RTS-186

Attachment 2 to
NG-91-3838


PROPOSED CHANGE RTS-186 TO THE DUANE ARNOLD ENERGY CENTER TECHNICAL SPECIFICATIONS

The holders of license DPR-49 for the Duane Arnold Energy Center propose to amend Appendix A (Technical Specifications) to said license by deleting the current pages and replacing them with the attached, new pages. The List of the Affected Pages is given below.

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* These pages are being deleted as a result of the proposed change in format.

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# TECHNICAL SPECIFICATIONS
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TECHNICAL SPECIFICATIONS
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TABLE 1.0-1

OPERATING MODES

| OPERATING MODE | REACTOR MODE SWITCH POSITION | AVERAGE REACTOR COOLANT TEMPERATURE |
|---|---|---|
| 1. RUN/POWER OPERATION | Run | NA |
| 2. STARTUP | Startup/Hot Standby or Refuel[a] | NA |
| 3. HOT SHUTDOWN[a] | Shutdown[c][d] | > 212°F |
| 4. COLD SHUTDOWN[a] | Shutdown[c][d][e] | ≤ 212°F |
| 5. REFUELING[b] | Shutdown or Refuel[c][f] | NA |

(a) Fuel in the reactor vessel with the reactor vessel head closure bolts fully tensioned.

(b) Fuel in the reactor vessel with the vessel head closure bolts less than fully tensioned or with the head removed.

(c) The reactor mode switch may be placed in the Run, Startup/Hot Standby or Refuel position to test the switch interlock functions and related instrumentation provided that the control rods are verified to remain fully inserted by a second licensed operator.

(d) The reactor mode switch may be placed in the Refuel position while a single control rod is being recoupled or withdrawn provided that the one-rod-out interlock is OPERABLE.

(e) The reactor mode switch may be placed in the Refuel position while a single control rod drive is being removed from the reactor pressure vessel per Specification 3.9.A.5 or 3.9.A.6.

(f) The reactor mode switch may be placed in the Startup position for demonstration of shutdown margin per Specification 4.3.A.1.

| LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENT |
|---|---|
| 3.1 REACTOR PROTECTION SYSTEM INSTRUMENTATION | 4.1 REACTOR PROTECTION SYSTEM INSTRUMENTATION |
| A. As a minimum, the reactor protection system instrumentation channels shown in Table 3.1-1 shall be OPERABLE with the PROTECTIVE INSTRUMENTATION RESPONSE TIME as shown in Table 3.1-2. | A.1 Each reactor protection system instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATING MODES and at the frequencies shown in Table 4.1-1. |
| The designed system response times from the opening of the sensor contact up to and including the opening of the trip actuator contacts shall not exceed 50 milliseconds. | 2. Response time measurements (from actuation of sensor contacts or trip point to de-energization of scram solenoid relay) are not part of the normal instrument calibration. The reactor trip system response time of each reactor trip function shall be demonstrated to be within its limit once per operating cycle. Each test shall include at least one logic train such that both logic trains are tested at least once per 36 months and one channel per function such that all channels are tested at least once every N times 18 months where N is the total number of redundant channels in a specific reactor trip function. |
| Applicability: | |
| As shown in Table 3.1-1. | |
| Action: | |
| 1. With one required channel inoperable in one or more Trip Functions, place the inoperable channel(s) and/or that trip system in the tripped condition* within 12 hours. | |
| 2. With more than one required channel inoperable in one or more Trip Functions; | |
| a. Verify sufficient channels remain OPERABLE or tripped to maintain trip capability in each Trip Function within one hour, and | |
| b. Place one trip system or the inoperable channel(s) in one trip system** in the tripped condition within 6 hours, and | |
| c. Restore the inoperable channels in the other trip system to OPERABLE status or tripped within 12 hours. | |
| Otherwise, take the ACTION required by Table 3.1-1. | |

* An inoperable channel or trip system need not be placed in the tripped condition where this would cause the Trip Function to occur. In these cases, if the inoperable channel is not restored to OPERABLE status within 12 hours, the ACTION required by Table 3.1-1 for that Trip Function shall be taken.

** The inoperable channel(s) or trip system need not be placed in the tripped condition if this would cause the Trip Function to occur. When a trip system can be placed in the tripped condition without causing the Trip Function to occur, place the trip system with the most inoperable channels in the tripped condition; if both systems have the same number of inoperable channels, place either trip system in the tripped condition.

| LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENT |
|---|---|
| B. Two RPS electric power monitoring modules (or Electric Protective Assemblies - EPA's) for each in-service RPS MG set or alternate source shall be OPERABLE or | B. The RPS power monitoring system (EPA's) instrumentation shall be determined OPERABLE: |
| 1. With one RPS electric power monitoring module (or EPA) for an in-service RPS MG set or alternate power supply inoperable, restore the inoperable module (EPA) to OPERABLE status within 72 hours or remove the associated RPS MG set or alternate power supply from service. | 1. Once per six months by performing a CHANNEL FUNCTIONAL TEST; and<br>2. Annually by demonstrating the OPERABILITY of over-voltage, under-voltage and under-frequency protective instrumentation by performance of a CHANNEL CALIBRATION including simulated automatic actuation of the protection relays, tripping logic and output circuit breakers and verifying the following limits: |
| 2. With both RPS electric power monitoring modules (EPA's) for an in-service MG set or alternate power supply inoperable, restore at least one to OPERABLE status within 30 minutes or remove the associated RPS MG set or alternate power supply from service. | a. Over voltage ≤ 132 VAC, with a time delay of $115^{+15}_{-15}$ millisecond<br>b. Under voltage ≥ 108 VAC, with a time delay of $115^{+15}_{-15}$ millisecond<br>c. Under frequency ≥ 57 Hz, with a time delay of $115^{+15}_{-15}$ millisecond |

TABLE 3.1-1

REACTOR PROTECTION SYSTEM INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | APPLICABLE OPERATING MODES | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM (a) | ACTION |
|---|---|---|---|---|
| 1. Intermediate Range Monitors (b): | | | | |
| a. Neutron Flux - High | ≤ 120/125 of Full Scale | 2<br>3,4<br>5 | 2<br>2<br>2 | 1<br>2<br>3 |
| b. Inoperative | NA | 2<br>3,4<br>5 | 2<br>2<br>2 | 1<br>2<br>3 |
| 2. Average Power Range Monitor (c): | | | | |
| a. Neutron Flux - Upscale, in STARTUP | ≤ 15% Power | 2<br>3,4<br>5 | 2<br>2<br>2 | 1<br>2<br>3 |
| b. Neutron Flux - Upscale | For Two Loop Operation:<br>≤ (.58W + 62%)*<br>For Single Loop Operation<br>≤ (.58W + 58.5%)* | 1 | 2 | 4 |
| c. Inoperative | NA | 1,2<br>3,4<br>5 | 2<br>2<br>2 | 1<br>2<br>3 |
| 3. Reactor Vessel Steam Dome Pressure - High | ≤ 1055 psig | 1,2(d) | 2 | 1 |
| 4. Reactor Water Level - Low | ≥ 170 Inches | 1,2 | 2 | 1 |
| 5. Main Steam Line Isolation Valve - Closure | ≤ 10% Valve Closure | 1(e) | 4 | 4 |
| 6. Main Steam Line Radiation - High | ≤ 3 x Normal Rated Power Background (j) | 1,2(d) | 2 | 5 |

