

TABLE 7.2-1

LIST OF REACTOR TRIPS, ENGINEERED SAFETY FEATURES, CONTAINMENT
AND STEAM LINE ISOLATION AND AUXILIARY FEEDWATER

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|---------------------------------------|--|---|
| 1. Manual | 1/2, no interlocks | |
| 2. High neutron flux (Power Range) | 2/4, low setpoint interlocked with P-10 | High and low settings; manual block and automatic reset of low setting by P-10, Table 7.2-2 |
| 3. Overtemperature ΔT | 2/4, no interlocks | |
| 4. Overpower ΔT | 2/4, no interlocks | |
| 5. Low pressurizer pressure | 2/4, interlocked with P-7 | |
| 6. High pressurizer pressure | 2/4, no interlocks | |
| 7. High pressurizer water level | 2/3, interlocked with P-7 | |
| 8. Low reactor coolant flow | 2/3 signals per loop, interlocked with P-7, and P-8 | Blocked below P-7. Low flow in 1 loop permitted below P-8. |

TABLE 7.2-1 (Cont)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|--|---|---|
| 9. Monitored electrical supply to reactor coolant pumps; | | |
| 9A. Undervoltage | 1/2 taken twice, interlocked with P-7 | |
| 9B. Underfrequency | 1/2 taken twice, interlocked with P-7 | 1/2 twice underfrequency signals trip all reactor coolant pumps and directly actuate reactor trip; interlocked with P-7. (Opening of the coolant pump breakers will also actuate a reactor trip.) |
| 9C. Reactor coolant pump breakers | Interlocked with P-7 | Blocked below P-7. Open breaker in 1 loop permitted above P-7. |
| 10. Safety injection signal (actuation) | Low pressurizer pressure (2/3) or 2/3 high containment pressure; or 2/3 differential steam line pressure signals of one line compared with the other three lines; or 2/4 high steam flow in coincidence with 2/4 low-low T _{avg} or 2/4 low steam line pressure; or manual 1/2 (See 7.2 System | Trips main feedwater pumps. Closes all feedwater control valves. Closes feedwater pump discharge valves and initiates Phase A isolation. Initiates turbine trip. |

TABLE 7.2-1 (Cont)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|--|---|--|
| | Description-Protective Action For Interlocks). | |
| 11. Turbine-generator trip | 2/3 low auto stop oil pressure (interlocked with P-9) or all stop valves closed | (Anticipatory trip of the reactor. No credit taken in accident analysis.) |
| 12. Low-low steam generator water level | 2/3, per loop | |
| 13. Intermediate range neutron flux | 1/2, manual block permitted by P-10 | Manual block and automatic reset |
| 14. Source range neutron flux | 1/2, manual block permitted by P-6, interlocked with P-10 | Manual block and automatic reset |
| 15. High flux rate trips (Note 2) | 2/4, no interlocks | Positive and negative high flux rate trips provided |

TABLE 7.2-1 (Cont.)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|--|--|---|
| 16. Containment pressure (Note 1) | Coincidence of 2/3 containment high pressure or 1/2 manual | Actuates all non-essential process lines containment isolation trip valves- ation Phase A |
| | Coincidence of 2/4 containment Hi-Hi pressure or 2/2 manual | Actuates all remaining trip valves (except those required for operation of engineered safeguard systems) |
| 17. High containment activity | High activity signal, from either air particulate detector or radiogas detector, or 1/2 manual | Closes containment purge supply, exhaust ducts and all others necessary to isolate containment atmosphere |
| <u>Engineered Safeguards Systems Actuation</u> | | |
| 18. Safety injection signal (S) | See Item 10 | |
| 19. Containment spray signal (P) | See second part of item 16 | |
| 20. NaOH addition | Containment Spray Actuation Signal | |

TABLE 7.2-1 (Cont.)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|--------------------------------------|--|---|
| Steam Lines Isolation Actuation | | |
| 21. Steam flow | High steam line flow in 2 out of 4 lines coincident with either low-low T _{avg} in 2 out of 4 loops or low steam pressure in 2 out of 4 lines | |
| Containment pressure (Note 1) | 2/4 Hi-Hi containment pressure | |
| 22. Manual (per steam line) | 1/1 per steam line | |
| <u>Auxiliary Feedwater Actuation</u> | | |
| 23. Turbine driven pump | Coincidence of 2/3 low-low level in any two steam generators; undervoltage 1/2 twice on RCP busses; or manual (local and remote) | 2/3 high level in steam generator trips main feedwater pumps |

