LEAKAGE. The reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. This action reduces the LEAKAGE and also reduces the factors that tend to degrade the pressure boundary.

The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems. In MODE 5, the pressure stresses acting on the RCPB are much lower, and further deterioration is much less likely.

ATTACHMENT B

Beaver Valley Power Station, Unit No. 1
Proposed Technical Specification Change No. 229
VOLTAGE-BASED TUBE REPAIR CRITERIA

A. DESCRIPTION OF AMENDMENT REQUEST

The proposed amendment would revise Specifications 3.4.5 and 3.4.6.2, and Bases 3/4.4.5 and 3/4.4.6.2 to maintain voltage-based steam generator tube repair criteria for the tube support plate elevations beyond the current cycle of operation.

B. BACKGROUND

Technical Specification Amendment 184 incorporated a 1.0 volt tube repair limit on an interim basis that will expire at the end of the current operating cycle. This proposed change would implement a 2.0 volt repair limit for future cycles and include changes in addition to those incorporated by Amendment 184 to reflect the guidance provided in NRC Generic Letter (GL) 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking."

C. JUSTIFICATION

The voltage-based repair criteria is based on the analysis described in WCAP-14122, "Beaver Valley Unit 1 Steam Generator Tube Plugging Criteria for Indications at Tube Support Plates," to maintain steam generator (SG) tube serviceability. A copy of the WCAP was provided to the Commission in our submittal of July 29, 1994. The WCAP provides justification for a 1.0 or 2.0 volt repair limit. The 2.0 volt repair limit detailed in the proposed technical specifications reflects a conservative approach for the Beaver Valley Unit No. 1 voltage-based repair criteria, recognizing that a 2.0 volt repair limit has been demonstrated to provide adequate margins in accordance with GL 95-05. The proposed tube repair criteria is provided in accordance with the following:

1. A bobbin coil inspection of 100 percent of the hot-leg and cold-leg tube support plate intersections down to the lowest cold-leg tube support plate with known outside diameter stress corrosion cracking (ODSCC) will be performed. Determination of the lowest cold-leg tube support plate intersections having ODSCC indications are based on performing a 20-percent random sampling of tubes inspected over their full length.

2. Degradation signals confined within the thickness of the tube support plate with bobbin voltages less than or equal to 2.0 volts will be allowed to remain in service.

3. Degradation signals confined within the thickness of the tube support plate with a bobbin voltage of greater than 2.0 volts will be plugged or repaired except as noted in Item 4.

4. Degradation signals confined within the thickness of the tube support plate with a bobbin voltage greater than 2.0 volts but less than or equal to the upper voltage repair limit may remain in service if a rotating pancake coil (RPC) probe inspection does not confirm degradation. Degradation indications with a bobbin voltage greater than the upper voltage repair limit will be plugged or repaired.

5. An end-of-cycle (EOC) voltage distribution will be established for each cycle based upon the most recent EOC eddy current data. Based upon this distribution, postulated main steamline break (MSLB) leakage will be determined based on the guidance of GL 95-05. Projected leakage must remain below a level which results in postulated offsite doses remaining within 10 CFR 100 requirements and postulated control room doses remaining within GDC-19. This level has been determined to be 6.8 gpm for all steam generators, 6.6 gpm in the limiting and assumed faulted loop based on offsite dose, and 4.5 gpm (Reference 5) based on control room dose. Should this estimation exceed 4.5 gpm, the steam generator tube(s) with the highest voltage indications will be successively repaired until the leakage estimation drops below 4.5 gpm.

6. An overall tube burst probability during a postulated MSLB event will be calculated and if found to be greater than 1.0 X 10^{-2}, the Commission will be notified.

The proposed change modifies the steam generator surveillance requirements, the reactor coolant system operational leakage limiting condition for operation, and related technical specification Bases. These proposed changes closely follow the model technical specifications contained in Attachment 2 of Generic Letter 95-05 and remove requirements related to interim plugging criteria. Specification 3.4.6.2 has been modified by deleting item "c", which limits total primary-to-secondary leakage to 450 gpd, since it is redundant to item "d", which limits primary-to-secondary leakage in any one steam generator to 150 gpd. Accordingly, items "d" and "e" have been renamed to items "c" and "d", respectively.

D. SAFETY ANALYSIS

The voltage-based repair criteria involves a correlation between eddy current bobbin probe signal amplitude (voltage) and indicated depth (phase angle) versus tube burst pressure and leak rate. The principal parameter is voltage amplitude which is correlated with tube burst capability and leakage potential.

Indicated depth is a secondary parameter utilized as a threshold value below which added margins incorporated in the repair criteria to minimize excessive MSLB leakage are not necessary. The repair criteria are developed from testing of laboratory induced ODSCC specimens, extensive examination of pulled tubes from operating steam generators, and field experience from leakage due to indications at the tube support plates.

The tube integrity issues raised by the presence of outer diameter stress corrosion cracking (ODSCC) at the tube support plate elevations of the Beaver Valley Power Station Unit 1 (BVPS-1) steam generators have been evaluated. Eddy current inspection data for BVPS-1 and data from other plants identified in References 1 and 2 are utilized along with tube pull results and burst test information to modify the existing 1.0 volt repair limit to a 2.0 volt limit. A technical evaluation of the voltage-based repair criteria is provided in Attachment C.

The BVPS-1 voltage-based tube plugging criteria has as its basis a correlation between eddy current bobbin probe signal amplitude and tube burst and leakage capability. Review of eddy current data from the last three outages at BVPS-1 indicates a decreasing degradation voltage growth rate, which shows that Duquesne Light Company has maintained control of the secondary chemistry, and implies that the possibility of a large increment of degradation in a few tubes during the next cycle is extremely small. Due to the enhanced and expanded inspection program and methodology required by the plugging criteria, the overall safety level of the BVPS-1 steam generator tubing will be increased.