TABLE 3.1-1 (continued)

REACTOR PROTECTION SYSTEM INSTRUMENTATION

| TRIP FUNCTION | | TRIP LEVEL SETTING | APPLICABLE OPERATING MODES | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM (a) | ACTION |
|---|---|---|---|---|---|
| 7. | Drywell Pressure - High | ≤ 2.0 psig | 1,2(f) | 2 | 1 |
| 8. | Scram Discharge Volume Water Level - High | ≤ 60 Gallons | 1,2<br>5(g) | 2<br>2 | 1<br>3 |
| 9. | Turbine Stop Valve - Closure | ≤ 10% Valve Closure | 1(h) | 4(i) | 6 |
| 10. | Turbine Control Valve Fast Closure, Valve Trip System Oil Pressure - Low | Within 30 milliseconds of the Start of Control Valve Fast Closure | 1(h) | 2(i) | 6 |
| 11. | Turbine First Stage Pressure Permissive | ≤ 165 psig | 1 | 2 | 6 |
| 12. | Reactor Mode Switch Shutdown Position | NA | 1,2<br>3,4<br>5 | 1<br>1<br>1 | 1<br>7<br>3 |
| 13. | Manual Scram | NA | 1,2<br>3,4<br>5 | 1<br>1<br>1 | 1<br>8<br>9 |

TABLE 3.1-1 (Continued)

REACTOR PROTECTION SYSTEM INSTRUMENTATION

ACTION

| | | |
|---|---|---|
| ACTION 1 | - | Be in at least HOT SHUTDOWN within 12 hours. |
| ACTION 2 | - | Verify all insertable control rods to be inserted in the core and lock the reactor mode switch in the Shutdown position within one hour. |
| ACTION 3 | - | Suspend all operations involving CORE ALTERATIONS* and insert all insertable control rods within one hour. |
| ACTION 4 | - | Be in at least STARTUP within 6 hours. |
| ACTION 5 | - | Be in STARTUP with the main steam line isolation valves closed within 6 hours or in at least HOT SHUTDOWN within 12 hours. |
| ACTION 6 | - | Initiate a reduction in THERMAL POWER within 15 minutes and reduce turbine first stage pressure to $\leq$ 165 psig, equivalent to THERMAL POWER less than 30% of RATED THERMAL POWER, within 2 hours. |
| ACTION 7 | - | Verify all insertable controls rods to be inserted within one hour. |
| ACTION 8 | - | Lock the reactor mode switch in the Shutdown position within one hour. |
| ACTION 9 | - | Suspend all operations involving CORE ALTERATIONS*, and insert all insertable control rods and lock the reactor mode switch in the SHUTDOWN position within one hour. |

*Except movement of IRM, SRM, or special movable detectors, or replacement of LPRM strings provided SRM instrumentation is OPERABLE per Spec. 3.9.B.

TABLE 3.1-1 (Continued)

REACTOR PROTECTION SYSTEM INSTRUMENTATION ACTION

TABLE NOTATIONS

* See Section 2.1.A.1

(a) A channel may be placed in an inoperable status for up to six hours for required surveillance without placing the trip system in the tripped condition provided at least one OPERABLE channel in the same trip system is monitoring that parameter.

(b) This function shall be automatically bypassed when the reactor mode switch is in the Run position.

(c) An APRM channel is inoperable if there are less than 2 LPRM inputs per level or less than the required** LPRM inputs to an APRM channel.

(d) This function is not required to be OPERABLE when the reactor pressure vessel head is unbolted or removed.

(e) This function shall be automatically bypassed when the reactor mode switch is not in the Run position.

(f) This function is not required to be OPERABLE when PRIMARY CONTAINMENT INTEGRITY is not required.

(g) With any control rod withdrawn. Not required for control rods removed or withdrawn per Specification 3.9.A.5 or 3.9.A.6.

(h) This function shall be automatically bypassed when turbine first stage pressure is $\leq$ 165 psig, equivalent to THERMAL POWER less than 30% of RATED THERMAL POWER. The value of first stage pressure assumes that the second stage reheaters are not in service below 30% of rated core power.

(i) Also actuates the EOC-RPT system.

(j) Within 24 hours prior to the planned start of the hydrogen injection test with the reactor power at greater than 20% rated power, the normal full-power radiation background level and associated trip and alarm setpoints may be changed based on a calculated value of the radiation level expected during the test. The background radiation level and associated trip and alarm setpoints may be adjusted during the test program based on either calculations or measurements of actual radiation levels resulting from hydrogen injection. The background radiation level shall be determined and associated trip setpoints shall be set within 24 hours of reestablishing normal radiation levels after completion of the hydrogen injection or within 12 hours of establishing reactor power levels below 20% rated power, while these functions are required to be operable.

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**APRMs A, B, C, and D require 9 or more inputs. APRM's E and F require 13 or more inputs.

TABLE 3.1-2

PROTECTIVE INSTRUMENTATION RESPONSE TIMES

| Functional Unit | Sensor Response Time | Reactor Trip System Response Time |
|---|---|---|
| 1. Reactor Vessel Steam Dome Pressure - High | $\leq$ .5 seconds | $\leq$ .55 seconds |
| 2. Reactor Water Level - Low | $\leq$ 1.0 seconds | $\leq$ 1.05 seconds |

TABLE 4.1-1

REACTOR PROTECTION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| FUNCTIONAL UNIT | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION (a) | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| 1. Intermediate Range Monitors: | | | | |
| a. Neutron Flux - High | S/U(b), Once/Shift | S/U(c),W(l) | Controlled Shutdown | 2 |
| | Once/Shift | W(l) | Controlled Shutdown | 3,4,5 |
| b. Inoperative | NA | S/U(c),W | NA | 2,3,4,5 |
| 2. Average Power Range Monitor (f): | | | | |
| a. Neutron Flux - Upscale in STARTUP | S/U(b), Once/Shift | S/U(c),W(l) | SA | 2 |
| | Once/Shift | W(l) | SA | 3,4,5 |
| b. Neutron Flux - Upscale | Once/Shift | Q(l) | D(d),R(e) | 1 |
| c. Inoperative | NA | Q | NA | 1,2,3,4,5 |
| 3. Reactor Vessel Steam Dome Pressure - High | Once/Shift | Q | Q | 1,2(h) |
| 4. Reactor Water Level - Low | Once/Shift | Q | Q | 1,2 |
| 5. Main Steam Line Isolation Valve - Closure | NA | Q | R(g) | 1 |
| 6. Main Steam Line Radiation - High | Once/Shift | Q(l) | Q(m),R(n) | 1,2(h) |
| 7. Drywell Pressure - High | Once/Shift | Q | Q | 1,2 |
| 8. Scram Discharge Volume Water Level - High | NA | Q | R(j) | 1,2,5(i) |
| 9. Turbine Stop Valve - Closure | NA | Q | R(g) | 1 |

