

**Final Submittal**  
(Blue Paper)

**FINAL RO/SRO WRITTEN  
EXAMINATION REFERENCES**

**NORTH ANNA JUNE 2008 EXAM**  
**05000338/2008301 & 05000339/2008301**

**GENERIC FUNDAMENTALS EXAMINATION**  
**EQUATIONS AND CONVERSIONS HANDOUT SHEET**

**EQUATIONS**

---

$$\dot{Q} = \dot{m}c_p\Delta T$$

$$\dot{Q} = \dot{m}\Delta h$$

$$\dot{Q} = UA\Delta T$$

$$\dot{Q} \propto \dot{m}_{\text{Nat Circ}}^3$$

$$\Delta T \propto \dot{m}_{\text{Nat Circ}}^2$$

$$K_{\text{eff}} = 1/(1 - \rho)$$

$$\rho = (K_{\text{eff}} - 1)/K_{\text{eff}}$$

$$\text{SUR} = 26.06/\tau$$

$$\tau = \frac{\bar{\beta}_{\text{eff}} - \rho}{\lambda_{\text{eff}} \rho}$$

$$\rho = \frac{\ell^*}{\tau} + \frac{\bar{\beta}_{\text{eff}}}{1 + \lambda_{\text{eff}} \tau}$$

$$\ell^* = 1 \times 10^{-4} \text{ sec}$$

$$\lambda_{\text{eff}} = 0.1 \text{ sec}^{-1} \text{ (for small positive } \rho \text{)}$$

$$\text{DRW} \propto \phi_{\text{tip}}^2 / \phi_{\text{avg}}^2$$

$$P = P_0 10^{\text{SUR}(t)}$$

$$P = P_0 e^{(\nu t)}$$

$$A = A_0 e^{-\lambda t}$$

$$\text{CR}_{\text{S/D}} = S/(1 - K_{\text{eff}})$$

$$\text{CR}_1(1 - K_{\text{eff}1}) = \text{CR}_2(1 - K_{\text{eff}2})$$

$$1/M = \text{CR}_1/\text{CR}_x$$

$$A = \pi r^2$$

$$F = PA$$

$$\dot{m} = \rho A \bar{v}$$

$$\dot{W}_{\text{Pump}} = \dot{m}\Delta P v$$

$$E = IR$$

Thermal Efficiency = Net Work Out/Energy In

$$\frac{g(z_2 - z_1)}{g_c} + \frac{(\bar{v}_2^2 - \bar{v}_1^2)}{2g_c} + v(P_2 - P_1) + (u_2 - u_1) + (q - w) = 0$$

$$g_c = 32.2 \text{ lbf-ft/lbf-sec}^2$$

**CONVERSIONS**

---

$$1 \text{ Mw} = 3.41 \times 10^6 \text{ Btu/hr}$$

$$1 \text{ hp} = 2.54 \times 10^3 \text{ Btu/hr}$$

$$1 \text{ Btu} = 778 \text{ ft-lbf}$$

$$^\circ\text{C} = (5/9)(^\circ\text{F} - 32)$$

$$^\circ\text{F} = (9/5)(^\circ\text{C}) + 32$$

$$1 \text{ Curie} = 3.7 \times 10^{10} \text{ dps}$$

$$1 \text{ kg} = 2.21 \text{ lbfm}$$

$$1 \text{ gal}_{\text{water}} = 8.35 \text{ lbfm}$$

$$1 \text{ ft}^3_{\text{water}} = 7.48 \text{ gal}$$

3.3 INSTRUMENTATION

3.3.1 Reactor Trip System (RTS) Instrumentation

LCO 3.3.1 The RTS instrumentation for each Function in Table 3.3.1-1 shall be OPERABLE.

APPLICABILITY: According to Table 3.3.1-1.

ACTIONS

----- NOTE -----  
Separate Condition entry is allowed for each Function.  
-----

| CONDITION   | REQUIRED ACTION   | COMPLETION TIME             |
|---|---|-----------------------------|
| A. One or more Functions with one or more required channels or trains inoperable. | A.1 Enter the Condition referenced in Table 3.3.1-1 for the channel(s) or train(s). | Immediately                 |
| B. One Manual Reactor Trip channel inoperable.                                    | B.1 Restore channel to OPERABLE status.   | 48 hours                    |
|   | <u>OR</u><br>B.2 Be in MODE 3.  | 54 hours                    |
| C. One channel or train inoperable.   | C.1 Restore channel or train to OPERABLE status.                                    | 48 hours                    |
|   | <u>OR</u><br>C.2.1 Initiate action to fully insert all rods.<br><br><u>AND</u>      | 48 hours<br><br>(continued) |