The 2.0 volt plugging limit remains commensurate with Regulatory Guide (RG) 1.121 and RG 1.83 criteria, and, hence, meets General Design Criteria 14, 15, 30, 31, and 32. It is shown that, during normal operating and accident conditions, tube burst margins are consistent with all applicable criteria of Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes". Also, General Design Criteria 2 and 4 continue to be met as it is expected that the BVPS-1 steam generators can continue to perform their intended safety function.

From a tube leakage perspective, the potential for adverse radiological consequences due to primary-to-secondary leakage during postulated accident condition loadings is addressed. The most limiting accident affected by the implementation of the 2.0 volt plugging limit with regard to the potential for radiological consequences evaluated in the BVPS-1 UFSAR is a postulated MSLB event. The potential for excessive leakage during a MSLB is minimized by verifying that the expected distribution of crack indications at the end of each cycle would result in a level of leakage for which the radiological consequences remain within the licensing basis. Calculated tube leakage is limited to assure that the assessment of doses resulting from a MSLB (outside of

containment and upstream of the main steamline isolation valve) will be less than the 10 CFR 100 requirements and GDC-19.

In support of the license amendment request for a 1.0 volt plugging limit for BVPS-1 for Cycle 11, an offsite dose assessment was performed to establish the maximum amount of leakage that, in the event of a MSLB event, would not result in offsite doses exceeding 10 CFR 100 requirements. This evaluation was based on the Standard Review Plan methodology (including iodine spiking, but using dose conversion factors derived from ICRP-30). This evaluation determined that primary-to-secondary leakage of 6.8 gpm (6.6 gpm in the faulted loop) would satisfy the licensing basis. For the current license amendment request, an assessment of the control room dose was performed to establish the maximum amount of leakage that, under similar circumstances, would not result in doses exceeding GDC-19. This evaluation was based on the Standard Review Plan methodology (including iodine spiking). This analysis assessed the dose quantities for Effective Dose Equivalent (external), Skin Dose Equivalent and Thyroid Committed Dose Equivalent using dose conversion factors derived from ICRP-26/ICRP-30. The analysis determined that the primary-to-secondary leakage would need to be limited to 4.5 gpm to satisfy GDC-19. Since the postulated control room dose is more limiting, the proposed 2.0 volt plugging limit is based on 4.5 gpm, rather than 6.6 gpm.

Application of the voltage-based plugging criteria continues to require that the primary-to-secondary leakage rate be limited to 150 gpd in any one steam generator. Axial cracks having leakage less than this limit will have an adequate margin of safety to withstand normal operating and accident loadings.

The above criteria represent the conservative limits which support structural integrity of the potentially degraded tube bundle, commensurate with the applicable NRC Regulatory Guides, during normal operation and postulated accident conditions.

In establishing the voltage-based tube plugging criteria, the general approach is to establish the existence of acceptable margins to tube burst and excessive steam generator tube leakage during all plant conditions.

NRC Generic Letter 95-05 (Reference 3) has established the framework for utilities to follow who desire to implement the voltage-based criteria. A 2.0 volt steam generator tube repair limit which includes the following items has been developed for BVPS-1:

1. Standardized inspection requirements and data analysis guidelines,

2. Determination of an end-of-cycle voltage distribution using an approved methodology,

3. Primary-to-secondary steam generator tube leakage prediction for a postulated MSLB event; the recommended MSLB leakage calculation will be performed using the most recent EPRI voltage-leakrate correlation (if applicable),

4. Calculation of a MSLB primary-to-secondary allowable leakage limit using NUREG-0800 guidance for comparison,

5. The continued use of a reduced normal operating primary-to-secondary leakage limit, and

6. Calculation of an overall end-of-cycle tube burst probability during a postulated MSLB.

In general, the degradation morphology occurring at the tube support plate (TSP) intersections at plants in the U.S. can be described as axially oriented ODSCC. Axially oriented macrocracks can occur at one or more azimuthal locations around the circumference of the tube. The macrocracks are comprised of short, nearly colinear microcracks separated by ligaments of nondegraded material. Typical microcrack length is less than 0.2 inch. The corresponding macrocrack can be as long as the support plate thickness. Minor to moderate intergranular attack (IGA) can occur in addition to the axial ODSCC. The corrosion morphology of the BVPS-1 pulled tubes are consistent with TSP degradation morphology experienced in other plants.

Three hot-leg steam generator tube segments were removed from SG A in 1995 (Tubes R10C48, R22C38, and R28C42) and were subsequently evaluated. A total of eight TSP locations were removed for destructive examination. Metallographic data showed that the corroded TSP crevice regions had combinations of axially oriented intergranular stress corrosion cracking (IGSCC) and intergranular cellular corrosion (ICC) with the axial IGSCC dominating. All corrosion was confined to the crevice regions. The corrosion was typical of pulled tubes within the EPRI database.

Pulled tube examination results from other plants indicate that through-wall cracks can potentially occur below 10 volts but that the associated crack lengths are short with no measurable leakage at operating conditions. Leakage at operating conditions has not been identified for bobbin coil voltages less than 7.7 volts in a 3/4" tube in the field. Operating leakage due to ODSCC at the TSPs has not been identified in a plant with 7/8" tubing.

The criterion of RG 1.121 to maintain a factor of 3 times normal operating pressure differential on tube burst is inherently satisfied during normal operating conditions due to proximity of the tube support plates to the degradation area. Based on BVPS-1 eddy current data, the tube support plate ODSCC is confined within the thickness of the tube support plates. Steam generator

tube denting (due to TSP corrosion) and cracking potentially initiate and progress at high temperature within the TSP. Since the tubes and support plates are in an equilibrium situation during normal operation, and since the causes of the cracking occur at the tube-to-tube support plate intersections, it is clear that the cracking would be situated within the plates during normal operating conditions and that tube burst cannot occur due to degradation within the TSP. Therefore, the most appropriate manner to assess degraded tube operability and burst potential with regard to RG 1.121 is to examine the tube integrity at faulted (MSLB) conditions, since the tube support plates have the potential to deflect during the rapid blowdown phase of a postulated double-ended guillotine break of the main steamline, thereby uncovering the degradation area.