TABLE 4.1-1 (Continued)

REACTOR PROTECTION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| FUNCTIONAL UNIT | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION (a) | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| 10. Turbine Control Valve Fast Closure, Valve Trip System Oil Pressure - Low | NA | Q | R(k) | 1 |
| 11. Turbine First Stage Pressure Permissive | NA | M | SA | 1 |
| 12. Reactor Mode Switch Shutdown Position | NA | R | NA | 1,2,3,4,5 |
| 13. Manual Scram | NA | W | NA | 1,2,3,4,5 |

## TABLE 4.1-1 (Continued)

## REACTOR PROTECTION SYSTEM INSTRUMENTATION SURVEILLANCE REQUIREMENTS

### TABLE NOTATIONS

(a) Neutron detectors may be excluded from CHANNEL CALIBRATION.

(b) The IRM and SRM channels shall be determined to overlap for at least 1/2 decades during each startup after entering the STARTUP MODE and the IRM and APRM channels shall be determined to overlap for at least 1/2 decades during each controlled shutdown, if not performed within the previous 7 days.

(c) Within 24 hours prior to startup, if not performed within the previous 7 days.

(d) This calibration shall consist of the adjustment of the APRM channel to conform to the power values calculated by a heat balance during the RUN MODE when THERMAL POWER >25% of RATED THERMAL POWER. Adjust the APRM channel if the absolute difference is greater than 2% of RATED THERMAL POWER.

(e) This calibration shall consist of the adjustment of the APRM flow biased channel to conform to a calibrated flow signal.

(f) The LPRMs shall be calibrated at least once per 1000 effective full power hours (EFPH) using the TIP system.

(g) This calibration shall consist of the physical inspection and actuation of these position switches.

(h) This function is not required to be OPERABLE when the reactor pressure vessel head is unbolted or removed.

(i) With any control rod withdrawn. Not applicable to control rods removed or withdrawn per Specification 3.9.A.5 or 3.9.A.6.

(j) Calibrate trip unit at least once per 92 days.

(k) Measure time interval baseline data for each operating cycle as follows: From energization of fast acting solenoid, measure time interval to response of oil pressure switch, HFA relay (RPS) and position response of control valves.

(l) This channel functional test will consist of injecting a simulated electrical signal into the measurement channels.

(m) This calibration shall consist of an instrument channel alignment only.

(n) This calibration shall be performed using a radiation source.

## 3.1 BASES

The reactor protection system automatically initiates a reactor scram to:

1. Preserve the integrity of the fuel cladding.
2. Preserve the integrity of the reactor coolant system.
3. Minimize the energy which must be absorbed following a loss-of-coolant accident, and prevent inadvertent criticality.

This specification provides the limiting conditions for operation necessary to preserve the ability of the system to perform its intended function even during periods when instrument channels may be out of service because of maintenance. When necessary, one channel may be made inoperable for brief intervals to conduct required functional tests and calibrations.

Allowed outage times have been incorporated consistent with General Electric topical report NEDC-30851-P-A, "Technical Specification Improvement Analysis for BWR Reactor Protection System," dated March, 1988.

The reactor protection system is of the dual channel type (Reference Subsection 7.2 of the Updated FSAR). The system is made up of two independent trip systems, each having three subchannels of tripping devices. One of the three subchannels has inputs from the manual scram push buttons and the reactor mode switch. Each remaining subchannel has an input from at least one independent instrument channel which monitors a critical parameter.

The outputs of the subchannels are combined in a 1 out of 2 logic; i.e., an input signal on either one or both of the subchannels will cause a trip system trip. The outputs of the trip systems are arranged so that a trip on both trip systems is required to produce a reactor scram.

This system meets the intent of IEEE - 279 for Nuclear Power Plant Protection Systems. The system has a reliability greater than that of a 2 out of 3 system and somewhat less than that of a 1 out of 2 system.

The measurement of response time at the specified frequencies provides assurance that the protective, isolation and emergency core cooling functions associated with each channel is completed within the time limit assumed in the accident analysis.

Response time may be demonstrated by any series of sequential, overlapping or total channel test measurements, provided such tests demonstrate the total channel response time as defined. Sensor response time verification may be demonstrated by either: 1) inplace on-site or off-site test measurements, or 2) utilizing replacement sensors with certified response times.

With the exception of the Average Power Range Monitor (APRM) channels, the Intermediate Range Monitor (IRM) channels, the Main Steam Isolation Valve closure and the Turbine Stop Valve closure, each subchannel has one instrument channel. When the minimum condition for operation on the number of operable instrument channels per untripped protection trip system is met or if it cannot be met and the affected protection trip system is placed in a tripped condition, the effectiveness of the protection system is preserved.

Three APRM instrument channels are provided for each protection trip system. APRM's A and E operate contacts in one subchannel and APRM's C and E operate contacts in the other subchannel. APRM's B, D and F are arranged similarly in the other protection trip system. Each protection trip system has one more APRM than is necessary to meet the minimum number required per channel. This allows the bypassing of one APRM per protection trip system for maintenance, testing or calibration. Additional IRM channels have also been provided to allow for bypassing of one such channel. The bases for the scram setting for the IRM, APRM, high reactor pressure, reactor low water level, MSIV closure, generator load rejection and turbine stop valve closure are discussed in Specifications 2.1 and 2.2.

Instrumentation (pressure switches) for the drywell are provided to detect a loss-of-coolant accident and initiate the emergency core cooling equipment. A high drywell pressure scram is provided at the same setting as the emergency core cooling systems (ECCS) initiation to minimize the energy which must be accommodated during a loss-of-coolant accident and to prevent return to criticality. This instrumentation is a backup to the reactor vessel water level instrumentation.

The reactor water level trip settings are referenced to the "top of the active fuel" which has been defined to be 344.5 inches above vessel zero.

