ENCLOSURE 5

TENNESSEE VALLEY AUTHORITY
BROWNS FERRY NUCLEAR PLANT (BFN)
UNITS 1, 2, AND 3

TECHNICAL SPECIFICATIONS (TS) CHANGES TS-431 AND TS-418
EXTENDED POWER UPRATE (EPU)

BFN STEAM DRYER MONITORING PLAN

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Introduction and Purpose

The Browns Ferry Nuclear Plant (BFN) Steam Dryer Monitoring Plan (SDMP) provides actions for monitoring of Units 1, 2 and 3 for evidence of flow induced vibration that could result in fatigue stress limits being exceeding for the steam dryers. Steam dryer stress analyses have been performed based upon measurements of pressure pulsations in the main steam lines (MSL) at 3458 megawatt thermal (MWt) determined by arrays of eight strain gages mounted in two separate locations on each steam line for a total of eight arrays. These pressure pulsations provide input to an Acoustic Circuit Model (ACM) which predicts cyclic pressure loads on the steam dryers. The cyclic pressure loads provide input to a Finite Element Model (FEM) of the steam dryer which calculates maximum and alternating stresses that can be compared to ASME Code limits.

During power ascension above 3458 MWt, data from the same strain gage arrays are recorded and used to predict changes in steam dryer stress as the steam line signals change with increasing steam flow. This is accomplished by comparing the frequency spectrum and amplitude of the strain gage signals at each of the eight array locations to established limit curves.

Scope

The SDMP applies to BFN Units 1, 2 and 3 above 3458 MWt until testing is completed at 3952 MWt and final results are submitted to the NRC. Long term steam dryer inspection is also performed to verify steam dryer performance at extended power uprate (EPU) conditions. These inspections are governed by BWRVIP-139.

Portions of the SDMP are required to comply with license conditions associated with the EPU license amendment. These license conditions are listed in Table 3.

Power Ascension Test Control

EPU power ascension above 3458 MWt is performed in small controlled steps in conjunction with the EPU power ascension test plan (PATP).

HOLD POINTS

Hold points above 3458 MWt will be established at increments of approximately 2.5% of 3458 MWt for data collection and evaluation.

TEST PLATEAUS

EPU test plateaus will be established at intervals of 5% of 3458 MWt according to the table below. Thermal power will not be increased above the plateau until steam dryer test results are evaluated. Each 5% plateau will be held for a minimum of 96 hours to allow for NRC review.

EPU Test Plateaus

Relative to 3458 MWt	100%	105%	110%	115%
Power (MWt)	3458	3631	3804	3952

Two levels of acceptance criteria are used for the SDMP.

LEVEL 1

Level 1 criteria indicate that limits could be exceeded. If level 1 criteria are exceeded, reactor power is promptly reduced to a previously acceptable power level until an engineering evaluation concludes that further power ascension is justified.

LEVEL 2

Level 2 criteria indicate that limits are being approached. If level 2 criteria are exceeded, power ascension is promptly suspended until an engineering evaluation concludes that further power ascension is justified.

Monitoring Parameters

For the SDMP, the parameters to be monitored are shown in Table 1.

Stress Limit Curves

Limit Curves (LC) - Unit specific LCs are developed based on unit specific steam line data, dryer design and analyzed dryer stresses at 3458 MWt. These curves utilize the resolved end to end bias and uncertainty determination developed from the qualification of the MSL strain gage, ACM, and FEM

methodologies. During power ascension, MSL strain gage signals are filtered and converted to power spectral density (PSD) for comparison to limit curves. Two levels of criteria are established. Table 2 provides the actions to be taken if the LCs are exceeded.

LEVEL 1

The Level 1 criteria curves represent the 3458 MWt acoustic signature for each point in the frequency spectrum scaled by the most limiting alternating stress ratio from the stress analysis. The Level 1 limit curves provide a conservative safeguard against the potential for dryer stresses becoming higher than allowable (13.6 ksi).

LEVEL 2

The Level 2 criteria curves represent 80% of the Level 1 limit curves (10.88 ksi). These curves will be used for evaluation of plant data as collected at each test plateau.

Refer to CDI Technical Note No. 07-30, "Limit Curve Analysis with ACM Rev. 4 for Power Ascension at Browns Ferry Nuclear Unit 1," for a detailed discussion of the LC development.