In accordance with GL 95-05, in establishing the acceptability of the voltage-based repair limit and in determining the upper voltage repair limit (V_{URL}), the supporting data set must contain all applicable data consistent with the latest revision of the industry data base as approved by the Commission. Based upon the voltage-burst correlation of Reference 1, an 8.82 volt end of cycle indication would satisfy the steamline break tube burst margin requirement of RG 1.121 with a 1.43 safety factor applied to the MSLB pressure differential. MSLB pressure differential will be limited to approximately 2560 psi, which is the approximate pressurizer safety valve liftoff setting.

The upper voltage repair limit (V_{URL}) will be determined prior to each outage using the most recently approved NRC database to determine the tube structural limit (V_{SL}). The structural limit is reduced by allowances for nondestructive examination (NDE) uncertainty (V_{NDE}) and growth (V_{GR}) to establish V_{URL}. As an example, the NDE uncertainty component of 20% and a voltage growth allowance of 30% per full power year can be utilized to establish a V_{URL} of 5.9 volts. The 20% NDE uncertainty represents a square-root-sum-of-the-squares (SRSS) combination of probe wear uncertainty and analyst variability. The degradation growth allowance should be an average growth rate or 30% per effective full power year, whichever is larger. This growth allowance is conservative for BVPS-1 as the percent voltage growth rates have decreased for each of the last three inspections (from 19% to 16% to 3%).

In order to control steam generator tube corrosion, Duquesne Light Company has undertaken several steps to help mitigate steam generator tube corrosion. These include boric acid addition in December of 1990, removal of copper moisture separator tubes, all volatile treatment (AVT) secondary chemistry and molar ratio control according to EPRI recommendations.

MSLB leakage as a function of EOC voltage distribution will be determined in accordance with GL 95-05, Section 2.b, "Total Leak Rate During MSLB." Generic Letter 95-05 provides an option for

applying a fraction of unconfirmed rotating pancake coil no detectable degradation (RPC NDD) indications in the beginning-of-cycle (BOC) voltage distribution. BVPS-1 will continue to track RPC NDD indications left in service to determine the fraction confirmed by RPC at the next outage. Based on this experience, a fraction of unconfirmed RPC indications will be included in the BOC distribution. The number of RPC NDD indications in each voltage bin (N_d in Reference 3) will be multiplied by this fraction. The fraction used shall be the larger of 0.25 or the values obtained using the data from the last two inspections.

Based on the NRC recommended leak rate database, the leak rate data do not satisfy the MSLB leak rate versus bobbin voltage correlation. The NRC requirement is that the p-value obtained from the regression for the slope parameter be less than or equal to 5%. For the NRC recommended data, the p-value is about 6.5% and the leak rate versus voltage correlation was not applied for end-of-cycle (EOC) 10 leakage calculations or EOC 11 projections. This is subject to change during subsequent MSLB leakage calculations for BVPS-1 as more data becomes available.

The maximum allowable MSLB leakage from steam generator tubing for BVPS-1 has been determined to be 4.5 gpm in the faulted loop. This value is established based on NUREG-0800 guidelines as suggested by GL 95-05 and assessed both offsite dose and control room dose. The technical specification reactor coolant and secondary coolant dose equivalent Iodine-131 activity limits of 1.0 microcuries per gram and 0.1 microcuries per gram, respectively, are used in the analysis for establishment of initial radioactivity conditions. Additionally, NUREG-0800 iodine spiking for transient conditions are used in the determination of the maximum allowable MSLB leakage. The dose evaluation for BVPS-1 determined that the accident initiated spike case for the control room produced the limiting condition (acceptable dose limited by 30 Rem thyroid) of 4.5 gpm. This analysis assessed the dose quantities for Effective Dose Equivalent (external), Skin Dose Equivalent and Thyroid Committed Dose Equivalent using dose conversion factors derived from ICRP-26/ICRP-30.

The normal operating primary-to-secondary leakrate limit defined in the technical specifications will be maintained at 150 gpd per steam generator, 450 gpd total, as part of the voltage-based license amendment. Postulated leakage at 150 gpd from a free span single crack would imply a throughwall crack length of approximately 0.41 inch at nominal leak rates and a single throughwall crack of 0.62 inch at the lower 95 percent confidence level leak rates at a primary-to-secondary pressure differential considered bounding for BVPS-1. A crack of this extent would exhibit a bobbin indication far in excess of any end-of-cycle predicted voltage. If primary-to-secondary leakage occurs during operation, it is reasonable to assume that more than 1 crack would contribute to the leakage value. The throughwall crack

lengths that would represent a potential for tube burst at 1.43 times the MSLB pressure differential and the MSLB pressure differential are approximately 0.57 and 0.84 inch, respectively.

Upon implementation of the 2.0 volt plugging limit, projected voltage distributions for the following cycle will be established using current EOC eddy current data. The overall tube burst probability for the next cycle will be established at that time and compared to the acceptance criteria of 1×10^{-2}.

The steam generator tube plugging criteria for the tube support plate elevation degradation observed in the BVPS-1 steam generators is summarized in Table 1.0. The recommended tube plugging criteria is based upon bobbin coil inspection voltage signal amplitude, which is correlated with tube burst capability. The criteria is developed to preclude free span tube burst if it is postulated that TSP displacement would occur under accident condition loadings. The plugging criteria provides RG 1.121 tube burst margin. The plugging criteria (which is much more conservative than the structural plugging limit) is expected to result in the majority of the EOC voltages existing below the MSLB leakage threshold. The upper voltage repair limit (V_{URL}) for tube support plate intersections will be established as previously discussed.