High radiation levels in the main steam line tunnel above that due to the normal nitrogen and oxygen radioactivity is an indication of leaking fuel. A scram is initiated whenever such radiation level exceeds three times normal background. For the performance of a Hydrogen Water Chemistry pre-implementation test, the scram setpoint may be changed based on a calculated value of the radiation level expected during the test. Hydrogen addition will result in an approximate one- to five-fold increase in the nitrogen (N-16) activity in the steam due to increased N-16 carryover in the main steam. The purpose of this scram is to reduce the source of such radiation to the extent necessary to limit the amount of radioactivity released due to gross fuel failure. Discharge of excessive amounts of radioactivity to the environs is prevented by the air ejector offgas monitors which cause an isolation of the main condenser offgas line to the main stack.

The MSIV closure scram is set to scram when the isolation valves are 10% closed in 3 out of 4 lines. This scram anticipates the pressure and flux transient which would occur when the valves close. By scramming at this setting, the resultant transient is less severe than either the pressure or flux transient which would otherwise result.

A reactor mode switch is provided which actuates or bypasses the various scram functions appropriate to the particular plant operating status.

The manual scram function is active in all modes, thus providing for a manual means of rapidly inserting control rods during all modes of reactor operation.

The APRM (High flux in Startup or Refuel) system provides protection against excessive power levels and short reactor periods in the startup and intermediate power ranges.

The IRM system provides protection against short reactor periods in these ranges.

A source range monitor (SRM) system is also provided to supply additional neutron level information during startup but has no scram functions (reference paragraph 7.6.1.4 of the Updated FSAR). Thus, the IRM and APRM are required in the "Refuel" and "Startup/Hot Standby" modes. In the power range the APRM system provides required protection (reference paragraph 7.6.1.7 of the Updated FSAR). Thus the IRM System is not required in the "Run" mode. The APRM's cover only the power range. The IRM's and APRM's provide adequate coverage in the startup and intermediate range.

The control rod drive scram system is designed so that all of the water which is discharged from the reactor by a scram can be accommodated in the discharge piping. The scram discharge volume accommodates in excess of 60 gallons of water and is the low point in the piping. No credit was taken for this volume in the design of the discharge piping as concerns the amount of water which must be accommodated during a scram.

During normal operation the discharge volume is empty; however, should it fill with water, the water discharged to the piping from the reactor could not be accommodated which would result in slow scram times or partial control rod insertion. To preclude this occurrence, level switches have been provided in the instrument volume which alarm and scram the reactor when the volume of water reaches 60 gallons. As indicated above, there is sufficient volume in the piping to accommodate the scram without impairment of the scram times or amount of insertion of the control rods. This function shuts the reactor down while sufficient volume remains to accommodate the discharged water and precludes the situation in which a scram would be required but not be able to perform its function adequately.

The high reactor pressure, high drywell pressure, reactor low water level and scram discharge volume high level scrams are required for Startup and Run modes of plant operation. They are, therefore, required to be operational for these modes of reactor operation.

Turbine stop valve closure trip occurs at approximately 10% of valve closure. Below 165 psig turbine first stage pressure (corresponding to 30% of rated core power), the scram signal due to turbine stop valve closure is by-passed because the flux and pressure scrams are adequate to protect the reactor below 30% of rated core power.

Turbine control valve fast closure scram trip shall initiate within 30 milliseconds of the start of control valve fast closure. The trip level setting is verified by measuring the time interval from energizing the fast acting solenoid (from valve test switch) to pressure switch response; the measured result is compared to base line data taken during each refueling outage. Turbine control valve fast closure is sensed by measuring disc dump electro-hydraulic oil line pressure (Relay Emergency Trip Supply) which decreases rapidly upon generator load rejection. This scram is only effective when turbine first stage pressure is above 165 psig (corresponding to 30% of rated core power).

The APRM downscale trip signal in the Run mode reactivated the IRM upscale trip to the RPS logic. It was determined that the operations addressed by this trip (startup and power descent) are adequately covered by the APRM upscale trip and the APRM downscale rod block. Consequently, the APRM downscale trip was deleted.

## 4.1 BASES

1. The minimum functional testing frequency used in this specification is based on a reliability analysis using the concepts developed in Reference 1. This concept was specifically adapted to the one out of two taken twice logic of the reactor protection system. The analysis shows that the sensors are primarily responsible for the reliability of the reactor protection system. This analysis makes use of "unsafe failure" rate experience at conventional and nuclear power plants in a reliability model for the system. An "unsafe failure" is defined as one which negates channel operability and which, due to its nature, is revealed only when the channel is functionally tested or attempts to respond to a real signal. Failures such as blown fuses, ruptured bourdon tubes, faulted amplifiers, and faulted cables, which result in "upscale" or "downscale" readings on the reactor instrumentation are "safe" and will be easily recognized by the operators during operation because they are revealed by an alarm or a scram.

The channels listed in Tables 4.1-1 are divided into three groups for functional testing. These are:

A. On-Off sensors that provide a scram trip function.

B. Analog devises coupled with bi-stable trips that provide a scram function.

C. Devices which only serve a useful function during some restricted mode of operation, such as startup or shutdown, or for which the only practical test is one that can be performed at shutdown.

The sensors that make up group 1 are specifically selected from among the whole family of industrial on-off sensors that have earned an excellent reputation for reliable operation. During design, a goal of 0.99999 probability of success (at the 50% confidence level) was adopted to assure that a balanced and adequate design is achieved. The probability of success is primarily a function of the sensor failure rate and the test interval. A three-month test interval is planned for Group 1 sensors. This is in keeping with good operating practices, and satisfies the design goal for the logic configuration utilized in the Reactor Protection System.

To satisfy the long-term objective of maintaining an adequate level of safety throughout the plant lifetime, a minimum goal of 0.9999 at the 95% confidence level is proposed. With the (1 out of 2) X (2) logic, this requires that each sensor have an available of 0.993 at the 95% confidence level. This level of availability may be maintained by adjusting the test interval as a function of the observed failure history (Reference 1). To facilitate the implementation of this technique, Figure 4.1-1 is provided to indicate an appropriate trend in test interval. The procedure is as follows:

1. Like sensors are pooled into one group for the purpose of data acquisition.

2. The factor M is the exposure hours and is equal to the number of sensors in a group, n, times the elapsed time T (M = nT).

3. The accumulated number of unsafe failures is plotted as an ordinate against M as an abscissa on Figure 4.1-1.

4. After a trend is established, the appropriate monthly test interval to satisfy the goal will be the test interval to the left of the plotted points.

5. A test interval of 1 month will be used initially until a trend is established, which is based on system availability analysis and good engineering judgement plus operating experience.

Group 2 devices utilize an analog sensor followed by an amplifier and a bi-stable trip circuit. The sensor and amplifier are active components and a failure is almost always accompanied by an alarm and an indication of the source of trouble. In the event of failure, repair or substitution can start immediately. An "as-is" failure is one that "sticks" mid-scale and is not capable of going either up or down in response to an out-of-limits input. This type of failure for analog devices is a rare occurrence and is detectable by an operator who observes that one signal does not track the other three. For purposes of analysis, it is assumed that this rare failure will be detected within two hours.