ACTIONS

| CONDITION  | REQUIRED ACTION   | COMPLETION TIME  |
|--|---|--|
| C. (continued)   | C.2.2 Place the Rod Control System in a condition incapable of rod withdrawal.  | 49 hours   |
| D. One Power Range Neutron Flux-High channel inoperable. | <p align="center">-----NOTE-----<br/>                     The inoperable channel may be bypassed for up to 12 hours for surveillance testing and setpoint adjustment of other channels.<br/>                     -----</p> <p>D.1.1 Place channel in trip.</p> <p align="center"><u>AND</u></p> <p>D.1.2 Reduce THERMAL POWER to <math>\leq 75\%</math> RTP.</p> <p align="center"><u>OR</u></p> <p>D.2.1 Place channel in trip.</p> <p align="center"><u>AND</u></p> <p align="center">-----NOTE-----<br/>                     Only required to be performed when the Power Range Neutron Flux input to QPTR is inoperable.<br/>                     -----</p> <p>D.2.2 Perform SR 3.2.4.2.</p> <p align="center"><u>OR</u></p> <p>D.3 Be in MODE 3.</p> | <p>72 hours</p> <p>78 hours</p> <p>72 hours</p> <p>Once per 12 hours</p> <p>78 hours</p> |

ACTIONS

| CONDITION   | REQUIRED ACTION   | COMPLETION TIME            |
|---|---|----------------------------|
| E. One channel inoperable.                                  | <p align="center">-----NOTE-----<br/>                     The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels.<br/>                     -----</p> E.1 Place channel in trip.<br>OR<br>E.2 Be in MODE 3.  | 72 hours<br><br>78 hours   |
| F. One Intermediate Range Neutron Flux channel inoperable.  | F.1 Reduce THERMAL POWER to < P-6.<br>OR<br>F.2 Increase THERMAL POWER to > P-10.   | 24 hours<br><br>24 hours   |
| G. Two Intermediate Range Neutron Flux channels inoperable. | <p align="center">-----NOTE-----<br/>                     Limited plant cooldown or boron dilution is allowed provided the change is accounted for in the calculated SDM.<br/>                     -----</p> G.1 Suspend operations involving positive reactivity additions.<br>AND<br>G.2 Reduce THERMAL POWER to < P-6. | Immediately<br><br>2 hours |

ACTIONS

| CONDITION   | REQUIRED ACTION  | COMPLETION TIME                                  |
|---|--|--|
| H. One Source Range Neutron Flux channel inoperable.  | <p align="center">-----NOTE-----<br/>                     Limited plant cooldown or boron dilution is allowed provided the change is accounted for in the calculated SDM.<br/>                     -----</p> H.1 Suspend operations involving positive reactivity additions. | Immediately                                      |
| I. Two Source Range Neutron Flux channels inoperable. | I.1 Open Reactor Trip Breakers (RTBs).   | Immediately                                      |
| J. One Source Range Neutron Flux channel inoperable.  | J.1 Restore channel to OPERABLE status.<br><br><u>OR</u><br><br>J.2.1 Initiate action to fully insert all rods.<br><br><u>AND</u><br><br>J.2.2 Place the Rod Control System in a condition incapable of rod withdrawal.  | 48 hours<br><br><br>48 hours<br><br><br>49 hours |

ACTIONS

| CONDITION  | REQUIRED ACTION   | COMPLETION TIME  |
|--|---|--|
| <p>K. Required Source Range Neutron Flux channel inoperable.</p> | <p>-----NOTE-----<br/>Plant temperature changes are allowed provided the temperature change is accounted for in the calculated SDM.<br/>-----</p> <p>K.1 Suspend operations involving positive reactivity additions.</p> <p><u>AND</u></p> <p>K.2 Perform SR 3.1.1.1.</p> | <p>Immediately</p> <p>1 hour</p> <p><u>AND</u></p> <p>Once per 12 hours thereafter</p> |
| <p>L. One channel inoperable.</p>                                | <p>-----NOTE-----<br/>The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels.<br/>-----</p> <p>L.1 Place channel in trip.</p> <p><u>OR</u></p> <p>L.2 Reduce THERMAL POWER to &lt; P-7.</p>                                 | <p>72 hours</p> <p>78 hours</p>  |