TABLE 1.0

STEAM GENERATOR TUBE PLUGGING CRITERIA
FOR
TUBE SUPPORT PLATE ELEVATION ODSCC

BOBBIN SIGNAL VOLTAGE	ACTION
$\leq$ 2.0	LIMITED*
> 2.0 but less than or equal to V_{URL}	ROTATING PROBE TECHNOLOGY**
> V_{URL}	PLUG OR REPAIR

* If it is found that the potential for MSLB leakage at end-of-cycle conditions exceeds 4.5 gpm in any steam generator, then additional tubes will be plugged or repaired to reduce MSLB leakage rate potential in that steam generator to below 4.5 gpm. If additional tubes are to be plugged in order to show compliance with the 4.5 gpm leakage rate limit, the largest bobbin coil voltage degradation indications would be plugged or repaired.

** Plug or repair if indications of ODSCC are detected.

Implementation of the voltage-based plugging criteria involves a 100% inspection of all hot-leg tubes down to the lowest cold-leg intersection with identified ODSCC in order to provide a conservative inspection philosophy and to monitor the progression of ODSCC. Pending NRC approval for the industry procedure for application of the probe variability requirement and probe wear measurements, the methods previously approved in Reference 4 will be applied at BVPS-1 for calculating NDE uncertainty.

An RPC inspection will be conducted for all degradation indications exceeding a signal amplitude of 2.0 volts but less than or equal to a floating upper voltage repair limit ($V_{URL}=V_{SL}-V_{NDE}-V_{GR}$). Generic Letter 95-05 permits the use of alternatives to rotating pancake coil for RPC inspections. The RPC results are to be evaluated to establish that the principal indications can be characterized as ODSCC. If indications other than ODSCC are identified, these indications will be evaluated against a (bobbin coil) 40% depth requirement for tube plugging. The RPC inspection recommendation is consistent with a threshold value below which MSLB leakage is expected to be negligible and other types of degradation (wear, cold-leg thinning, etc.) are not expected to have a significant effect on steam generator tube integrity. The standardized inspection plan provided by the 2.0 volt plugging criteria uses an ASME calibration standard cross-calibrated to the laboratory standard and the use of a probe wear standard.

Previous evaluations have indicated a potential for tube deformation and collapse during a postulated loss-of-coolant-accident (LOCA) + safe-shutdown-earthquake (SSE) event. The tube collapse potential arises from TSP deformation at the support wedges. Analysis results provided in Reference 1 demonstrate that no tubes were subject to deformation or collapse. Therefore, no tubes are excluded from application of the criteria due to tube deformation or collapse concerns.

The proposed amendment may preclude occupational radiation exposure that would otherwise be incurred by plant workers involved in tube plugging operations. It would minimize the loss of margin in the reactor coolant flow through the steam generators in LOCA analyses. The proposed amendment would, therefore, assist in demonstrating that minimum flow rates are maintained in excess of that required for operation at full power. Reduction in the amount of tube plugging required can reduce the length of plant outages and reduce the time that the steam generator is open to the containment environment during an outage. Based on the methodology described in WCAP-14122, DLC has determined that this methodology is applicable to our steam generators and provides a safe and effective alternative to plugging.

E. NO SIGNIFICANT HAZARDS EVALUATION

The no significant hazard considerations involved with the proposed amendment have been evaluated, focusing on the three standards set forth in 10 CFR 50.92(c) as quoted below:

> The Commission may make a final determination, pursuant to the procedures in paragraph 50.91, that a proposed amendment to an operating license for a facility licensed under paragraph 50.21(b) or paragraph 50.22 or for a testing facility involves no significant hazards consideration, if operation of the facility in accordance with the proposed amendment would not:
>
> (1) Involve a significant increase in the probability or consequences of an accident previously evaluated; or
>
> (2) Create the possibility of a new or different kind of accident from any accident previously evaluated; or
>
> (3) Involve a significant reduction in a margin of safety.

The following evaluation is provided for the no significant hazards consideration standards.

1. Does the change involve a significant increase in the probability or consequences of an accident previously evaluated?

   Tube burst criteria are inherently satisfied during normal operating conditions due to the proximity of the tube support plate (TSP). Test data indicates that tube burst cannot occur within the TSP, even for tubes which have 100% throughwall electric discharge machining notches, 0.75 inch long, provided that the TSP is adjacent to the notched area. Since tube-to-TSP proximity precludes tube burst during normal operating conditions, use of the criteria must retain tube integrity characteristics which maintain a margin of safety of 1.43 times the bounding faulted condition, main steamline break (MSLB) pressure differential. As previously stated, the Regulatory Guide (RG) 1.121 criterion requiring maintenance of a safety factor of 1.43 times the MSLB pressure differential on tube burst is satisfied by 7/8" diameter tubing with bobbin coil indications with signal amplitudes less than 8.82 volts, regardless of the indicated depth measurement.

   The upper voltage repair limit (V_{URL}) will be determined prior to each outage using the most recently approved NRC database to determine the tube structural limit (V_{SL}). The structural limit is reduced by allowances for nondestructive examination (NDE) uncertainty (V_{NDE}) and growth (V_{GR}) to establish V_{URL}. Using the Generic Letter (GL) 95-05 NDE and

growth allowances for an example, the NDE uncertainty component of 20% and a voltage growth allowance of 30% per full power year can be utilized to establish a V_{URL} of 5.9 volts. The 20% NDE uncertainty represents a square-root-sum-of-the-squares (SRSS) combination of probe wear uncertainty and analyst variability. The degradation growth allowance should be an average growth rate or 30% per effective full power year, whichever is larger. This growth allowance is conservative for BVPS-1 as the percent voltage growth rates have decreased for each of the last three inspections.

