9.4.1 General Precautions and Notes

9.4.1.1 Changes in ASI directly affect the temperature and power of the reactor and the larger the ASI swing is, the greater affect it has. As ASI becomes more negative (moves to the top of the core), temperature and power rise. The opposite affect occurs when ASI becomes more positive (moves to the bottom of the core), temperature and power drop. Thus, if ASI is controlled closer to Equilibrium Shape Index (ESI) and its changes are limited, then the effect it has on Reactor Power and Temperature will be reduced.

9.4.1.2 Axial Shape Control should be applied at all times when the reactor is above 20% power.

9.4.1.3 Maintain Axial Shape Index (ASI) within the following Equilibrium Shape Index (ESI):

9.4.1.3.1	During steady-state operations	± 0.05
9.4.1.3.2	During load transients	± 0.05
9.4.1.3.3	During Xenon Oscillation control	± 0.005

9.4.1.4 Axial Shape Control guidelines are not applicable during emergency or off-normal conditions.

9.4.1.5 The CEA insertion/withdrawal sequence and insertion limits of Technical Specifications shall be observed.

9.4.1.6 Control rods should be manually withdrawn or inserted in a deliberate and carefully controlled manner, while closely monitoring reactor response.

9.4.1.7 ASI should be monitored closely for several minutes after CEA motion, to determine the impact of the movement.

9.4.1.8 CEA motion should be slow and smooth (less than 3 inches), particularly in the outward direction.

9.4.1.9 CEDMCS should be operated in Manual Group with Groups 5, 6 or P being used for control. **[T.S. 3.1.3.6]**.

9.4.1.10 If operating with both CEACs Inoperable, then do not insert group 6 CEAs below 127.5 inches withdrawn and maintain group P CEAs at the full out position.

9.4.1.11 Do not insert Group 5, 6 or P CEAs below 75 inches withdrawn.

9.4.1.12 During axial shape control, monitor DNBR Margin (PID 107) on the most limiting CPC channel. If margin decreases to 0.2 then cease CEA insertion and slowly begin to borate CEAs back out. Reduce power as necessary to maintain at least 0.2 DNBR margin.

9.4.1.13 If control of ASI with temperature is used during Steady State operations, then a flat ASI will be achieved and CEA movement to control ASI will be less frequent.

9.4.1.14 Reactor Engineering should be contacted if any problems are encountered.

9.4.1.15 To prevent exceeding the Transient Insertion Limits of Technical Specification 3.1.3.6 and the Shutdown margin requirements of Technical Specification 3.1.1.1, Regulating Group 5 CEAs shall not be inserted to less than 145 inches withdrawn for ASI control above 80% Power.

Below 80% Power, Regulating Group 5 CEAs may be inserted within the bounds of the Transient Insertion Limit as long as Regulating Group 6 CEAs are inserted first, and maintained at least 15 inches below Regulating Group 5 CEAs.

An Imminent Out-Of-Sequence CWP will be generated if Regulating Group 5 CEAs come within 7.5 inches of Regulating Group 6 CEAs. Penalty factors will be applied to the Radial Peaking Factor causing a CPC generated trip whenever Regulating Group 5 CEAs become more inserted than Regulating Group 6 CEAs.

At any time with Reactor Power $\geq$ 20% and Regulating Group 6 or Group P CEAs are $\leq$ 120 inches withdrawn, or Regulating Group 5 CEAs are $\leq$ 145 inches withdrawn for ASI control, then the amount of time shall be logged in accordance with OP-903-001, Technical Specification Surveillance Logs.

9.4.2 Control of Axial Xenon Oscillations During Steady State Operations

9.4.2.1 Establish a plot of COLSS ASI (PID C24003) on the PMC, and monitor the value of COLSS ASI.

NOTE

Reactor Engineering will provide target ESI control values for 100% power and a recommended deviation value to assist in determining when ASI control should be used. Both of these values will be frequently updated in accordance with NE-003-001, Core Performance Monitoring.