NRC Notifications

At each of the 5% power plateaus above 3458 MWt or if strain gage signals exceed the established Level 1 criteria, an evaluation of steam dryer performance from the SDMP will be provided to the NRC Project Manager via electronic transmission or fax. TVA shall not increase reactor power above the power plateau for a minimum of 96 hours from the time of the NRC's receipt of this information. This process will be repeated at each of the 5% power plateaus until EPU conditions are reached.

Results of the SDMP will be submitted to the NRC in a report within 60 days from completion of steam dryer power ascension testing.

NRC Approvals

NRC approval is required prior to changes that result in the following key attributes being less restrictive:

- During initial power ascension testing above 3458 MWt, each test plateau increment shall be approximately 5 percent of 3458 MWt.

- Level 1 performance criteria; and

- The methodology for establishing the stress spectra used for the Level 1 and Level 2 performance criteria.

Long Term Actions

- BFN dryers will be inspected at each of the following two refueling outages following completion of the EPU power ascension.

- Inspections to be per General Electric Services Information Letter (SIL) 644, and/or BWRVIP-139, latest approved versions.

- Moisture carryover measurements will continue after power ascension based on SIL 644 recommendations.

- Equipment associated with temporarily installed pressure and vibration monitoring may be removed from service following achievement of one operating cycle.

Table 1 - Steam Dryer Surveillance Requirements during Reactor Power Operation above a Previously Attained Power Level

Parameter	Surveillance Frequency
Moisture Carryover (MC)	Every 24 hours during power ascension (Notes 1 and 2)
Main Steam Line (MSL) Pressure data from strain gages	At least once at every 2.5% above 3458 MWt AND Within one hour after achieving every 2.5% above 3458 MWt(Note 3)
Main Steam Line data from accelerometers	At least once at every 2.5% above 3458 MWt AND Within one hour after achieving every 2.5% above 3458 MWt(Note 3)
Reactor pressure, water level, individual steam line flow, and feedwater flow	At least once at every 2.5% above 3458 MWt AND Within one hour after achieving every 2.5% above 3458 MWt(Note 3)

Notes:

1. MC to be in accordance with the recommendations of GE SIL 644, Sup 1, Rev. 1. Provided that the performance criteria are not exceeded, when steady state operation at any given power level exceeds 168 consecutive hours, MC monitoring frequency may be reduced to once a week.

2. If MC cannot be determined within 24 hours of achieving a 5% power plateau, an orderly power reduction shall be made within the subsequent 12 hours to a power level at which MC was previously determined to be acceptable.

3. MSL pressure data shall be measured hourly when increasing power above a level at which data was previously attained. Data is required once at each 2.5% power step above 3458 MWt. If the surveillance is met at a given power

level, additional surveillances do not need to be performed at that power level where data had been previously obtained.

Table 2 - Steam Dryer Performance Criteria and Required Actions

Performance Criteria	Required Actions if Performance Criteria Exceeded and Required Completion
Level 2: • Moisture Carryover (MC)>0.1% OR • MC > 0.1% and increases by > 50% over the average of the three previous measurements taken above 3458 MWt OR • Pressure data > Level 2 Spectra (Note 1)	1. Promptly suspend reactor power ascension until an engineering evaluation concludes that further power ascension is justified. 2. Before resuming reactor power ascension, the steam dryer performance data shall be reviewed as apart of an engineering evaluation to assess whether further power ascension can be made without exceeding the Level 1 criteria.
Level 1: • MC > 0.3% OR • Pressure data exceed Level 1 Spectra	1. Promptly initiate a reactor power reduction and achieve a previously acceptable power level within two hours, unless an engineering evaluation concludes that continued power operation at the current power level or power ascension is acceptable. 2. Within 24 hours, re-measure MC and perform an engineering evaluation of steam dryer structural integrity. If the evaluation does not support continued plant operation, the reactor shall be placed in a hot shutdown condition within the following 24 hours. If the evaluation supports continued operation, implement step 3. 3. If the engineering evaluation supports continued operation, reduce further power ascension step increases and plateau levels to nominal increases of 1.25% and 2.5% of 3458 MWt, respectively, for any additional power ascension.

Notes:

1. The steam dryer limit curve spectra and dryer stress to MSL frequency correlations shall be determined and documented in an engineering calculation or report. Acceptable Level 2 shall be based on maintaining <10.88 ksi. Acceptable Level 1 Spectra shall be based on maintaining <13.6 ksi. The Level 1 and Level 2 LCs and stress limits shall be adjusted for uncertainty.

Table 3 - Steam Dryer License Conditions

Requirement
<This table will contain the final approved steam dryer license conditions.>