Relative to the expected leakage during accident condition loadings, it has been previously established that a postulated MSLB outside of containment but upstream of the main steam isolation valve (MSIV) represents the most limiting radiological condition relative to the plugging criteria. In support of implementation of the revised plugging limit, analyses will be performed to determine whether the distribution of cracking indications at the tube support plate intersections during future cycles are projected to be such that primary-to-secondary leakage would result in postulated site boundary and control room doses exceeding 10 CFR 100, and 10 CFR 50, Appendix A, GDC-19 requirements, respectively. A separate calculation has determined the maximum allowable MSLB leakage limit in a faulted loop. This limit was calculated using the technical specification reactor coolant system (RCS) Iodine-131 activity level of 1.0 microcuries per gram dose equivalent Iodine-131 and the recommended Iodine-131 transient spiking values consistent with NUREG-0800. The projected MSLB leakage rate calculation methodology prescribed in Section 2.b of GL 95-05 will be used to calculate the end-of-cycle (EOC) leakage. Projected EOC voltage distribution will be developed using the most recent EOC eddy current results and considering an appropriate voltage measurement uncertainty. The log-logistic probability of leakage correlation will be used to establish the MSLB leakrate used for comparison with the faulted loop allowable limit. Due to the relatively low voltage levels of indications at BVPS-1 and low voltage growth rates, it is expected that the calculated leakage values will not exceed this limit. Therefore, as implementation of the 2.0 volt voltage-based plugging criteria at BVPS-1 does not adversely affect steam generator tube integrity and implementation will be shown to result in acceptable dose consequences, the proposed amendment does not result in any increase in the probability or consequences of an accident previously evaluated in the UFSAR.

2. Does the change create the possibility of a new or different kind of accident from any accident previously evaluated?

Implementation of the proposed steam generator tube 2.0 volt plugging limit does not introduce any significant changes to

the plant design basis. Use of the 2.0 volt plugging limit does not provide a mechanism which could result in an accident outside of the region of the tube support plate elevations as no outside diameter stress corrosion cracking (ODSCC) is occurring outside the thickness of the tube support plates. Neither a single or multiple tube rupture event would be expected in a steam generator in which the plugging limit has been applied (during all plant conditions).

Duquesne Light Company will continue to implement a maximum primary-to-secondary leakage rate limit of 150 gpd per steam generator to help preclude the potential for excessive leakage during all plant conditions. The RG 1.121 criterion for establishing operational leakage rate limits that require plant shutdown are based upon leak-before-break considerations to detect a free span crack before potential tube rupture during faulted plant conditions. The 150 gpd limit provides for leakage detection and plant shutdown in the event of the occurrence of an unexpected single crack resulting in leakage that is associated with the longest permissible crack length. RG 1.121 acceptance criteria for establishing operating leakage limits are based on leak-before-break considerations such that plant shutdown is initiated if the leakage associated with the longest permissible crack is exceeded.

The single through-wall crack lengths that result in tube burst at 1.43 times the MSLB pressure differential and the MSLB pressure differential alone are approximately 0.57 inch and 0.84 inch, respectively. A leak rate of 150 gpd will provide for detection of 0.41 inch long cracks at nominal leak rates and 0.62 inch long cracks at the lower 95% confidence level leak rates. Since tube burst is precluded during normal operation due to the proximity of the TSP to the tube and the potential exists for the crevice to become uncovered during MSLB conditions, the leakage from the maximum permissible crack must preclude tube burst at MSLB conditions. Thus, the 150 gpd limit provides for plant shutdown prior to reaching critical crack lengths for MSLB conditions using the lower 95% leakrate data. Additionally, this leak-before-break evaluation assumes that the entire crevice area is uncovered during blowdown. Partial uncovery will provide benefit to the burst capacity of the intersection. Analyses have shown that only a small percentage of the TSPs are deflected greater than the TSP thickness during a postulated MSLB.

As steam generator tube integrity upon implementation of the 2.0 volt plugging limit continues to be maintained through inservice inspection and primary-to-secondary leakage monitoring, the possibility of a new or different kind of

accident from any accident previously evaluated is not created.

3. Does the change involve a significant reduction in a margin of safety?

The use of the voltage-based bobbin probe tube support plate elevation plugging criteria at BVPS-1 maintains steam generator tube integrity commensurate with the criteria of RG 1.121. This guide describes a method acceptable to the Commission for meeting GDCs 14, 15, 30, 31, and 32 by reducing the probability or the consequences of steam generator tube rupture. This is accomplished by determining the limiting conditions of degradation of steam generator tubing, as established by inservice inspection, for which tubes with unacceptable cracking should be removed from service. Upon implementation of the proposed criteria, even under the worst case conditions, the occurrence of ODSCC at the tube support plate elevations is not expected to lead to a steam generator tube rupture event during normal or faulted plant conditions. The EOC distribution of crack indications at the tube support plate elevations will be confirmed to result in acceptable primary-to-secondary leakage during all plant conditions and that radiological consequences are not adversely impacted.

In addressing the combined effects of loss-of-coolant-accident (LOCA) + safe shutdown earthquake (SSE) on the steam generator component (as required by GDC 2), it has been determined that tube collapse may occur in the steam generators at some plants. This is the case as the tube support plates may become deformed as a result of lateral loads at the wedge supports at the periphery of the plate due to the combined effects of the LOCA rarefaction wave and SSE loadings. Then, the resulting pressure differential on the deformed tubes may cause some of the tubes to collapse. There are two issues associated with steam generator tube collapse. First, the collapse of steam generator tubing reduces the RCS flow area through the tubes. The reduction in flow area increases the resistance to flow of steam from the core during a LOCA which, in turn, may potentially increase peak clad temperature. Second, there is a potential that partial through-wall cracks in tubes could progress to complete through-wall cracks during tube deformation or collapse.

The results of an analysis using the larger break inputs show that the LOCA loads were found to be of insufficient magnitude to result in steam generator tube collapse or significant deformation. Since the leak-before-break methodology is applicable to the BVPS-1 reactor coolant loop piping, the probability of breaks in the primary loop piping is sufficiently low that they need not be considered in the

structural design of the plant. The limiting LOCA event becomes either the accumulator line break or the pressurizer surge line break. Analysis results provided in WCAP-14122, dated July 1994, demonstrate that no tubes were subject to deformation or collapse. No tubes have been excluded from application of the subject voltage-based steam generator plugging criteria.