ACTIONS

| CONDITION   | REQUIRED ACTION  | COMPLETION TIME                 |
|---|--|---------------------------------|
| <p>M. One Reactor Coolant Pump Breaker Position channel inoperable.</p> | <p>-----NOTE-----<br/>The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels.<br/>-----</p> <p>M.1 Restore channel to OPERABLE status.</p> <p><u>OR</u></p> <p>M.2 Reduce THERMAL POWER to &lt; P-7.</p> | <p>72 hours</p> <p>78 hours</p> |
| <p>N. One Turbine Trip channel inoperable.</p>                          | <p>-----NOTE-----<br/>The inoperable channel may be bypassed for up to 12 hours for surveillance testing of other channels.<br/>-----</p> <p>N.1 Place channel in trip.</p> <p><u>OR</u></p> <p>N.2 Reduce THERMAL POWER to &lt; P-8.</p>              | <p>72 hours</p> <p>76 hours</p> |
| <p>O. One train inoperable.</p>   | <p>-----NOTE-----<br/>One train may be bypassed for up to 4 hours for surveillance testing provided the other train is OPERABLE.<br/>-----</p> <p>O.1 Restore train to OPERABLE status.</p> <p><u>OR</u></p> <p>O.2 Be in MODE 3.</p>                  | <p>24 hours</p> <p>30 hours</p> |

| ACTIONS                             |  |                              |
|-------------------------------------|--|------------------------------|
| CONDITION                           | REQUIRED ACTION  | COMPLETION TIME              |
| P. One RTB train inoperable.        | <p>-----NOTES-----</p> <p>1. One train may be bypassed for up to 2 hours for surveillance testing, provided the other train is OPERABLE.</p> <p>2. One RTB may be bypassed for up to 2 hours for maintenance on undervoltage or shunt trip mechanisms, provided the other train is OPERABLE.</p> <p>3. One RTB train may be bypassed for up to 4 hours for concurrent surveillance testing of the RTB and automatic trip logic, provided the other train is OPERABLE.</p> <p>-----</p> |                              |
|                                     | <p>P.1 Restore train to OPERABLE status.</p> <p><u>OR</u></p> <p>P.2 Be in MODE 3.</p>   | <p>1 hour</p> <p>7 hours</p> |
| Q. One or more channels inoperable. | <p>Q.1 Verify interlock is in required state for existing unit conditions.</p> <p><u>OR</u></p> <p>Q.2 Be in MODE 3.</p>   | <p>1 hour</p> <p>7 hours</p> |

ACTIONS

| CONDITION                                     | REQUIRED ACTION   | COMPLETION TIME |
|---|---|-----------------|
| R. One or more channels inoperable.           | R.1 Verify interlock is in required state for existing unit conditions. | 1 hour          |
|   | <u>OR</u><br>R.2 Be in MODE 2.  | 7 hours         |
| S. One trip mechanism inoperable for one RTB. | S.1 Restore inoperable trip mechanism to OPERABLE status.               | 48 hours        |
|   | <u>OR</u><br>S.2 Be in MODE 3.  | 54 hours        |

SURVEILLANCE REQUIREMENTS

----- NOTE -----  
Refer to Table 3.3.1-1 to determine which SRs apply for each RTS Function.  
-----

| SURVEILLANCE   | FREQUENCY |
|--|-----------|
| SR 3.3.1.1 Perform CHANNEL CHECK.  | 12 hours  |
| SR 3.3.1.2 -----NOTE-----<br>Not required to be performed until 12 hours after THERMAL POWER is $\geq$ 15% RTP.<br>-----<br>Compare results of calorimetric heat balance calculation to power range channel output. Adjust power range output if calorimetric heat balance calculation result exceeds power range channel output by more than +2% RTP. | 24 hours  |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE |  | FREQUENCY                           |
|--------------|--|-------------------------------------|
| SR 3.3.1.3   | <p>-----NOTE-----<br/>                     Not required to be performed until 72 hours after THERMAL POWER is <math>\geq</math> 15% RTP.<br/>                     -----</p> <p>Compare results of the incore detector measurements to Nuclear Instrumentation System (NIS) AFD. Adjust NIS channel if absolute difference is <math>\geq</math> 3%.</p> | 31 effective full power days (EFPD) |
| SR 3.3.1.4   | <p>-----NOTE-----<br/>                     This Surveillance must be performed on the reactor trip bypass breaker immediately after placing the bypass breaker in service.<br/>                     -----</p> <p>Perform TADOT.</p>  | 31 days on a STAGGERED TEST BASIS   |
| SR 3.3.1.5   | Perform ACTUATION LOGIC TEST.  | 31 days on a STAGGERED TEST BASIS   |
| SR 3.3.1.6   | <p>-----NOTE-----<br/>                     Verification of setpoint is not required.<br/>                     -----</p> <p>Perform TADOT.</p>  | 92 days                             |
| SR 3.3.1.7   | <p>-----NOTE-----<br/>                     Not required to be performed for source range instrumentation prior to entering MODE 3 from MODE 2 until 4 hours after entry into MODE 3.<br/>                     -----</p> <p>Perform COT.</p>  | 92 days                             |