The bi-stable trip circuit which is a part of the Group 2 devices can sustain unsafe failures which are revealed only on test. Therefore, it is necessary to test them periodically.

A study was conducted of the instrumentation channels included in the Group 2 devices to calculate their "unsafe" failure rates. The analog devices (sensors and amplifiers) are predicted to have an unsafe failure rate of less than 20 X $10^{-6}$ failure/hour. The bi-stable trip circuits are predicted to have unsafe failure rate of less than 2 X $10^{-6}$ failures/hour. Considering the two hour monitoring interval for the analog devices as assumed above, and a weekly test interval for the bi-stable trip circuits, the design reliability goal of 0.99999 is attained with ample margin.

The bi-stable devices are monitored during plant operation to record their failure history and establish a test interval using the curve of Figure 4.1-1. There are numerous identical bi-stable devices used throughout the plant's instrumentation system. Therefore, significant data on the failure rates for the bi-stable devices should be accumulated rapidly.

The frequency of calibration of the APRM Flow Biasing Network is once per operating cycle. The flow biasing network is functionally tested at least once per quarter and in addition, cross calibration checks of the flow input to the flow biasing network can be made during the functional test by direct meter reading. There are several instruments which must be calibrated and it will take several days to perform the calibration of the entire network. While the calibration is being performed, a zero flow signal will be sent to half of the APRM's resulting in a half scram and rod block condition. Thus, if the calibration were performed during operation, flux shaping would not be possible. Based on experience at other generating stations, drift of instruments, such as those in the Flow Biasing Network, is not significant and therefore, to avoid spurious scrams, a calibration frequency of once per operating cycle is established.

Group 3 devices are active only during a given portion of the operational cycle. For example, the IRM is active during startup and inactive during full-power operation. Thus, the only test that is meaningful is the one performed just prior to shutdown or startup; i.e., the tests that are performed just prior to use of the instrument.

Calibration frequency of the instrument channel is divided into two groups. These are as follows:

1. Passive type indicating devices that can be compared with like units on a continuous basis.

2. Vacuum tube or semi-conductor devices and detectors that drift or lose sensitivity.

Experience with passive type instruments in generating stations and substations indicates that the specified calibrations are adequate. For those devices which employ amplifiers, etc., drift specifications call for drift to be less than 0.4%/month; i.e., in the period of a month a maximum drift of 0.4% could occur, thus providing for adequate margin.

For the APRM system, drift of electronic apparatus is not the only consideration in determining a calibration frequency. Change in power distribution and loss of chamber sensitivity dictate a calibration every seven days. Calibration on this frequency assures plant operation at or below thermal limits.

The mode switch in shutdown and manual scram trip functions are simple on-off switches and, hence, calibration during operation is not applicable.

2. The peak heat flux is checked once per day to determine if the APRM scram requires adjustment. This will normally be done by checking the LPRM readings. Only a small number of control rods are moved daily and thus the power distribution is not expected to change significantly and thus a daily check of the peak heat flux is adequate.

   The sensitivity of LPRM detectors decreases with exposure to neutron flux at a slow and approximately constant rate. This is compensated for in the APRM system by calibrating twice a week using heat balance data and by calibrating individual LPRM's every 1000 effective full power hours, using TIP traverse data.

   Several channel functional test frequencies were extended from monthly to quarterly in accordance with NEDC-30851-P-A, "Technical Specification Improvement Analysis for BWR Reactor Protection System," dated March, 1988.

## 4.1 REFERENCES

1. Reliability of Engineered Safety Features as a Function of Testing Frequency, I. M. Jacobs, "Nuclear Safety", Volume 9, No. 4, July-August 1968, pp. 310-312.

## LIMITING CONDITIONS FOR OPERATION

### 3.2 PROTECTIVE INSTRUMENTATION

#### A. ISOLATION ACTUATION INSTRUMENTATION

1. The isolation actuation instrumentation channels shall be OPERABLE as shown in Table 3.2-A.

Applicability:

As shown in Table 3.2-A

Action:

a. With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip System requirement for one trip system:

1) If placing the inoperable channel(s) in the tripped condition would cause an isolation, the inoperable channel(s) shall be restored to OPERABLE status within 6 hours

or the ACTION required by Table 3.2-A for the affected trip function shall be taken.

OR

2) If placing the inoperable channel(s) in the tripped condition would not cause an isolation, the inoperable channel(s) and/or that trip system shall be placed in the tripped condition within

a) 12 hours for trip functions common to RPS Instrumentation; and

b) 24 hours for trip functions not common to RPS Instrumentation.

## SURVEILLANCE REQUIREMENT

### 4.2 PROTECTIVE INSTRUMENTATION

#### A. ISOLATION ACTUATION INSTRUMENTATION

1. Each isolation actuation instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATING MODES and at the frequencies shown in Table 4.2-A.

2. LOGIC SYSTEM FUNCTIONAL TESTS shall be performed at least once per operating cycle for the following:

a. Main Steam Line Isolation Valves
Main Steam Line Drain Valves
Reactor Water Sample Valves

b. RHR-Isolation Valve Control
Shutdown Cooling Valves

c. Reactor Water Cleanup Isolation

d. Drywell Isolation Valves
TIP Withdrawal
Atmospheric Control Valves
Sump Drain Valves

e. Standby Gas Treatment System
Reactor Building Isolation

f. HPCI Subsystem Auto Isolation

g. RCIC Subsystem Auto Isolation

| LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENT |
|---|---|
| b. With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip System requirement for both trip systems, place at least one trip system* in the tripped condition within one hour and take the ACTION required by Table 3.2-A. | |

* Place one trip system (with the most inoperable channels) in the tripped condition. The trip system need not be placed in the tripped condition when this would cause the isolation to occur.