9.4.2.2 When ASI reaches or exceeds the recommended deviation value, or at SM/CRS discretion, then initiate control action as ASI crosses the target ESI value and is trending in the negative direction.

9.4.2.3 Maintain ESI ±0.005 by small and frequent CEA insertions, allowing ASI to stabilize between steps. Monitor DNBR margin during and following CEA insertions.

9.4.2.4 Eventually, ASI should turn and drift in the positive direction. As ASI reaches ESI ±0.005, withdraw the CEAs in small steps until fully withdrawn.

9.4.2.5 If there is no CEA movement with CEAs inserted and ASI has changed less than ±0.005 for a period exceeding 6 hours, then withdraw CEAs two steps and repeat withdrawing CEAs at a rate of 4 steps per hour to return to an ARO configuration.

9.4.2.6 If ASI is less than ESI control value and it is necessary to control ASI, then do not drive ASI back to target ESI value. Substitute current value for ASI for target ESI and control oscillation within ±0.005 of the new target ESI.

9.4.2.7 Contact Reactor Engineering if problems are encountered.

9.4.3 Short Term Power Reduction Control of ASI

CAUTION

(1) TO PREVENT EXCEEDING THE TRANSIENT INSERTION LIMITS OF TECHNICAL SPECIFICATION 3.1.3.6 AND THE SHUTDOWN MARGIN REQUIREMENTS OF TECHNICAL SPECIFICATION 3.1.1.1, REGULATING GROUP 5 CEAS SHALL NOT BE INSERTED TO LESS THAN 145 INCHES WITHDRAWN FOR ASI CONTROL ABOVE 80% POWER.

(2) BELOW 80% POWER, REGULATING GROUP 5 CEAS MAY BE INSERTED WITHIN THE BOUNDS OF THE TRANSIENT INSERTION LIMIT AS LONG AS REGULATING GROUP 6 CEAS ARE INSERTED FIRST, AND MAINTAINED AT LEAST 15 INCHES BELOW REGULATING GROUP 5 CEAS.

(3) AT ANY TIME WITH REACTOR POWER > 20% AND REGULATING GROUP 6 OR GROUP 'P' CEAS ARE $\leq$ 120 INCHES WITHDRAWN OR REGULATING GROUP 5 CEAS ARE $\leq$ 145 INCHES WITHDRAWN FOR ASI CONTROL, THEN THE AMOUNT OF TIME SHALL BE LOGGED IN ACCORDANCE WITH OP-903-001, TECHNICAL SPECIFICATION SURVEILLANCE LOGS.

9.4.3.1 Power reduction should be initiated by boration. As power begins to lower, ASI should move in the negative direction. Insert CEAs to maintain the ASI in a small band about the target ESI as recommended by Reactor Engineering.

9.4.3.2 Continue to maintain ASI at target ESI ±0.05. Dilution or T_{avg} deviations may be required in response to CEA insertion, or as a result of Xenon buildups to reduce the rate of power reduction, or to level power at the final desired level.

9.4.3.3 When final power level is obtained following a rapid power reduction using CEAs, then the CEAs should be borated out and used to control ASI at the target ESI ±0.05.

9.4.3.4 If power operation is to continue for > 72 hours at a reduced power level, then Reactor Engineering should be consulted to determine if it is desirable to return to an ARO configuration. If this is recommended, then a target ESI for the reduced power level must be recommended by Reactor Engineering.

9.4.3.5 When a return to the pre-reduction power level is desired, then initiate the power increase by dilution. Withdraw CEAs to maintain ASI at the target ESI ±0.05.

9.4.3.6 Prior to power escalation above 50% power, verify ASI at ESI ±0.05.

9.4.3.7 Contact Reactor Engineering if problems are encountered.

9.4.4 ASI Control of Power Escalations Following A Reactor Trip

NOTE

This section provides guidance on controlling ASI during power escalations within 2 days of a reactor trip or plant shutdown.

