Georgia Power

POWER GENERATION DEPARTMENT

VOGTLE ELECTRIC GENERATING PLANT

TRAINING LESSON PLAN

TITLE:	POWER DISTRIBUTION LIMITS 3/4.2	NUMBER:	LO-LP-39206-00
PROGRAM:	LICENSED OPERATOR	REVISION:	0
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INSTRUCTOR GUIDELINES:

FORMAT: LECTURE

MATERIALS: OVERHEAD PROJECTOR

TRANSPARENCIES

WHITE BOARD

MARKERS

ERASER

MASTER

I. PURPOSE STATEMENT:

TO TEACH THE STUDENT HOW TO USE AND APPLY THE APPLICABILITY STATEMENTS, LCO, AND ACTION STATEMENTS FOR THE 5 POWER DISTRIBUTION TECH SPECS SECTION 3/4.2.

II. LIST OF OBJECTIVES:

TERMINAL

The student will be able to demonstrate how to apply the 5 power distribution tech specs in different simulated situations.

ENABLING

1. The student will be able to define axial flux difference.
2. The student will be able to demonstrate the physical location of the AFD target band graph.
3. The student will be able to tell how the AFD target is determined.
4. The student will be able to list from memory when AFD tech spec is applicable.
5. The student will be able to define cumulative penalty deviation time and demonstrate how to calculate it.
6. The student will be able to state the required actions if AFD is outside of band if greater than or equal to 90% rated thermal power.
7. The student will be able to state the required actions if greater than 1 hour of cumulative penalty time is incurred OR if AFD is outside of the acceptable operation limits area, when power is greater than or equal to 50% but less than 90%.
8. The student will be able to state the required actions if greater than 1 hour cumulative penalty time has been incurred in the last 24 hours if power is less than 50% but greater than 15% rated thermal power.
9. The student will be able to state the conditions necessary to exist for AFD to be considered outside of target band.
10. The student will be able to state the definition of heat flux hot channel factor ($F_Q^{(Z)}$)
11. The student will be able to state the limits on F_Q^Z.
12. The student will be able to interpret the core height correction factor curve.

II. LIST OF OBJECTIVES

13. The student will be able to state the applicability of F_Q^Z tech spec.

14. The student will from memory be able to state the less than or equal to 1 hour actions necessary when F_Q^Z is outside allowable limit.

15. The student will be able to briefly describe how F_Q^Z is evaluated.

16. The student will be able to state the definition of nuclear enthalpy hot channel factor ($F^N_{\text{delta H}}$).

17. The student will be able to state the limit of $F^N_{\text{delta H}}$.

18. The student will be able to state the applicability of nuclear enthalpy hot channel factor tech spec.

19. The student will be able to state the definition of quadrant power tilt ratio.

20. The student will be able to state the limit on QTPR.

21. The student will be able to state the applicability of QTPR tech spec.

22. The student will be able to state the required actions (1 hour or less) if QTPR is between 1.02 and 1.09.

23. The student will be able to state the required actions (1 hour or less) if QTPR is greater than 1.09 due to and not due to a stuck or misaligned rod.

24. The student will be able to list the related DNB parameters and their limits.

25. The student will be able to state the applicability for DNB parameter tech spec.

26. State (SRO) or be familiar with (RO) the basis for each of the LCOs.

REFERENCES:

TECHNICAL SPECIFICATIONS (REV. MARCH 20, 1985, DRAFT A)

SECTION 3/4.2

III. LESSON OUTLINE:

A. Axial Flux Difference

1. AFD - difference in flux signals (normalized to their full power sum and expressed as their percentage) between the top and bottom halves of a two section excore neutron detector. (Ensures F_Q^Z stays in limits.)

2. Location of limit curve - located in the simulator "curve book" stored behind the shift supervisor's chair.

3. Target/Target band

   a. Target values determined at:

      1) Xenon free

      2) Rods near normal position

   b. Target determined periodically due to fuel burnup

   c. Target band about the target shifts between ±5% (less than 3000 MWD/MTU) and +3, -12% (greater than 3000 MWD/MTU).

4. AFD tech spec is applicable when in mode 1 and greater than 15% rated thermal power.

5. Cumulative penalty deviation time

   a. Accumulated from present time to 24 hours previously

   b. Accumulated when AFD is outside the target band.

   c. Accumulated on the following bases:

      1) 1 minute penalty deviation for each 1 minute of power operation outside of the target band when greater than or equal to 50% rated thermal power.

      2) 1/2 minute penalty deviation for each 1 minute of power operation outside of the target band at thermal power levels between 15% and 50%.