**SURVEILLANCE REQUIREMENTS**

| SURVEILLANCE   |  | FREQUENCY |
|--|--|-----------|
| <p>SR 3.3.1.8</p> <p align="center">-----NOTE-----</p> <p>This Surveillance shall include verification that interlocks P-6 and P-10 are in their required state for existing unit conditions.</p> <p align="center">-----</p> <p>Perform COT.</p>  | <p align="center">-----NOTE-----</p> <p>Only required when not performed within previous 92 days</p> <p align="center">-----</p> <p>Prior to reactor startup</p> <p><u>AND</u></p> <p>Four hours after reducing power below P-6 for source range instrumentation</p> <p><u>AND</u></p> <p>Twelve hours after reducing power below P-10 for power and intermediate range instrumentation</p> <p><u>AND</u></p> <p>Once per 92 days thereafter</p> |           |
| <p>SR 3.3.1.9</p> <p align="center">-----NOTES-----</p> <p>1. Adjust NIS channel if absolute difference <math>\geq 3\%</math>.</p> <p>2. Not required to be performed until 72 hours after THERMAL POWER is <math>\geq 50\%</math> RTP.</p> <p align="center">-----</p> <p>Compare results of the excore channels to incore detector measurements.</p> | <p>92 EFPD</p>   |           |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE |  | FREQUENCY   |
|--------------|--|---|
| SR 3.3.1.10  | <p align="center">-----NOTE-----<br/>                     This Surveillance shall include verification that the time constants are adjusted to the prescribed values.<br/>                     -----</p> <p>Perform CHANNEL CALIBRATION.</p> | 18 months   |
| SR 3.3.1.11  | <p align="center">-----NOTE-----<br/>                     Neutron detectors are excluded from CHANNEL CALIBRATION.<br/>                     -----</p> <p>Perform CHANNEL CALIBRATION.</p>  | 18 months   |
| SR 3.3.1.12  | Perform CHANNEL CALIBRATION.   | 18 months   |
| SR 3.3.1.13  | Perform COT.   | 18 months   |
| SR 3.3.1.14  | <p align="center">-----NOTE-----<br/>                     Verification of setpoint is not required.<br/>                     -----</p> <p>Perform TADOT.</p>   | 18 months   |
| SR 3.3.1.15  | <p align="center">-----NOTE-----<br/>                     Verification of setpoint is not required.<br/>                     -----</p> <p>Perform TADOT.</p>   | Prior to exceeding the P-8 interlock whenever the unit has been in MODE 3, if not performed within the previous 31 days |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE   | FREQUENCY                                 |
|--|---|
| SR 3.3.1.16 -----NOTE-----<br>Neutron detectors are excluded from<br>response time testing.<br>-----<br>Verify RTS RESPONSE TIME is within limits. | 18 months on a<br>STAGGERED TEST<br>BASIS |

Table 3.3.1-1 (page 1 of 5)  
Reactor Trip System Instrumentation

| FUNCTION                           | APPLICABLE MODES<br>OR OTHER<br>SPECIFIED<br>CONDITIONS | REQUIRED<br>CHANNELS | CONDITIONS | SURVEILLANCE<br>REQUIREMENTS   | ALLOWABLE VALUE                                |
|------------------------------------|---|----------------------|------------|--|--|
| 1. Manual Reactor Trip             | 1, 2  | 2                    | B          | SR 3.3.1.14  | NA   |
|                                    | 3 <sup>(a)</sup> , 4 <sup>(a)</sup> , 5 <sup>(a)</sup>  | 2                    | C          | SR 3.3.1.14  | NA   |
| 2. Power Range Neutron Flux        |   |                      |            |  |  |
| a. High                            | 1, 2  | 4                    | D          | SR 3.3.1.1<br>SR 3.3.1.2<br>SR 3.3.1.3<br>SR 3.3.1.7<br>SR 3.3.1.11<br>SR 3.3.1.16 | ≤ 110% RTP                                     |
| b. Low                             | 1 <sup>(b)</sup> , 2                                    | 4                    | E          | SR 3.3.1.1<br>SR 3.3.1.8<br>SR 3.3.1.11<br>SR 3.3.1.16                             | ≤ 26% RTP                                      |
| 3. Power Range Neutron Flux Rate   |   |                      |            |  |  |
| a. High Positive Rate              | 1, 2  | 4                    | E          | SR 3.3.1.7<br>SR 3.3.1.11  | ≤ 5.5% RTP<br>with time<br>constant<br>≥ 2 sec |
| b. High Negative Rate              | 1, 2  | 4                    | E          | SR 3.3.1.7<br>SR 3.3.1.11<br>SR 3.3.1.16   | ≤ 5.5% RTP<br>with time<br>constant<br>≥ 2 sec |
| 4. Intermediate Range Neutron Flux | 1 <sup>(b)</sup> , 2 <sup>(c)</sup>                     | 2                    | F, G       | SR 3.3.1.1<br>SR 3.3.1.8<br>SR 3.3.1.11  | ≤ 40% RTP                                      |
| 5. Source Range Neutron Flux       | 2 <sup>(d)</sup>  | 2                    | H, I       | SR 3.3.1.1<br>SR 3.3.1.8<br>SR 3.3.1.11<br>SR 3.3.1.16                             | ≤ 1.3 E5 cps                                   |
|                                    | 3 <sup>(a)</sup> , 4 <sup>(a)</sup> , 5 <sup>(a)</sup>  | 2                    | I, J       | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.11<br>SR 3.3.1.16                             | ≤ 1.3 E5 cps                                   |
|                                    | 3 <sup>(e)</sup> , 4 <sup>(e)</sup> , 5 <sup>(e)</sup>  | 1                    | K          | SR 3.3.1.1<br>SR 3.3.1.11  | NA   |