Addressing RG 1.83 considerations, implementation of the bobbin probe voltage-based tube plugging criteria of 2.0 volts is supplemented by: enhanced eddy current inspection guidelines to provide consistency in voltage normalization, a 100% eddy current inspection sample size at the tube support plate elevations, and rotating pancake coil inspection requirements for the larger indications left inservice to characterize the principal degradation as ODSCC.

As noted previously, implementation of the tube support plate intersection voltage-based plugging criteria will decrease the number of tubes which must be repaired. The installation of steam generator tube plugs reduces the RCS flow margin. Thus, implementation of the 2.0 volt plugging limit will maintain the margin of flow that would otherwise be reduced in the event of increased tube plugging.

Based on the above, it is concluded that the proposed license amendment request does not result in a significant reduction in margin with respect to plant safety as defined in the UFSAR or any BASES of the plant technical specifications.

F. NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION

Based on the considerations expressed above, it is concluded that the activities associated with this license amendment request satisfies the no significant hazards consideration standards of 10 CFR 50.92(c) and, accordingly, a no significant hazards consideration finding is justified.

REFERENCES

1. WCAP-14122, "Beaver Valley Unit 1 Steam Generator Tube Plugging Criteria for Indications at Tube Support Plates," July 1994.

2. Letter from G. S. Thomas (Duquesne Light Company) to U. S. Nuclear Regulatory Commission, "Beaver Valley Unit 1 Interim Plugging Criteria 90 Day Report," June 9, 1995.

3. NRC Generic Letter 95-05, "Voltage-Based Repair Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," August 3, 1995.

4. US NRC Letter, "Safety Evaluation by the Office of Nuclear Reactor Regulation Related to Amendment No. 184 to Facility Operating License No. DPR-66, Duquesne Light Company, BVPS-1, Docket No. 50-334."

5. ERS-SFL-98-008, "Safety Analysis of the Common Control Room Doses From a Main Steam Line Break Outside CNMT at U1 with Increased Primary-to-Secondary Leakage," November 1995.

ATTACHMENT C

Beaver Valley Power Station, Unit No. 1
Proposed Technical Specification Change No. 229

TECHNICAL EVALUATION OF VOLTAGE-BASED REPAIR CRITERIA

INTRODUCTION

The purpose of this Attachment is to provide the technical basis for a request for license amendment to change the Beaver Valley Power Station Unit 1 (BVPS-1) technical specifications (TS) for the implementation of the 2.0 volt repair criteria for steam generator tubes affected by outside diameter stress corrosion cracking (ODSCC), according to the guidance of NRC Generic Letter (GL) 95-05 (Reference 1) on this subject.

This attachment describes the BVPS-1 plan for implementation of the 2.0 volt repair limit and the requirements of GL 95-05. Sections 1 to 6 of Attachment 1 to GL 95-05 are addressed herein to summarize the BVPS-1 plan, which complies with the requirements of GL 95-05. Clarifications and temporary exclusions to the Section 3 Inspection Criteria are identified in the corresponding section of this attachment. These considerations relate to implementation of the bobbin probe variability requirements (Section 3.c.2), the probe wear requirements (Section 3.c.3) and the use of alternate probes to the rotating pancake coil (RPC) probe. GL 95-05 Section 2.b.1 requests NRC approval of a method of applying a fraction of unconfirmed RPC indications to develop the beginning-of-cycle (BOC) voltage distribution.

BVPS-1 is currently operating with a 1.0 volt interim plugging criteria for ODSCC in accordance with NRC Safety Evaluation Report (SER) of Reference 2. The subsequent BVPS-1 compliance with this SER is documented in Reference 3. ODSCC inspection results from the 1995 refueling outage, summarized on Table 1 of this attachment, indicate the suitability of BVPS-1 steam generators for application of a 2.0 volt repair limit. Of the 94 tubes plugged in the 1995 outage (which were in service during the previous cycle and exhibited ODSCC tube support plate (TSP) indications), only one exceeded the proposed 2.0 volt plug/repair limit; 27 tubes were plugged for non-ODSCC reasons and 66 were plugged in accordance with the current cycle 1.0 volt repair limit.

BVPS-1 DESIGN FEATURES

BVPS-1 is a Westinghouse 3-loop pressurized water reactor plant with Series 51 steam generators (SG) featuring drilled hole tube support plates and 7/8 inch diameter Alloy 600 tubing. These SGs do not have a flow distribution baffle plate.

Section 1: APPLICABILITY

The repair criteria will be applied to predominantly axial ODSCC indications at tube-to-TSP intersections (within the TSP thickness) of the steam generator tube bundle. Tubes pulled from BVPS-1 for ODSCC at TSPs have been shown to have crack morphology consistent with this requirement and the EPRI database used for the supporting voltage correlations. Any other type of tube degradation or any other location in the tube bundle shall continue to be evaluated in accordance with existing BVPS-1 technical specifications. The observation of circumferential cracks, or primary water stress corrosion cracking associated with TSP indications, or ODSCC beyond the TSP thickness will be reported to the NRC before the plant is returned to power.

The voltage-based repair criteria will not be applied at the following atypical tube-to-TSP intersections of the steam generator tube bundle:

1. At locations where tubes with degradation would substantially deform or collapse during postulated loss-of-coolant-accident (LOCA) and safe-shutdown-earthquake (SSE) loading. Analysis results given in Reference 4 demonstrate that such locations do not occur at BVPS-1 and no tube locations need to be excluded from application of the alternate repair criteria.

2. At tube-to-TSP intersections with dent signals exceeding 5.0 (bobbin) volts. Any indications confirmed by RPC will be repaired.

3. At tube-to-TSP intersections where mixed residuals could mask a 1.0 volt bobbin coil ODSCC indication. Any indications confirmed by RPC will be repaired.

4. At tube-to-TSP intersections where copper deposits interfere with bobbin coil signals. Any indications confirmed by RPC will be repaired.

Section 2: TUBE INTEGRITY EVALUATION

There are three principal engineering analyses that shall be performed during each 2.0 volt repair process at BVPS-1:

a. Prediction of SG bobbin voltage population distribution.

b. Calculation of SG tube leakage during a postulated main steamline break (MSLB).

c. Calculation of SG tube burst probability during a postulated MSLB.