NOTES

Note: Stress difference between target & target band

III. LESSON OUTLINE: | NOTES

6. Actions if LCO not met:

   a. If outside target band and greater than or equal to 90% rated thermal power then in 15 min either:

      1) Restore AFD to target band OR

      2) Reduce power to less than 90%

   b. If outside target band for more than 1 hour cumulative penalty time during last 24 hours OR outside acceptable operations limits when between 50 and 90% RTP then (do both):

      1) Reduce to less than 50% RTP within 30 min AND

      2) Reduce high flux setpoints to less than 55% RTP (non - 1 hour action)

7. Conditions of exceeding target band

   a. Two operable excore channels indicating AFD is outside of band.

B. Heat Flux Hot Channel Factor ($F_Q^{(Z)}$)

1. $F_Q^{(Z)}$ - The maximum local heat flux on the surface of a fuel rod at elevation Z divided by the average fuel rod heat flux (allowing for manufacturing tolerances on fuel pellets and rods and measurement uncertainty).

2. Limits

   a. Limit on $F_Q^{(Z)}$ ensures that:

      1) Design limits on minimum DNBR are not exceeded.

      2) In event of a LOCA the fuel clad temp will not exceed 2200°F (ECCS criteria)

   b. $F_Q^{(Z)}$ (and $F^N_{\text{delta H}}$) are kept within limits between surveillances by ensuring:

      1) Rod bank alignment

      2) Rod bank overlap (sequence)

III. LESSON OUTLINE:

NOTES

3) Rod insertion limits (RIL)

4) AFD within limits

c. Values

1) Greater than 50% power, limit is less than or equal to $2.3 \times K_{(Z)}$

2) Less than 50% power, limit is less than or equal to $4.6 \times K_{(Z)}$

$K_{(Z)}$ = Core height correction factor

3. Applicability

a. $F_Q^{(Z)}$ is applicable in Mode 1

4. Action

a. For every 1% $F_Q^{(Z)}$ exceeds its limit reduce thermal power 1% within 15 minutes.

b. Correct before raising power above reduced limit.

5. $F_Q^{(Z)}$ Determination

a. $F_{XY}^{(Z)}$ = Radial Peaking Factor

1) Ratio of peak power density to average power density in the horizontal plane at core elevation Z.

b. $F_{XY}^{(Z)}$ is evaluated to see if $F_Q^{(Z)}$ is within limits by:

1) Obtain power distribution map (movable incore detectors) (must be greater than 5% RTP)

2) F_{XY} is from map are adjusted 3% up for manufacturing tolerances and 5% up for measurement uncertainties and is now called $F_{XY}^{(C)}$

3) Compare $F_{XY}^{(C)}$ to limit $F_{XY}^{(RTP)}$

$F_{XY}^{(RTP)}$ = limits at rated thermal power are located in radial peaking factor report for all core planes containing Bank D rods and all unrodded core planes. (See tech spec 4.2.2.2F 1-4 for location exceptions.)

III. LESSON OUTLINE:

4) Compare $F_{XY}^{(C)}$ to Limit F_{XY}^{L}

F_{XY}^{L} = limit at fractional power level

(equates F_{XY}^{RTP} to power level where F_{XY} was measured.)

C. Nuclear Enthalpy Hot Channel Factor - $F_{\text{delta H}}^{N}$

1. $F_{\text{delta H}}^{N}$ - The ratio of the integral of linear power along the rod with the highest integrated power to the average rod power, allowing for measurement uncertainty.

2. Limits

a. Limit on $F_{\text{delta H}}^{N}$ ensures that:

1) Design limits on peak power density is not exceeded

2) In the event of a LOCA the fuel clad temp. will not exceed 2200°F (ECCS criteria)

b. $F_{\text{delta H}}^{N}$ (and $F_{Q}^{(Z)}$) are kept within limits between surveillances by ensuring:

1) Rod bank alignment

2) Rod bank overlap (sequence)

3) Rod insertion limits (RIL)

4) Axial flux difference limits (AFD)

c. Values

1) Less than or equal to

$$1.55[1 + .3(1 - \frac{\text{Thermal Power}}{\text{Rated Thermal Power}})]$$

3. Applicability

a. $F_{\text{delta H}}^{N}$ is applicable in mode 1

NOTES

Note: Rod Bow Penalties are no longer used due to conservative design margins

III. LESSON OUTLINE:

NOTES

4. Action

   a. Many non-1 hour actions

      1) Reduce to less than 50% RTP in 2 hours

      2) Reduce trip setpoints in next 4 hours — Not required (optional)

      3) Demonstrate in limits by flux map within 24 hours OR reduce to less than 5% RTP in next two hours.

5. $F^N_{\text{delta H}}$ Determination

   a. Determined by obtaining an incore flux map.

   b. Measured value raised 4% for measured uncertainty

D. Quadrant Power Tilt Ratio (QTPR)

1. QTPR - Ratio of max calibrated upper detector output to the ave. calibrated upper detector output OR ratio of max. calibrated lower detector output to the ave. calibrated lower detector output.

