7.20 INSTRUMENT SETPOINT METHODOLOGY

7.20.1 Objectives

In the September 14, 2006, supplement to Technical Specifications (TS) change TS-453 “Instrument Setpoint Methodology,” TVA made an NRC commitment to incorporate into the SAR by reference the design output documentation which contains the nominal trip setpoints for the instrument functions that were changed by TS-453. The affected instrument functions are those to which the footnote was added to the TS instrument tables in the referenced TS-453 supplement and a listing of the design output documentation is provided in Table 7.20-1.

The commitment also specified that the methodology used to determine the nominal trip setpoint, the Allowable As Found (AAF) tolerance band and the Allowable As Left (AAL) tolerance band will be described in the UFSAR.

7.20.2 Design Bases

The instrument setpoints methodology for Browns Ferry is consistent with ISA standard 67.04-2000 and is incorporated into TVA Technical Instructions for performance of instrument uncertainty analyses.

7.20.3 Description

7.20.3.1 Setpoint Methodology

The following summarizes the methodology used for establishing instrument setpoints.

The establishment of setpoints and the relationships between a Nominal Trip Setpoint (NTSP), Allowable As Found (AAF) tolerance band, the Allowable As Left (AAL) tolerance band, Allowable Value (AV), Analytical Limit (AL), and Safety Limit are discussed in this section.

7.20.3.2 Safety Limit (SL)

A safety limit is specified to protect the integrity of physical barriers that guard against the uncontrolled release of radioactivity. The safety limit for a parameter is typically provided in the plant safety analyses in accordance with 10 CFR 50.36(c).1.ii.A.

7.20.3.3 Analytical Limit (AL)

The analytical limit represents the parameter value at which a safety action is assumed to be initiated to ensure that the safety limits are not exceeded during

either accidents or anticipated operational occurrences. The AL is developed from event analysis models including associated safety actions which consider parameters such as process delays, rod insertion times, core cooling flow rates, reactivity changes, or instrument response times. The AL may apply directly to a parameter (e.g., main steam relief valve opening pressure setpoint to maintain reactor pressure below its safety limit) or it may apply indirectly (e.g., reactor scram on low water level to main fuel peak clad temperature below its safety limit).

7.20.3.4 Technical Specification Allowable Value (AV)

The numerical parameter values/limits in the technical specification actions or surveillance requirements are the AVs. The AV is a value that the setpoint can have when tested periodically, beyond which the instrument channel shall be evaluated for operability. The AV ensures that sufficient margin exists to the AL to account for unmeasurables such as process effects and specified instrument uncertainties to ensure that the safety action is performed under worst case conditions before the AL is exceeded.

7.20.3.5 Nominal Trip Setpoint (NTSP)

The NTSP is the nominal value the instrument is set to when it is calibrated. Since many instruments cannot be set to an exact value, the instrument is set to the nominal setpoint within an allowed tolerance band as described in Section 7.20.3.9.

7.20.3.6 Operational Limit (OL)

The operational limit is a value which the operating parameter is not expected to exceed during normal operation. The NTSP is set beyond the OL so that spurious trips of the instrument do not occur.

7.20.3.7 Instrument Uncertainties

Instruments exhibit errors or uncertainties, some of which can be measured or detected during a normal calibration while other errors cannot be measured during normal calibrations since the external factor causing the error is not present at that time. Examples of external factors which are not present during a normal calibration are design basis accident temperature, design basis accident radiation and some process dependent effects. Additionally, instruments exhibit other errors such as drift which must be calculated based on operating experience.
Instrument setpoint calculations include both the effects of the measurable, and unmeasurable uncertainties to ensure the associated safety actions are performed in a timely manner so that safety limits are not exceeded. Incorporating these uncertainties provides assurance that the AL will not be exceeded under accident conditions if the AV is satisfied under normal conditions.

The square root sum of the squares (SRSS) method is used for combining uncertainty terms to meet the following three criteria: random, independent, and approximately normal distribution. The probability that all of the independent processes would simultaneously be at their maximum value (i.e., + or -) is very small. The SRSS method provides a means to combine individual random uncertainty terms to establish a net random uncertainty term. All other uncertainties that do not meet any of the three criteria are arithmetic summed.

The allowance between the AL and the NTSP is to be large enough to contain the total uncertainty (measurable and unmeasurable), during accident or seismic and normal operation, as determined using the SRSS method. The allowance between the AV and the NTSP should be large enough to contain that portion of the instrument channel being tested for the surveillance interval (monthly, quarterly, or refueling) and should account for only the measurable uncertainties. Examples of this are:

1) Drift (based on surveillance interval)

2) Instrument uncertainties for the portion of the instrument channel tested.

3) Instrument uncertainties during normal operation which are measured during testing

Another calculated variable defined as the normal measurable accuracy (A_{nf}) also called the as found tolerance, provides a means to identify unacceptable instrument performance which, if exceeded, may require corrective action. The (A_{nf}) represents a tolerance band on either side of the NTSP which defines the limits of acceptable instrument performance.

In the discussion which follows, it is assumed that the process variable increases toward the AL. If the process variable decreases toward the AL, the directions given would be reversed.

The limiting AV is determined by subtracting the unmeasurable uncertainty effects from the AL. The NTSP could then be calculated by subtracting the normal measurable uncertainties such as those items identified above, (drift, calibration uncertainties, and uncertainties observed during normal operations) plus any margin from the AV. This calculated AV is the bounding maximum limit Av_{max}. If margin exists between both the NTSP versus the AL and the NTSP and the operational limit, the NTSP could be reduced to a lower limit OL plus the normal uncertainties and then the AV could be reduced to the new NTSP plus the measurable uncertainties. This calculated AV is the bounding minimum value Av_{min} to prevent spurious initiations. The actual AV can be set within these two limits.

7.20.3.8 As Found Tolerance

The as found tolerance provides a means to identify unacceptable instrument performance which, if exceeded, may require corrective action. The (A_{nf}) represents a tolerance band on either side of the NTSP which defines the limits of acceptable instrument performance. As described previously, examples of the as found tolerance measurable uncertainties are:

1) Drift (based on surveillance interval)

2) Instrument calibration uncertainties for the portion of the instrument channel tested

3) Instrument uncertainties during normal operation which are measured during testing

7.20.3.9 As Left Tolerance

This calibration tolerance is usually based on the reference accuracy of the device being calibrated. The selection of the as left tolerance (acceptance band) for a device is arbitrary; however, the as left tolerance shall be large enough to allow the trip setpoints to be easily adjusted between these limits. The as left tolerance should always be equal to or greater than the device's reference accuracy.

7.20.4 Instrument Setpoints - Design Output

Table 7.20-1 lists the design output document for the parameters which meet the definition of a Limiting Safety System Setting (LSSS) in accordance with 10 CFR 50.36. These documents can be revised as needed under the provisions of 10 CFR 50.59.