## Table 3.2-A
## ISOLATION ACTUATION INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | APPLICABLE OPERATING MODE | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM[a] | VALVE GROUPS ISOLATED BY SIGNAL | ACTION |
|---|---|---|---|---|---|
| Common Isolation Signals | | | | | |
| Reactor Water Level-Low | ≥ 170 Inches | 1,2,3 | 2 | 2 | 20 |
| | | 1,2,3 and * | 2 | 3[c] | 26 |
| | | 1,2,3 | 2 | 4,5 | 23 |
| Reactor Water Level - Low-Low-Low | ≥ 18.5 Inches | 1,2,3 | 2 | 1 | 21 |
| | | 1,2,3 | 2 | 7 | 20 |
| Drywell Pressure - High | ≤ 2.0 psig | 1,2,3 | 2 | 2 | 20 |
| | | 1,2,3 and * | 2 | 3[c] | 26 |
| | | 1,2,3 | 2 | 4,9[f] | 23 |
| Main Steam Line Isolation | | | | | |
| Main Steam Line Pressure - Low | ≥ 850 psig | 1 | 2 | 1 | 22 |
| Main Steam Line Flow - High | ≤ 140% of Rated Steam Flow | 1,2,3 | 2/line | 1 | 20 |
| Condenser Backpressure - High | ≤ 20 In. Hg | 1,2**,3** | 2 | 1 | 21 |
| Main Steam Line Tunnel Temperature - High | ≤ 200°F | 1,2,3 | 2/line | 1 | 21 |
| Turbine Building Temperature - High | ≤ 200°F | 1,2,3 | 4 | 1 | 21 |
| Main Steam Line Radiation - High | ≤ 3 x Normal Rated Power Background[j] | 1,2,3 | 2 | 1[b] | 21 |

Table 3.2-A (Continued)
ISOLATION ACTUATION INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | APPLICABLE OPERATING MODE | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM[a] | VALVE GROUPS ISOLATED BY SIGNAL | ACTION |
|---|---|---|---|---|---|
| Secondary Containment | | | | | |
| Refuel Floor Exhaust Duct - High Radiation | $\leq$ 9 mr/hr | 1,2,3 and * | 1 | 3[c] | 26 |
| Reactor Building Exhaust Shaft - High Radiation | $\leq$ 11 mr/hr | 1,2,3 and * | 1 | 3[c] | 26 |
| Offgas Vent Stack - High Radiation | $\leq 1.5\text{x}10^4$ cps | 1,2,3 and * | 1 | 3[c] | 26 |
| RHR System Shutdown Cooling | | | | | |
| Reactor Vessel Pressure - High | $\leq$ 135 psig | 1,2,3 | 1 | 4 | 23 |
| Reactor Water Cleanup | | | | | |
| RWCU Differential Flow - High | $\leq$ 40 gpmd | 1,2,3 | 1 | 5 | 23 |
| RWCU Area Temperature - High | $\leq$ 130°F | 1,2,3 | 1 | 5 | 23 |
| RWCU Area Ventilation Differential Temperature - High | Δ14°F[d] | 1,2,3 | 1 | 5 | 23 |
| Standby Liquid Control System Initiation | NA | Note i | 1 | 5[e] | 23 |

Table 3.2-A (Continued)
ISOLATION ACTUATION INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | APPLICABLE OPERATING MODE | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM[(a)] | VALVE GROUPS ISOLATED BY SIGNAL | ACTION |
|---|---|---|---|---|---|
| Reactor Core Isolation Cooling | | | | | |
| RCIC Steam Line Differential Pressure (Flow) - High | ≤ 110 Inches $H_2O$ | 1,2,3 | 1 | 6A | 23 |
| RCIC Steam Supply Pressure - Low | 100 > P > 50 psig | 1,2,3 | 2 | 6A | 23 |
| RCIC Turbine Exhaust Diaphragm Pressure - High | ≤ 10 psig | 1,2,3 | 2 | 6A | 23 |
| RCIC Equipment Room Temperature - High | ≤ 175°F | 1,2,3 | 1 | 6A | 23 |
| RCIC Room Ventilation Differential Temperature - High | ≤ Δ50°F | 1,2,3 | 1 | 6A | 23 |
| RCIC Leak Detection Time Delay | ≤ 30 Minutes | 1,2,3 | 1 | 6A | 23 |
| Suppression Pool Area Temperature - High | ≤ 150°F | 1,2,3 | 1 | 6A | 23 |
| Suppression Pool Area Ventilation Differential Temperature - High | ≤ Δ50°F | 1,2,3 | 1 | 6A | 23 |
| Manual Initiation | NA | 1,2,3 | 1/RCIC System | 6A[(g)] | 25 |
| RCIC System Initiation | MO-2404 Not Full Closed | 1,2,3 | 1/RCIC System | 8 | 23 |

Table 3.2-A (Continued)
ISOLATION ACTUATION INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | APPLICABLE OPERATING MODE | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM[(a)] | VALVE GROUPS ISOLATED BY SIGNAL | ACTION |
|---|---|---|---|---|---|
| High Pressure Coolant Injection | | | | | |
| HPCI Steam Line Differential Pressure (Flow) - High | ≤ 53 Inches $H_2O$ (Outboard)<br>≤ 99 Inches $H_2O$ (Inboard) | 1,2,3 | 1 | 6B | 23 |
| HPCI Steam Supply Pressure - Low | 100 > P > 50 psig | 1,2,3 | 2 | 6B | 23 |
| HPCI Turbine Exhaust Diaphragm Pressure - High | ≤ 10 psig | 1,2,3 | 2 | 6B | 23 |
| HPCI Equipment Room Temperature - High | ≤ 175°F | 1,2,3 | 1 | 6B | 23 |
| HPCI Room Ventilation Differential Temperature - High | ≤ Δ50°F | 1,2,3 | 1 | 6B | 23 |
| HPCI Leak Detection Time Delay | ≤ 15 Minutes | 1,2,3 | 1 | 6B | 23 |
| Suppression Pool Area Temperature - High | ≤ 150°F | 1,2,3 | 1 | 6B | 23 |
| Suppression Pool Area Ventilation Differential Temperature - High | ≤ Δ50°F | 1,2,3 | 1 | 6B | 23 |
| HPCI System Initiation | MO-2202 Not Full Closed | 1,2,3 | 1/HPCI System | 8 | 23 |
| Manual Initiation | NA | 1,2,3 | 1/HPCI System | 6B[(h)] | 25 |

## Table 3.2-A (Continued)

## ISOLATION ACTUATION INSTRUMENTATION

### ACTION

ACTION 20 - Be in at least HOT SHUTDOWN within 12 hours and in COLD SHUTDOWN within the next 24 hours.

ACTION 21 - Be in at least STARTUP with the associated isolation valves closed within 6 hours or be in at least HOT SHUTDOWN within 12 hours and in COLD SHUTDOWN within the next 24 hours.

ACTION 22 - Be in at least STARTUP within 6 hours.

ACTION 23 - Close the affected system isolation valves within one hour and declare the affected system inoperable.

ACTION 24 - Not Used

ACTION 25 Restore the manual initiation function to OPERABLE status within 8 hours or close the affected system isolation valves within the next hour and declare the affected system inoperable.

ACTION 26 - Establish SECONDARY CONTAINMENT INTEGRITY with the Standby Gas Treatment System operating within one hour.

### NOTES

* When handling irradiated fuel in the secondary containment and during CORE ALTERATIONS and operations with a potential for draining the reactor vessel.

** When any turbine stop valve is greater than 90% open and/or when the key-locked bypass switch is in the NORM position.

(a) A channel may be placed in an inoperable status for up to 6 hours for required surveillance without placing the trip system in the tripped condition provided at least one OPERABLE channel in the same trip system is monitoring that parameter.