2. Limits

   a. Limit assures that radial power distribution satisfies the design values used in the power capability analysis

   b. Provides DNB and linear heat generation protection with X-Y tilts

   c. Value - 1.02

3. Applicability

   a. Mode 1 greater than 50% rated thermal power

4. Action

   a. 1.02 -- 1.09

      1) Calculate QTPR once per hour until QTPR is in limits or thermal power reduced to less than 50%.

III. LESSON OUTLINE:	NOTES
2) Within 2 hours: QTPR in limit <u>or</u> reduce thermal power at least 3% for each 1% QTPR is greater than 1.0 (reduce high flux setpoints within 4 hours.	
3) Within 24 hrs. verify QTPR in limit <u>or</u> reduce to less than 50% power in next 2 hours and reduce high flux setpoints.	Non-1 hour actions
b. Greater than 1.09 (due to misaligned <u>or</u> stuck rod)	
1) Reduce power 3% for each 1% QTPR is greater than 1.0 in <u>30 minutes</u>.	
2) Calculate QTPR once per hour until QTPR is in limits <u>or</u> power reduced to less than 50%	
3) Within 2 hours: verify QTPR in limit <u>or</u> reduce power to less than 50% in next two hours and reduce high flux setpoints	Non-1 hour actions
c. Greater than 1.09 (other than misaligned rod)	
1) Calculate QTPR once per hour until QTPR is in limits <u>or</u> thermal power is less than 50%	
2) Reduce power to less than 50% within 2 hours, reduce high flux setpoints	Non-1 hour action
5. Surveillance	
a. When more than 50% power by:	
1) calculating ratio once per 7 days (QPTR alarm operable)	
2) calculating ratio once per 12 hours during steady state operations with the QPTR alarm inoperable.	
b. Must calculate QTPR when greater than 75% power and one channel of power range inoperative with movable incore detectors (every 12 hours).	
E. DNB Parameters	
1. DNB - the onset of the boiling crisis	

III. LESSON OUTLINE:

2. Limits

   a. Assures that key DNB related parameters are in analyzed values assumed in transient and accident analysis

   b. Assures DNBR greater than or equal to 1.30 throughout each analyzed transient.

   c. Parameters/values

      1) T_{ave} - less than or equal to later

      2) Pressurizer Pressure - later

         a) Not applicable for greater than 5%/min or 10% step in power

         OR

         b) Less than 2% power on startup or shutdown

      3) RCS $Flow_{total}$ - later

3. Applicability - model

   a. Action

      1) Restore parameter within 2 hours or be less than 5% power in next 4 hours.

NOTES

Note: Non-1 hour action

IV. PRACTICAL EXERCISES

A. (NSIC 190554) on 3-21-84, at 1400 hrs, and in Mode 1 at 99% rated thermal power (RTP), a flux map was taken which indicated that Tech Spec surveillance requirement 4.2.2.2.C for RMQ(Z) wa exceeded. Reactor power was subsequently reduced to 96% RTP. This circumstance occurred due to self-imposed conservatisms resulting in a discrete drop in the allowable power level when rod cluster control assembly bank D is inserted into the core at or beyond the 217 step position. Further review showed that the surveillance requirement was not exceeded. This did not constitute a condition outside of Unit 1 cycle 8 safety analysis. In the interest of addressing this event, this voluntary LER is being submitted.

1. Major points for discussion:

    a. Which VEGP Tech Spec LCO violated
    b. How was condition found
    c. What action was taken and why

B. (NSIC 187531) with the unit at full power, control rod B-6 dropped to its fully inserted position. The resulting quadrant power tilt was greater than 2% which is contrary to Tech Spec - 3.12.B.6 and is reportable per Tech Spec - 6.6.2.B.(2). A power decrease due to a turbine runback reduced the consequences of the tilt. All other control rods remained operable. The control rod dropped because of a failed voltage regulation card in the associated power cabinet. The card was replaced.

1. Major points for discussion:

    a. How would a dropped rod cause QPTR to exceed limit
    b. Why would a turbine runback reduce the consequences of the tilt
    c. What action is required

C. (NSIC 187863) at 0045 on 11-16-83, the core axial flux difference was determined to be outside of its target band by 0.5%. Tech Spec 3.2.1 requires the AFD to be inside this target band. Tech Spec 3.2.1 action statement requirements were met. This event was caused by personnel error. Earlier, the plant operator had initiated, but failed to secure in a timely manner, a boron thermal regeneration system (BTRS) dilution. This caused reactor power to start to increase. The dilution was secured and the control rods were inserted to reduce power level. The control rod insertion caused the core AFD to exceed the target band. A boration was initiated to allow control rod withdrawal. The control rods were withdrawn, restoring the core AFD to within the target band, at 0047 on 11-16-83. The personnel involved have been counseled concerning this event.

1. Major points for discussion:

    a. How would BTRS cause the Delta I problem
    b. What action was required to correct the problem
    c. What actions would have been required if this condition was prolonged