TABLE 7.2-1 (Cont.)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|-----------------------|--|---|
| 24. Motor drive pumps | 2/3 low level in any steam generator: or trip of both main feedwater pumps, or safeguards sequence signal, or blackout sequence signal, or manual (local and remote) | Safeguards automatic loading signal blocks manual start |

Main Feedwater Isolation

| | | |
|--|---|--|
| 25. Close main feedwater control valves (fast closure) and feedwater bypass valves and feedwater inlet stop valves | Actuated by: 1. Safety injection (See No. 10) 2. 2/3 Hi-Hi level in steam generator 3. Low actioneered T _{avg} and reactor trip | |
|--|---|--|

NOTE 1: Definition of "S", "T", and "P" signals:

| <u>Signal</u> | <u>Initiated by:</u> | <u>Action</u> |
|---------------|-------------------------|--|
| "S" | Safety injection signal | Actuates safety injection |
| "T" | Safety injection signal | Actuates containment isolation Phase A (All non-essential process lines) |

TABLE 7.2-1 (Cont)

| <u>Reactor Trip</u> | <u>Coincidence Circuitry and Interlocks</u> | <u>Comments</u> |
|---------------------|---|--|
| "p" | 2/4 Hi-Hi Containment Pressure | Activates containment spray, steam lines isolation and Phase B containment isolation (remaining process lines) |

NOTE 2: Salem NRC License Amendment 278-261 (Salem 1 and 2 respectively) approved the removal of the Negative Flux Rate Trip. This function was initially disabled by setting the setpoint to a greater value than the Maximum Negative Rate expected (per design change package (DCP) 80094424). The Negative Flux Rate Trip circuitry has been physically removed for Unit 1 and 2 per DCPs 80097106 and 80099680).

TABLE 7.2-2

INTERLOCK CIRCUITS

| <u>Designation</u> | <u>Derivation</u> | <u>Function</u> |
|--------------------|---|--|
| P-4 | Reactor trip | <p>Actuates turbine trip</p> <p>Close main feedwater valves on Tavg below setpoint</p> <p>Prevents opening of main feedwater valves which were closed by safety injection or high steam generator water level</p> <p>Prevents or defeats the automatic block of steam dump control via load rejection controller (enables plant trip controller)</p> |
| P-6 | 1/2 Neutron flux (intermediate range) above setpoint | Allows manual block of source range reactor trip |
| | 2/2 Neutron flux (intermediate range) below setpoint | Defeats the block of source range reactor trip |
| P-7 | 3/4 Neutron flux (power range) below setpoint (from P-10) and 2/2 turbine steamline inlet pressure below setpoint (from P-13) | Blocks reactor trip on: Low flow or reactor coolant pump breakers open in more than one loop, undervoltage, underfrequency, pressurizer low pressure, and pressurizer high level |
| P-8 | 3/4 Neutron flux (power range) below setpoint | Blocks reactor trip on low flow in a single loop |
| P-9 | 2/4 Neutron flux (power range) above setpoint | Prevents or defeats the automatic block of reactor trip on turbine trip 50% of rated thermal power |
| P-10 | 2/4 Neutron flux (power range) above setpoint | Allows manual block of power range (low setpoint) reactor trip |

TABLE 7.2-2 (Cont)

| <u>Designation</u> | <u>Derivation</u> | <u>Function</u> |
|--------------------|-------------------|---|
| | | Allows manual block of intermediate range reactor trip and intermediate range rod stops (C-1) |
| | | Blocks source range reactor trip (backup for P-6) |

TABLE 7.2-2 (Cont.)

| <u>Designation</u> | <u>Derivation</u> | <u>Function</u> |
|--------------------|---|--|
| P-10 cont. | 3/4 Neutron flux (power range) below setpoint | Defeats the block of power range (low setpoint) reactor trip Defeats the block of intermediate range reactor trip and intermediate range rod stops (C-1) Input to P-7 |
| P-11 | 2/3 Pressurizer pressure below setpoint | Allows manual block of safety injection actuation on low pressurizer pressure signal coincident with low pressurizer level signal |
| | 2/3 Pressurizer pressure above setpoint | Defeats manual block of safety injection actuation |
| P-12 | 2/4 T_{avg} below setpoint | Actuates safety injection and steamline isolation on high steamline flow. Allows manual block of safety injection actuation on high steam line flow Blocks steam dump to all valves Allows manual bypass of steam dump block for the cooldown valves only |
| | 3/4 T_{avg} above setpoint | Defeats the manual block of safety injection actuation on high steam line flow Defeats the manual bypass of steam dump block |
| P-13 | 2/2 Turbine steamline inlet pressure below setpoint | Input to P-7 |
| P-14 | 2/3 Hi-Hi steam generator level above setpoint on any steam generator | Trips all feedwater pumps, isolates feedwater, and trips turbine |