The latest approved EPRI database (7/8 inch diameter tubing) utilizing NRC approved data exclusion criteria will be applied in the voltage correlations (burst, probability of leakage, MSLB leak rate) used for the leak rate, burst probability and upper voltage repair limit

calculations. If a significant increase in pulled tube data occurs between an EPRI database update and a BVPS-1 outage, the database will be updated to include significant new data, provided NRC concurrence is obtained on the database update.

The methodology for the performance of these analyses, including correlations which relate bobbin voltage amplitudes, free span burst pressure, probability of leakage and associated leak rates is documented in Reference 6 and is consistent with the methodology of Attachment 1, Section 2 of GL 95-05. In addition, the upper voltage repair limit used to repair bobbin indications independent of RPC confirmation will be determined at each outage based on the guidance of Section 2.a.2 of GL 95-05.

MSLB Tube Leak Rate

The calculated maximum allowable tube leak rate for BVPS-1 during a hypothetical MSLB event shall not exceed 4.5 gpm in the faulted loop. The 4.5 gpm leak rate is calculated consistent with currently accepted licensing basis assumptions as specified in Paragraph 2.b.4 of GL 95-05. The analyses do NOT take credit for reduced reactor coolant system iodine activity, as allowed by this paragraph. The analyses of offsite doses and control room doses utilized dose conversion factors based on ICRP-30 as substitutes for the factors specified in the Standard Review Plan. The 4.5 gpm leak rate value is based on postulated control room doses analyzed in Reference 5. This value is more limiting than the 6.6 gpm leak rate value based on offsite dose that was established in Reference 4, and previously reviewed and accepted by the NRC as part of the BVPS-1 1.0 volt interim plugging criteria (IPC) license amendment. The 4.5 gpm leak rate value in the faulted loop (with leakage in the intact loops equal to the technical specification normal operation leakage limit of 150 gpd) will not result in off site doses exceeding 10% of 10 CFR 100 requirements or control room doses exceeding 10 CFR 50, Appendix A, GDC-19, and therefore, is consistent with the BVPS-1 licensing basis. If it is determined during the operating cycle that this leakage limit might be exceeded, the reporting requirements of Paragraph 6.a.1 will be followed.

Consistent with the guidance of Section 2.c, the BVPS-1 MSLB leak rate analysis performed prior to returning the SGs to service may be performed based on the projected next end-of-cycle (EOC) voltage distribution or the actual measured distribution at a given outage. The method selected at a given outage will be based on outage schedule constraints, particularly the ability to complete the growth rate analysis prior to restart.

Application of Unconfirmed Indications in BOC Distribution

GL 95-05, Section 2.b.1 provides an option for applying a fraction of unconfirmed rotating pancake coil no detectable degradation (RPC NDD) indications in the BOC voltage distribution. NRC approval is requested to apply a fraction of RPC NDD indications as described below.

For the last two cycles, BVPS-1 has tracked RPC NDD indications left in service to determine the fraction confirmed by RPC at the following outage. This fraction is summarized on Table 2 for the last two cycles at BVPS-1. The table includes data from other plants which have implemented IPC and tracked RPC NDD for two successive IPC inspections. These results represent the second inspection [EOC-(n+1)] RPC confirmation of RPC NDD indications left in service at BOC based on the prior inspection [EOC-(n)]. Thus, they represent an evaluation of RPC results at the prior inspections, which were not IPC inspections for BVPS-1. The overall average of the data is a 26.5% next cycle confirmation rate for RPC NDDs left in service. The last BVPS-1 inspection resulted in an unusually high RPC NDD confirmation rate of 50.9%. Based on this experience, NRC approval is requested to apply RPC NDD indications in the BOC distribution as given by:

- A fraction of unconfirmed RPC indications left in service will be included in the BOC bobbin voltage distribution. The number of RPC NDD indications in each voltage bin (N_d in GL 95-05) will be multiplied by this fraction. The fraction used shall be the larger of the values obtained for the last two inspection cycles. For the next BVPS-1 inspection, this guideline would result in applying the larger of 0.51 or the next inspection result as the fraction of RPC NDD included in the BOC distribution.

Voltage Growth Due to Defect Progression

The more conservative growth rate of the previous two cycles shall be used for the projection of bobbin voltage distribution during the next operating cycle, consistent with Section 2.b.2(2) of GL 95-05 and existing practice (References 4 and 6). Both BOC and corresponding EOC bobbin indications at a tube-to-TSP intersection are necessary to specify a growth data point. Growth data from both cycles may be combined if necessary to obtain at least 200 data points in the distribution, otherwise industry data will be used. Negative growth rates shall not be used in growth rate distributions used to make voltage projections although they shall be used in establishing the upper voltage repair limit of 2.a.2.

Section 3: INSPECTION CRITERIA

All SG tubes will be inspected with a bobbin coil during each normally scheduled refueling outage. The inspection will include all hot-leg side tube-to-TSP intersections and all cold-leg side tube-to-TSP intersections to the extent of any known ODSCC. Data acquisition and analysis will be performed consistent with the methodology of Appendix A of Reference 4. The supplementary guidance of Section 3 of GL 95-05 will be applied with the clarifications noted below. Any indication with bobbin voltage exceeding 2.0 volts shall be inspected with a rotating pancake coil and shall be repaired if the bobbin indication is confirmed by RPC. Any indication will be plugged or repaired

regardless of any RPC inspection results, if the bobbin voltage exceeds the upper voltage repair limit as obtained per Section 2.a.2 of GL 95-05.

Clarifications to Section 3, Inspection Criteria

1. The industry procedure for probe variability requirements (Section 3.c.2), will be implemented when approved by the NRC. NRC comments to an industry procedure for application of the requirement (Attachment 5, Item II-2 of Reference 7) indicate that further NRC/industry discussion is necessary to obtain an approved procedure.