(a) With Rod Control System capable of rod withdrawal or one or more rods not fully inserted.

(b) Below the P-10 (Power Range Neutron Flux) interlocks.

(c) Above the P-6 (Intermediate Range Neutron Flux) interlocks.

(d) Below the P-6 (Intermediate Range Neutron Flux) interlocks.

(e) With the Rod Control System incapable of rod withdrawal. In this condition, source range Function does not provide reactor trip but does provide indication.

Table 3.3.1-1 (page 2 of 5)  
Reactor Trip System Instrumentation

| FUNCTION   | APPLICABLE MODES<br>OR OTHER<br>SPECIFIED<br>CONDITIONS | REQUIRED<br>CHANNELS | CONDITIONS | SURVEILLANCE<br>REQUIREMENTS   | ALLOWABLE VALUE                       |
|--|---|----------------------|------------|--|---------------------------------------|
| 6. Overtemperature $\Delta T$                      | 1, 2  | 3                    | E          | SR 3.3.1.1<br>SR 3.3.1.3<br>SR 3.3.1.7<br>SR 3.3.1.9<br>SR 3.3.1.12<br>SR 3.3.1.16 | Refer to<br>Note 1 (Page<br>3.3.1-16) |
| 7. Overpower $\Delta T$                            | 1, 2  | 3                    | E          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.12  | Refer to<br>Note 2 (Page<br>3.3.1-17) |
| 8. Pressurizer Pressure                            |   |                      |            |  |                                       |
| a. Low   | 1 <sup>(f)</sup>  | 3                    | L          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10<br>SR 3.3.1.16                             | $\geq 1860$ psig                      |
| b. High  | 1, 2  | 3                    | E          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10<br>SR 3.3.1.16                             | $\leq 2370$ psig                      |
| 9. Pressurizer Water Level-High                    | 1 <sup>(f)</sup>  | 3                    | L          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10<br>SR 3.3.1.16                             | $\leq 93\%$                           |
| 10. Reactor Coolant Flow-Low                       | 1 <sup>(f)</sup>  | 3 per<br>loop        | L          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10<br>SR 3.3.1.16                             | $\geq 89\%$                           |
| 11. Reactor Coolant Pump (RCP)<br>Breaker Position | 1 <sup>(f)</sup>  | 1 per<br>RCP         | M          | SR 3.3.1.14  | NA                                    |
| 12. Undervoltage RCPs                              | 1 <sup>(f)</sup>  | 1 per<br>bus         | L          | SR 3.3.1.6<br>SR 3.3.1.10<br>SR 3.3.1.16   | $\geq 2870$ V                         |
| 13. Underfrequency RCPs                            | 1 <sup>(f)</sup>  | 1 per<br>bus         | L          | SR 3.3.1.6 <sup>(g)</sup><br>SR 3.3.1.10<br>SR 3.3.1.16                            | $\geq 56$ Hz                          |
| 14. Steam Generator (SG) Water<br>Level-Low Low    | 1, 2  | 3 per SG             | E          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10<br>SR 3.3.1.16                             | $\geq 17\%$                           |

(f) Above the P-7 (Low Power Reactor Trips Block) interlock.

(g) Required to be performed for Unit 2 only.