(b) Also trips Mechanical Vacuum Pump which results in a subsequent isolation of the Mechanical Vacuum Pump suction valves.

(c) Also starts the Standby Gas Treatment System.

(d) Actual setpoint shall be 14°F above the 100% operation ambient temperature conditions as determined by DAEC plant test procedure.

(e) Closes MO-2701 and MO-2740 only.

(f) Requires system steam supply pressure-low coincident with drywell pressure-high to close HPCI/RCIC exhaust vacuum breaker valves.

(g) Manual isolation closes MO-2401 only, if RCIC initiation signal present.

(h) Manual isolation closes MO-2239 only, if HPCI initiation signal present.

(i) When the Standby Liquid Control System is required to be OPERABLE per Specification 3.4.A.

(j) Within 24 hours prior to the planned start of the hydrogen injection test with the reactor power at greater than 20% rated power, the normal full-power radiation background level and associated trip setpoints may be changed based on a calculated value of the radiation level expected during the test. The background radiation level and associated trip setpoints may be adjusted during the test program based on either calculations or measurements of actual radiation levels resulting from hydrogen injection. The background radiation level shall be determined and associated trip setpoints shall be set within 24 hours of reestablishing normal radiation levels after completion of the hydrogen injection test or within 12 hours of establishing reactor power levels below 20% rated power, while these functions are required to be operable.

Table 4.2-A

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| TRIP FUNCTION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| Common Isolation Signals | | | | |
| Reactor Water Level-Low (###) | Once/Shift | Q | Q | 1,2,3 and * |
| Reactor Water Level-Low-Low-Low (##) | Once/Shift | Q | Q | 1,2,3 |
| Drywell Pressure - High (###) | NA | Q | Q | 1,2,3 and * |
| Main Steam Line Isolation | | | | |
| Main Steam Line Pressure - Low | NA | Q | Q | 1 |
| Main Steam Line Flow - High | Once/Shift | Q | Q | 1,2,3 |
| Condenser Backpressure - High | NA | Q | A | 1,2**,3** |
| Main Steam Line Tunnel Temperature - High | D | Q | A | 1,2,3 |
| Turbine Building Temperature - High | D | Q | A | 1,2,3 |
| Main Steam Line Radiation - High (#) | Once/Shift | Q | R | 1,2,3 |
| Secondary Containment | | | | |
| Refuel Floor Exhaust Duct - High Radiation | D | Q | R | 1,2,3 and * |
| Reactor Building Exhaust Shaft - High Radiation | D | Q | R | 1,2,3 and * |
| Offgas Vent Stack - High Radiation | D | Q | R | 1,2,3 and * |

Table 4.2-A (Continued)

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| TRIP FUNCTION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| RHR System Shutdown Cooling | | | | |
| Reactor Vessel Pressure - High | NA | Q | Q | 1,2,3 |
| Reactor Water Cleanup | | | | |
| RWCU Differential Flow - High | D | Q | Q | 1,2,3 |
| RWCU Area Temperature - High | NA | Q(a) | A | 1,2,3 |
| RWCU Area Ventilation Differential Temperature - High | NA | Q | A | 1,2,3 |
| Standby Liquid Control System Initiation | NA | R | NA | Note b |
| Reactor Core Isolation Cooling | | | | |
| RCIC Steam Line Differential Pressure (Flow) - High | NA | Q | Q | 1,2,3 |
| RCIC Steam Supply Pressure - Low | NA | Q | Q | 1,2,3 |
| RCIC Turbine Exhaust Diaphragm Pressure - High | NA | Q | R | 1,2,3 |
| RCIC Equipment Room Temperature - High | D | Q | A | 1,2,3 |
| RCIC Room Ventilation Differential Temperature - High | D | Q | A | 1,2,3 |
| RCIC Leak Detection Time Delay | NA | NA | A | 1,2,3 |
| Suppression Pool Area Temperature - High | D | Q | A | 1,2,3 |
| Suppression Pool Area Ventilation Differential Temperature - High | D | Q | A | 1,2,3 |
| Manual Initiation | NA | R | NA | 1,2,3 |
| RCIC System Initiation (MO-2404 Not Full Closed) | NA | R | NA | 1,2,3 |

Table 4.2-A (Continued)

ISOLATION ACTUATION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| TRIP FUNCTION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| High Pressure Coolant Injection | | | | |
| HPCI Steam Line Differential Pressure (Flow) - High | NA | Q | Q | 1,2,3 |
| HPCI Steam Supply Pressure - Low | NA | Q | Q | 1,2,3 |
| HPCI Turbine Exhaust Diaphragm Pressure - High | NA | Q | R | 1,2,3 |
| HPCI Equipment Room Temperature - High | D | Q | A | 1,2,3 |
| HPCI Room Ventilation Differential Temperature - High | D | Q | A | 1,2,3 |
| HPCI Leak Detection Time Delay | NA | Q | A | 1,2,3 |
| Suppression Pool Area Temperature - High | D | Q | A | 1,2,3 |
| Suppression Pool Area Ventilation Differential Temperature - High | D | Q | A | 1,2,3 |
| HPCI System Initiation (MO-2202 Not Full Closed) | NA | R | NA | 1,2,3 |
| Manual Initiation | NA | R | NA | 1,2,3 |

*When handling irradiated fuel in the secondary containment and during CORE ALTERATIONS and operations with a potential for draining the reactor vessel.

**When any turbine stop valve is greater than 90% open and/or when the key-locked bypass switch is in the Norm position.

#These trip functions are common to the RPS function.

##These trip functions are common to the ECCS activation trip function.

###These trip functions are common to the RPS and ECCS activation trip functions.

(a)The functional test will consist of comparing the analog signal of the active thermocouple element feeding the isolation logic to a redundant thermocouple element.

(b)When the Standby Liquid Control System is required to be OPERABLE per Specification 3.4.A.

LIMITING CONDITIONS FOR OPERATION

B. CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

1. The core and containment cooling system actuation instrumentation channels shall be OPERABLE as shown in Table 3.2-B.

APPLICABILITY:

As shown in Table 3.2-B.

ACTION:

With one or more core and containment cooling systems actuation instrumentation channels inoperable, take the ACTION required by Table 3.2-B.

SURVEILLANCE REQUIREMENT

B. CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

1. Each core and containment cooling system actuation instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATING MODES and at the frequencies shown in Table 4.2-B.