TABLE 7.2-2 (Cont)

| <u>Designation</u> | <u>Derivation</u> | <u>Function</u> |
|--------------------|---|---|
| C-1 | 1/2 Neutron flux (intermediate range) above setpoint | Blocks automatic and manual control rod withdrawal |
| C-2 | 1/4 Neutron flux (power range) above setpoint | Blocks automatic and manual control rod withdrawal |
| C-3 | 2/4 Over- temperature ΔT above setpoint | Blocks automatic and manual control rod withdrawal Actuates turbine runback via load reference |
| C-4 | 2/4 Overpower ΔT above setpoint | Blocks automatic and manual control rod withdrawal Starts turbine runback via load reference |
| C-5 | 1/1 Turbine steamline inlet pressure below setpoint | Blocks automatic control rod withdrawal |
| C-6 | 1/2 Turbine steamline inlet pressure below setpoint | Blocks turbine runback via load limit |
| C-7 | 1/1 Time derivative (absolute value) of turbine steamline inlet pressure (decrease only) above setpoint | Makes steam dump valves available for either tripping or modulation |

TABLE 7.2-2 (Cont.)

| <u>Designation</u> | <u>Derivation</u> | <u>Function</u> |
|--------------------|---|--|
| C-9 | Any Condenser pressure above setpoint or all circulation water pump breakers open | Blocks steam dump to condenser |
| C-20 | 2/2 turbine steamline inlet pressure above setpoint | Arms AMSAC; below setpoint, blocks AMSAC (no control grade only) |

TABLE 7.2-3

LEGEND OF ANALOG SYMBOLS

| | |
|------------------|--|
| Al | - Alarm |
| Buf | - Buffer |
| f | - Special Function (such as a pressure compensation unit or lead/lag compensation) |
| F | - Amplifier |
| FC | - Flow controller (off-on unless output signal is shown) |
| FI | - Flow Indicator |
| FLTR | - Filter |
| FS | - Flow Stream |
| FT | - Flow Transmitter |
| FW | - Flow Water |
| Hi LRT | - High Level Reactor Trip |
| HI PRT | - High Pressure Reactor Trip |
| I/I | - Isolation Current Repeater |
| ISOL | - Isolation (other than I/I) |
| LC | - Level Controller (off-on unless output signal is shown) |
| LI | - Level Indicator |
| L-Low | - Low Level |
| Lo L | - Low Level |
| Lo LRT | - Low Level Reactor Trip |
| Lo PRT | - Low Pressure Reactor Trip |
| L _{ref} | - Programmed Reference Level |
| L/L | - Lead/Lag |
| LT | - Level Transmitter |
| NC | - Nuclear Flux Controller (Bistable) |
| NE | - Nuclear Detector |
| NI | - Nuclear Flux Indicator |
| NM | - Nuclear Modifier |
| NQ | - Nuclear Power Supply |
| P | - Pressure |
| PC | - Pressure Controller (off-on unless output signal is shown) |

TABLE 7.2-3 (Cont)

| | |
|------------------|---|
| PI | - Pressure Indicator |
| PM | - Pressure Modifier |
| P _{ref} | - Programmed Reference Pressure |
| PS | - Power Supply |
| PT | - Pressure Transmitter |
| QM | - Flux Modifier |
| R/I | - Resistance to Current Connector |
| RT | - Reactor Trip |
| RTD | - Resistance Temperature Detector |
| S | - Control Channel Transfer Switch (used to maintain auto channel during test of the protection channel) |
| SI | - Safety Injection |
| sp | - Set Point |
| T | - Transmitter |
| TC | - Temperature Controller |
| TE | - Temperature Element |
| TI | - Temperature Indicator |
| TJ | - Test Signal Insertion Jack |
| TM | - Temperature Modifier |
| TP | - Test Point |
| ϕ_U, L | Out of core upper or lower ion chamber flux signals |
| $\frac{d}{dt}$ | - Time Rate Change |
| Σ | - Sum |

TABLE 7.2-4

SALEM UNIT 1

REACTOR TRIP SYSTEM INSTRUMENTATION RESPONSE TIMES

**THE INFORMATION CONTAINED IN THIS TABLE WAS RELOCATED
TO THE SALEM TECHNICAL REQUIREMENTS MANUAL**

TABLE 7.2-5

SALEM UNIT 2

REACTOR TRIP SYSTEM INSTRUMENTATION RESPONSE TIMES

**THE INFORMATION CONTAINED IN THIS TABLE WAS RELOCATED
TO THE SALEM TECHNICAL REQUIREMENTS MANUAL**