Table 3.3.1-1 (page 3 of 5)  
Reactor Trip System Instrumentation

| FUNCTION  | APPLICABLE MODES<br>OR OTHER<br>SPECIFIED<br>CONDITIONS | REQUIRED<br>CHANNELS | CONDITIONS | SURVEILLANCE<br>REQUIREMENTS            | ALLOWABLE VALUE                      |
|---|---|----------------------|------------|---|--------------------------------------|
| 15. SG Water Level—Low  | 1, 2  | 2 per SG             | E          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10 | ≥ 24%                                |
| Coincident with Steam<br>Flow/Feedwater Flow Mismatch   | 1, 2  | 2 per SG             | E          | SR 3.3.1.1<br>SR 3.3.1.7<br>SR 3.3.1.10 | ≤ 42.5% full<br>steam flow at<br>RTP |
| 16. Turbine Trip  |   |                      |            |   |                                      |
| a. Low Auto Stop Oil Pressure   | 1 <sup>(h)</sup>  | 3                    | N          | SR 3.3.1.10<br>SR 3.3.1.15              | ≥ 40 psig                            |
| b. Turbine Stop Valve Closure   | 1 <sup>(h)</sup>  | 4                    | N          | SR 3.3.1.10<br>SR 3.3.1.15              | ≥ 0% open                            |
| 17. Safety Injection (SI) Input<br>from Engineered Safety Feature<br>Actuation System (ESFAS) | 1, 2  | 2 trains             | O          | SR 3.3.1.14                             | NA                                   |
| 18. Reactor Trip System Interlocks  |   |                      |            |   |                                      |
| a. Intermediate Range Neutron<br>Flux, P-6  | 2 <sup>(d)</sup>  | 2                    | Q          | SR 3.3.1.11<br>SR 3.3.1.13              | ≥ 3E-11 amp                          |
| b. Low Power Reactor Trips<br>Block, P-7  | 1   | 1 per<br>train       | R          | SR 3.3.1.5                              | NA                                   |
| c. Power Range Neutron Flux,<br>P-8   | 1   | 4                    | R          | SR 3.3.1.11<br>SR 3.3.1.13              | ≤ 31% RTP                            |
| d. Power Range Neutron Flux,<br>P-10  | 1, 2  | 4                    | Q          | SR 3.3.1.11<br>SR 3.3.1.13              | ≥ 7% RTP<br>≤ 11% RTP                |
| e. Turbine Impulse Pressure,<br>P-13  | 1   | 2                    | R          | SR 3.3.1.10<br>SR 3.3.1.13              | ≤ 11% turbine<br>power               |
| 19. Reactor Trip Breakers <sup>(i)</sup>  | 1, 2  | 2 trains             | P          | SR 3.3.1.4                              | NA                                   |
|   | 3 <sup>(a)</sup> , 4 <sup>(a)</sup> , 5 <sup>(a)</sup>  | 2 trains             | C          | SR 3.3.1.4                              | NA                                   |
| 20. Reactor Trip Breaker<br>Undervoltage and Shunt Trip<br>Mechanisms                         | 1, 2  | 1 each<br>per RTB    | S          | SR 3.3.1.4                              | NA                                   |
|   | 3 <sup>(a)</sup> , 4 <sup>(a)</sup> , 5 <sup>(a)</sup>  | 1 each<br>per RTB    | C          | SR 3.3.1.4                              | NA                                   |
| 21. Automatic Trip Logic  | 1, 2  | 2 trains             | O          | SR 3.3.1.5                              | NA                                   |
|   | 3 <sup>(a)</sup> , 4 <sup>(a)</sup> , 5 <sup>(a)</sup>  | 2 trains             | C          | SR 3.3.1.5                              | NA                                   |

(a) With Rod Control System capable of rod withdrawal or one or more rods not fully inserted.

(d) Below the P-6 (Intermediate Range Neutron Flux) interlocks.

(h) Above the P-8 (Power Range Neutron Flux) interlock.

(i) Including any reactor trip bypass breakers that are racked in and closed for bypassing an RTB.

Table 3.3.1-1 (page 4 of 5)  
Reactor Trip System Instrumentation

Note 1: Overtemperature  $\Delta T$

The Overtemperature  $\Delta T$  Function Allowable Value shall not exceed the following nominal trip setpoint by more than 2.0% of  $\Delta T$  span.

$$\Delta T \leq \Delta T_0 \left\{ K_1 - K_2 \frac{(1 + \tau_1 s)}{(1 + \tau_2 s)} [T - T'] + K_3 (P - P') - f_1(\Delta I) \right\}$$

Where:  $\Delta T$  is measured RCS  $\Delta T$ , °F.  
 $\Delta T_0$  is the indicated  $\Delta T$  at RTP, °F.  
 $s$  is the Laplace transform operator, sec<sup>-1</sup>.  
 $T$  is the measured RCS average temperature, °F.  
 $T'$  is the nominal  $T_{avg}$  at RTP,  $\leq$  [\*]°F.