2. Pending NRC approval of an industry procedure for probe wear measurements (Section 3.c.3), the methods previously approved (Reference 2) will be applied. The industry, through EPRI/NEI, is currently responding to NRC questions (Reference 8) on the proposed industry procedure. Upon NRC/industry concurrence on a probe wear procedure, the resulting procedure will be implemented at BVPS-1.

Section 4: TUBE REMOVAL AND EXAMINATION/TESTING

The BVPS-1 program fc tube removal and examination will comply with the guidance of Section 4 of GL 95-05. Three tubes were removed from BVPS-1 in 1995 upon the initial implementation of voltage-based repair criteria. Either an additional tube will be removed at the refueling outage following accumulation of 34 effective full power months following the 1995 outage, or BVPS-1 will participate in an NRC endorsed industry program per Section 4.a.

Section 5: LEAKAGE

The operational leakage limit will be maintained, as defined in the technical specification, at 150 gpd through each SG. SG tubes with known leaks will be repaired prior to returning to service. Leakage monitoring measures will follow the guidance of the industry/EPRI report of Reference 9.

Section 6: REPORTING REQUIREMENTS

BVPS-1 will comply with the reporting requirements of Section 6 of GL 95-05.

REFERENCES

1. NRC Generic Letter 95-05, "Voltage-Based Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," August 3, 1995.

2. US NRC Letter, "Safety Evaluation by the Office Of Nuclear Regulation Related to Amendment No. 184 to Facility Operating License No. DPR-66, Duquesne Light Company, Beaver Valley Power Station, Unit No. 1 Docket No. 50-334."

3. Letter from G. S. Thomas (Duquesne Light Company) to U. S. Nuclear Regulatory Commission, "Beaver Valley Unit 1 Interim Plugging Criteria 90 Day Report," June 9, 1995.

4. WCAP-14122, "Beaver Valley Unit 1 Steam Generator Tube Plugging Criteria for Indications at Tube Support Plates," July 1994.

5. ERS-SFL-95-008, "Safety Analysis of the Common Control Room Doses From a Main Steam Line Break Outside CNMT at U1 with Increased Primary-to-Secondary Leakage," November 1995.

6. WCAP-14277, "SLB Leak Rate and Tube Burst Probability Analysis Methods for ODSCC at TSP Intersections," Westinghouse NSD, January 1995.

7. US NRC Memorandum To: Edward L. Jordan, From: Frank J. Miraglia, Subject: Request for CRGR Review of Generic Letter 95-XX, "Voltage-Based Criteria for Westinghouse Steam Generator Tubes Affected by Outside Diameter Stress Corrosion Cracking," May 30, 1995.

8. US NRC Letter to Mr. Alex Martin from Brian W. Sheron regarding Alternate Probe Wear Criteria, June 30, 1995.

9. EPRI TR-104788, "PWR Primary-to-Secondary Leak Guidelines," Research Project S550, Final Report, May 1995.

Table 1
Beaver Valley Unit 1 1995 Steam Generator Inspection Consolidated Data

		S/G A					S/G B				
		EOC-10 In Service			EOC-10 Deplugged		EOC-10 In Service			EOC-10 Deplugged	
Voltage Bin		Bobbin	Repaired	Left in Service	Bobbin	Returned to Service	Bobbin	Repaired	Left in Service	Bobbin	Returned to Service
≤1.0V	No. of Indications	411	20	391	124	109	363	21	342	135	107
	No. of Tubes	353	11	342	80	76	307	15	292	86	81
>1.0V	No. of Indications	71	41	30	32	4	37	19	18	40	2
≤2.0V	No. of Tubes	70	40	30	29	4	37	19	18	29	2
>2.0V	No. of Indications	2	1	1	2	0	0	0	0	21	1
	No. of Tubes	2	1	1	2	0	0	0	0	16	1
All Volts	No. of Indications	484	62	422	158	113	400	40	360	196	110
	No. of Tubes	425	52	373	111	80	344	34	310	131	84

		S/G C					Combined				
		EOC-10 In Service			EOC-10 Deplugged		EOC-10 In Service			EOC-10 Deplugged	
Voltage Bin		Bobbin	Repaired	Left in Service	Bobbin	Returned to Service	Bobbin	Repaired	Left in Service	Bobbin	Returned to Service
≤1.0V	No. of Indications	190	2	188	0	0	964	43	921	259	216
	No. of Tubes	164	1	163	0	0	824	27	797	166	157
>1.0V	No. of Indications	15	7	8	0	0	123	67	56	72	6
≤2.0V	No. of Tubes	14	7	7	0	0	121	66	55	58	6
>2.0V	No. of Indications	0	0	0	0	0	2	1	1	23	1
	No. of Tubes	0	0	0	0	0	2	1	1	18	1
All Volts	No. of Indications	205	9	196	0	0	1089	111	978	354	223
	No. of Tubes	178	8	170	0	0	947	94	853	242	164

NOTE: Any tube may have more than one indication, but the tube is counted only once in its highest voltage bin (i.e. that tube will not be included in count of lower voltage bins).

Table 2

ANALYSIS OF RPC NDD DATA FROM SUCCESSIVE OUTAGES

Plant and Year of Outage (n+1)	Cycle (n) Evaluated		EOC-(n+1) Inspection of RPC NDD Left In Service		
	Cycle No.	RPC NDD Left In Service	Total RPC Inspected	Total RPC Confirm.	% RPC Confirm.
BVPS-1 1995 Outage	10	519	110	56	50.9
BVPS-1 1993 Outage	9	174	173	47	27.2
Plant A-2 1995 Outage	9	18	10	0	0.0
Plant A-1 1994 Outage	11		168	22	13.1
Plant R-1 1995 Outage	7	541	113	8	7.1
Plant R-1 1993 Outage	6		116	24	20.7
Plant D-1 1994 Outage	12	24	16	2	12.5
Plant AA-1 1995 Outage	4	874	199	81	40.7
TOTALS			905	240	26.5