CAUTION

(1) TO PREVENT EXCEEDING THE TRANSIENT INSERTION LIMITS OF TECHNICAL SPECIFICATION 3.1.3.6 AND THE SHUTDOWN MARGIN REQUIREMENTS OF TECHNICAL SPECIFICATION 3.1.1.1, REGULATING GROUP 5 CEAS SHALL NOT BE INSERTED TO LESS THAN 145 INCHES WITHDRAWN FOR ASI CONTROL ABOVE 80% POWER.

(2) BELOW 80% POWER, REGULATING GROUP 5 CEAS MAY BE INSERTED WITHIN THE BOUNDS OF THE TRANSIENT INSERTION LIMIT AS LONG AS REGULATING GROUP 6 CEAS ARE INSERTED FIRST AND MAINTAINED AT LEAST 15 INCHES BELOW REGULATING GROUP 5 CEAS.

(3) AT ANY TIME WITH REACTOR POWER > 20% AND REGULATING GROUP 6 CEAS OR GROUP 'P' ARE $\leq$ 120 INCHES WITHDRAWN, OR REGULATING GROUP 5 CEAS ARE $\leq$ 145 INCHES WITHDRAWN FOR ASI CONTROL, THEN THE AMOUNT OF TIME SHALL BE LOGGED IN ACCORDANCE WITH OP-903-001, TECHNICAL SPECIFICATION SURVEILLANCE LOGS.

9.4.4.1 Power escalations beyond 20% will begin with groups 5, 6 or P inserted no more than 75 inches.

9.4.4.2 Establish a plot of COLSS ASI (PMC PID C24003). Monitor ASI and determine its trend.

9.4.4.3 ASI should shift in the positive direction. Plant conditions will dictate the preference for either CEA withdrawal or ASI increases in the positive direction.

9.4.4.4 As long as the trend to increase ASI or to withdraw CEAs continues, control of ASI is satisfactory. If ASI starts to trend in the negative direction, then insert CEAs slightly to mitigate the negative shift in ASI.

9.4.4.5 Once ASI is within target ESI ±0.05, resume normal ASI control as described during steady state operations.

9.4.4.6 Contact Reactor Engineering if problems are encountered.

9.4.5 ASI Control During A Xenon Free Startup

NOTE

Xenon Free startup for purposes of this section is one in which reactor has been shutdown for greater than 72 hours.

9.4.5.1 Achieve an ARO configuration at as low a power level as possible prior to exceeding 50%.

9.4.5.2 Monitor ASI during the power increase. ASI should become more positive as power is raised above 50% to the value of ESI at 100%.

9.4.5.3 CEA insertion should not be necessary for Axial Shape Control.

9.4.5.4 Contact Reactor Engineering if problems are encountered.

9.4.6 ASI Control Using RCS Temperature

NOTE

The preferred method of controlling Axial Shape Index during steady state operations is with RCS Temperature instead of CEAs.

9.4.6.1 As ASI becomes more negative (goes to the top of the core), the operator must raise temperature by dilution which also raises Reactor Power. As power rises, the operator must reduce the Main Turbine load which further raises T_{cold}. As T_{cold} and T_{hot} rise, ASI is forced to the bottom of the core since the change in density at the top of the core is greater than the change in density at the bottom of the core. This affect adds negative reactivity at the top of the core relative to the bottom and forces ASI to the bottom of the core. This is seen by approximately a 0.1 to 0.5 degree rise in T_{cold} depending on the magnitude of the ASI swing. Main Turbine MW output should remain relatively constant during this evolution.

9.4.6.2 As ASI becomes more positive (goes to the bottom of the core), T_{hot} and T_{cold} will drop and power will drop. The operator will raise load on the Main Turbine and power will rise while T_{cold} and T_{hot} will further decrease. This effectively adds positive reactivity in the top of the core relative to the bottom as the change in density is greater at the top versus the bottom of the core. Again, Main Turbine MW output should remain relatively constant. The key is try not to add water when temperature lowers but to have room (i.e. 0.5°F) to raise turbine load to maintain 100% power.