$P$  is the measured pressurizer pressure, psig  
 $P'$  is the nominal RCS operating pressure,  $\geq$  [\*] psig

$K_1 \leq$  [\*]                       $K_2 \geq$  [\*]/°F                       $K_3 \geq$  [\*]/psig

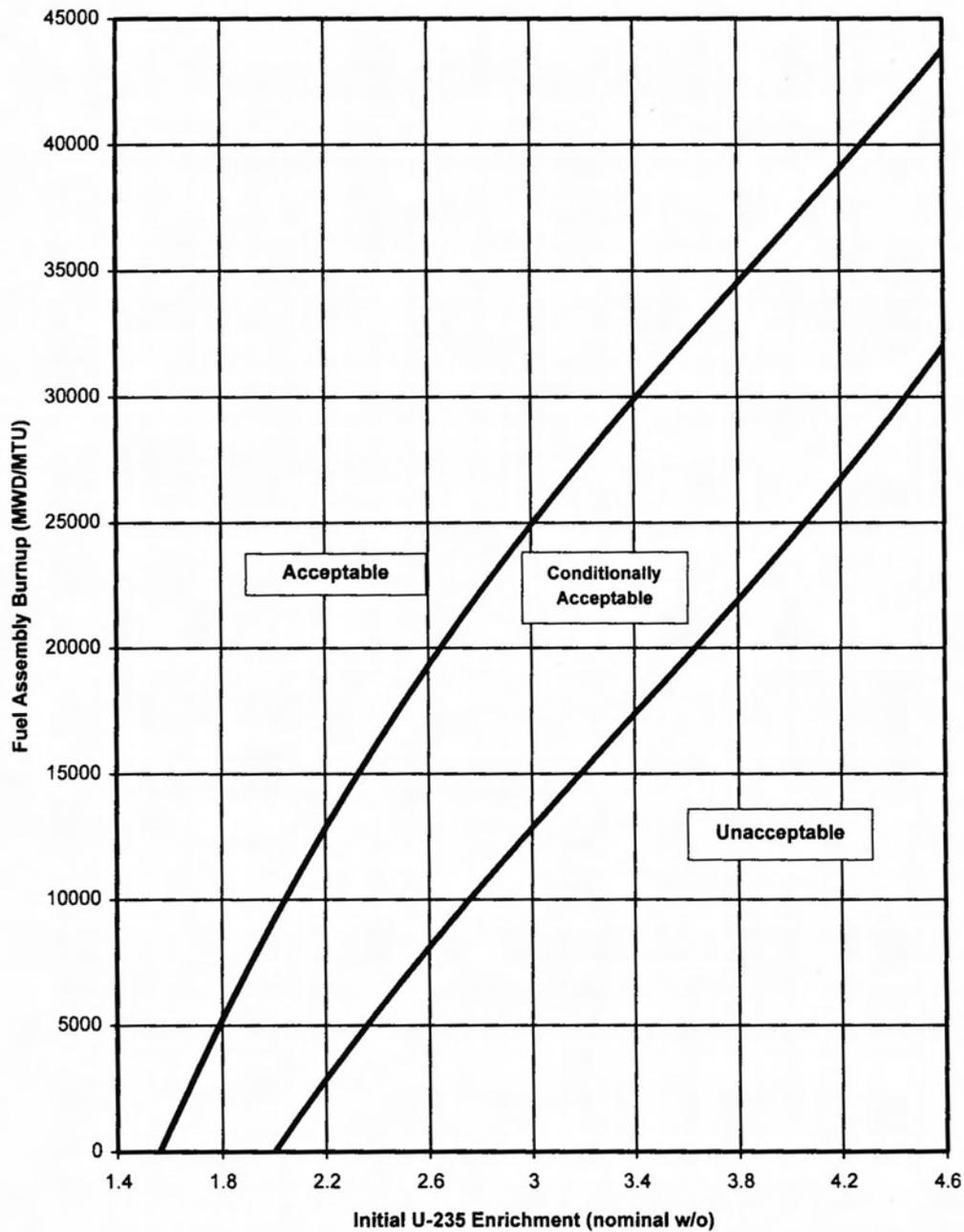
$\tau_1 \geq$  [\*] sec                       $\tau_2 \leq$  [\*] sec

|   |  |  |
|---|--|--|
| $f_1(\Delta I) =$ [*] { [*] - ( $q_t - q_b$ ) } | when $q_t - q_b <$ [*] % RTP                     |  |
| 0   | when [*] % RTP $\leq$ $q_t - q_b \leq$ [*] % RTP |  |
| [*] { ( $q_t - q_b$ ) - [*] }                   | when $q_t - q_b >$ [*] % RTP                     |  |

Where  $q_t$  and  $q_b$  are percent RTP in the upper and lower halves of the core, respectively, and  $q_t + q_b$  is the total THERMAL POWER in percent RTP.

The values denoted with [\*] are specified in the COLR.





**Acceptable:** Acceptable for storage in non-matrix location or low reactivity location in matrix configuration. May also be placed in high reactivity locations in matrix configuration.

**Conditionally Acceptable:** Acceptable for storage in non-matrix location, but must be placed in high reactivity location if stored in matrix configuration.

**Unacceptable:** Must be stored in high reactivity location in matrix configuration. Surry spent fuel must be stored in high reactivity locations in a matrix.

Figure 3.7.18-1 (page 1 of 1)  
Burnup Credit Requirements

3.8 ELECTRICAL POWER SYSTEMS

3.8.7 Inverters-Operating

LCO 3.8.7 The Train H and Train J inverters shall be OPERABLE.

----- NOTE -----

One inverter may be disconnected from its associated DC bus for ≤ 24 hours to perform an equalizing charge on its associated battery, provided:

- a. The associated AC vital bus is energized from its constant voltage source transformer; and
- b. All other AC vital buses are energized from their associated OPERABLE inverters.

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

ACTIONS

| CONDITION  | REQUIRED ACTION   | COMPLETION TIME |
|--|---|-----------------|
| A. One inverter inoperable.                                | A.1 -----NOTE-----<br>Enter applicable Conditions and Required Actions of LCO 3.8.9, "Distribution Systems-Operating" with any vital bus de-energized.<br>-----<br>Restore inverter to OPERABLE status. | 7 days          |
| B. Required Action and associated Completion Time not met. | B.1 Be in MODE 3.   | 6 hours         |
|  | <u>AND</u><br>B.2 Be in MODE 5.   | 36 hours        |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE   | FREQUENCY |
|--|-----------|
| SR 3.8.7.1 Verify correct inverter voltage and alignment to required AC vital buses. | 7 days    |

3.8 ELECTRICAL POWER SYSTEMS

3.8.9 Distribution Systems—Operating

LCO 3.8.9 The following distribution subsystems shall be OPERABLE:

- a. The Train H and Train J AC, DC, and AC vital buses; and
- b. One AC and DC bus on the other unit for each required shared component.

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

ACTIONS

| CONDITION   | REQUIRED ACTION   | COMPLETION TIME  |
|---|---|--|
| <p>A. One or more LCO 3.8.9.a AC electrical power distribution subsystem(s) inoperable.</p> | <p>A.1 -----NOTE-----<br/>Enter applicable Conditions and Required Actions of LCO 3.8.4, "DC Sources—Operating," for DC train(s) made inoperable by inoperable distribution subsystem(s).<br/>-----<br/>Restore AC electrical power distribution subsystem(s) to OPERABLE status.</p> | <p>8 hours<br/><u>AND</u><br/>16 hours from discovery of failure to meet LCO</p> |

Distribution Systems—Operating  
3.8.9

ACTIONS

| CONDITION   | REQUIRED ACTION  | COMPLETION TIME  |
|---|--|--|
| <p>B. One or more LCO 3.8.9.a AC vital bus(es) inoperable.</p>  | <p>B.1 Restore AC vital bus subsystem(s) to OPERABLE status.</p>                     | <p>2 hours<br/><u>AND</u><br/>16 hours from discovery of failure to meet LCO</p> |
| <p>C. One or more LCO 3.8.9.a DC electrical power distribution subsystem(s) inoperable.</p>   | <p>C.1 Restore DC electrical power distribution subsystem(s) to OPERABLE status.</p> | <p>2 hours<br/><u>AND</u><br/>16 hours from discovery of failure to meet LCO</p> |
| <p>D. -----NOTE-----<br/>Separate Condition entry is allowed for each AC subsystem.<br/>-----<br/><br/>One or more required LCO 3.8.9.b AC electrical power distribution subsystem(s) inoperable.</p> | <p>D.1 Declare associated shared component(s) inoperable.</p>                        | <p>Immediately</p>   |
| <p>E. -----NOTE-----<br/>Separate Condition entry is allowed for each DC subsystem.<br/>-----<br/><br/>One or more required LCO 3.8.9.b DC electrical power distribution subsystem(s) inoperable.</p> | <p>E.1 Declare associated shared component(s) inoperable.</p>                        | <p>Immediately</p>   |

ACTIONS

| CONDITION  | REQUIRED ACTION                 | COMPLETION TIME |
|--|---------------------------------|-----------------|
| F. Required Action and associated Completion Time for Condition A, B, or C not met.                                      | F.1 Be in MODE 3.<br><u>AND</u> | 6 hours         |
|  | F.2 Be in MODE 5.               | 36 hours        |
| G. Two or more LCO 3.8.9.a electrical power distribution subsystems inoperable that result in a loss of safety function. | G.1 Enter LCO 3.0.3.            | Immediately     |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE  | FREQUENCY |
|---|-----------|
| SR 3.8.9.1 Verify correct breaker alignments and voltage to required AC, DC, and AC vital bus electrical power distribution subsystems. | 7 days    |