2. LOGIC SYSTEM FUNCTIONAL TESTS shall be performed at least once per operating cycle for the following:

a. Core Spray System

b. Low Pressure Coolant Injection Mode of RHR System

c. Containment Spray Interlocks

d. HPCI System

e. ADS System

f. Area Cooling for Safeguard Systems

g. Low-Low Set Function

## TABL[illegible]2-B

## CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

| Trip Function | Trip Level Setting | Minimum Operable Channels per Trip Function[a] | Applicable Operating Mode | Action |
|---|---|---|---|---|
| CORE SPRAY SYSTEM | | | | |
| Reactor Water Level-Low-Low-Low | ≥ +18.5 Inches | 4(b) | 1,2,3,4*,5* | 30 |
| Drywell Pressure-High | ≤ 2.0 psig | 4(b) | 1,2,3 | 30 |
| Reactor Pressure-Low (Permissive) | ≥ 450 psig | 4 | 1,2,3<br>4*,5* | 31<br>32 |
| Core Spray Pump Start Time Delay | 5 sec | 1/pump | 1,2,3,4*,5* | 31 |
| LOW PRESSURE COOLANT INJECTION MODE OF RHR | | | | |
| Reactor Water Level-Low-Low-Low | ≥ +18.5 Inches | 4 | 1,2,3,4*,5* | 30 |
| Drywell Pressure-High | ≤ 2.0 psig | 4 | 1,2,3 | 30 |
| Reactor Pressure-Low (Permissive) | ≥ 450 psig | 4 | 1,2,3<br>4*,5* | 31<br>32 |
| LPCI Pump Start Time Delay | 10 sec (A&B)<br>15 sec (C&D) | 1/pump | 1,2,3,4*,5* | 31 |
| LPCI Loop Select | | | | |
| Reactor Water Level-Low-Low | ≥ +119.5 Inches | 4 | 1,2,3,4*,5* | 31 |
| Reactor Pressure-Low | ≥ 900 psig | 4 | 1,2,3,4*,5* | 31 |
| Recirculation Pump Differential Pressure | ≤ 2 psid | 4/pump | 1,2,3,4*,5* | 31 |
| Recirculation Riser Differential Pressure | 0.5 < p < 1.5 psid | 4 | 1,2,3,4*,5* | 31 |

TABLE 3.2-[illegible]ontinued)

CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

| Trip Function | Trip Level Setting | Minimum Operable Channels per Trip Function[a] | Applicable Operating Mode | Action |
|---|---|---|---|---|
| HIGH PRESSURE COOLANT INJECTION SYSTEM (#) | | | | |
| Reactor Water Level-Low-Low | ≥ +119.5 Inches | 4 | 1,2,3 | 34 |
| Drywell Pressure-High | ≤ 2.0 psig | 4 | 1,2,3 | 34 |
| Reactor Water Level-High | ≤ +211 Inches | 2[d] | 1,2,3 | 31 |
| Condensate Storage Tank Level-Low | ≥ 12 Inches above tank bottom (10,000 gallons) | 2[c] | 1,2,3 | 35 |
| Suppression Pool Water Level-High | ≤ 5 Inches above normal level | 2[c] | 1,2,3 | 35 |
| REACTOR CORE ISOLATION COOLING SYSTEM (#) | | | | |
| Reactor Water Level-Low-Low | ≥ +119.5 Inches | 4 | 1,2,3 | 30 |
| Reactor Water Level-High | ≤ +211 Inches | 2[d] | 1,2,3 | 31 |
| Condensate Storage Tank Level-Low | ≥ 12 Inches above tank bottom (10,000 gallons) | 2[c] | 1,2,3 | 35 |

TABLE 3.2-[illegible]ontinued)

CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

| Trip Function | Trip Level Setting | Minimum Operable Channels per Trip Function[a] | Applicable Operating Mode | Action |
|---|---|---|---|---|
| AUTOMATIC DEPRESSURIZATION SYSTEM (##) | | | | |
| Reactor Water Level-Low-Low-Low | ≥ +18.5 Inches | 4 | 1,2,3 | 30 |
| Reactor Water Level-Low (Confirmatory) | ≥ +170 Inches | 2 | 1,2,3 | 31 |
| ADS Timer | 120 sec | 2 | 1,2,3 | 31 |
| Core Spray Pump Discharge Pressure-High (Permissive) | 145 psig | 2/pump | 1,2,3 | 31 |
| RHR(LPCI) Pump Discharge Pressure-High (Permissive) | 125 psig | 1/pump | 1,2,3 | 31 |
| CONTAINMENT COOLING | | | | |
| Reactor Water Level-Low (Inside Shroud) | ≥ - 39 Inches (2/3 core height) | 4 | 1,2,3 | 30 |
| Containment Pressure-High | ≥ 2.0 psig | 4 | 1,2,3 | 30 |

TABLE 3.2-[illegible]ontinued)

CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION

| Trip Function | Trip Level Setting | Minimum Operable Channels per Trip Function[a] | Applicable Operating Mode | Action |
|---|---|---|---|---|
| LOSS OF POWER | | | | |
| 4.16 kv Emergency Bus Undervoltage (Loss of Voltage) | $20 \leq V \leq 28$ volts | 2 | 1,2,3,4**,5** | 33 |
| 4.16 kv Emergency Bus Degraded Voltage | a. $108 \leq V \leq 111$ volts<br>b. $8.0 \leq t \leq 8.5$ sec time delay | 8 | 1,2,3,4**,5** | 36 |
| 4.16 kv Emergency Transformer Supply - Undervoltage | 65% of Rated Voltage | 4 | 1,2,3,4**,5** | 36 |
| 4.16 kv Emergency Bus Sequential Loading Relay | 65% of Rated Voltage | 2 | 1,2,3,4**,5** | 36 |

NOTES

(a) A channel may be placed in an inoperable status for up to 6 hours during periods of required surveillance without placing the trip system in the tripped condition provided at least one OPERABLE channel in the same trip system is monitoring that parameter.

(b) Also actuates the associated emergency diesel generators.

(c) One trip system. Provides signal to the pump suction valves only.

(d) Provides signal to trip pump turbine only.

* When the system is required to be OPERABLE per Specification 3.5.A.
** Required OPERABLE when ESF equipment is required to be OPERABLE.
\# Not required to be OPERABLE when reactor steam dome pressure is less than or equal to 150 psig.
\#\# Not required to be OPERABLE when reactor steam dome pressure is less than or equal to 100 psig.

## ACTION

ACTION 30 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement:

a. With one channel inoperable, place the inoperable channel in the tripped condition within 24 hours or declare the associated system inoperable.

b. With more than one channel inoperable, declare the associated system inoperable.

ACTION 31 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, declare the associated ECCS inoperable within 24 hours.

ACTION 32 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, place the inoperable channel in the tripped condition within 24 hours.

ACTION 33 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, declare the associated emergency diesel generator inoperable and take the action required by Specification 3.5.G.1.

ACTION 34 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement:

a. For one channel inoperable, place the inoperable channel in the tripped condition within 24 hours or declare the HPCI system inoperable.

b. With more than one channel inoperable, declare the HPCI system inoperable.

ACTION 35 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, place at least one inoperable channel in the tripped condition within 24 hours or declare the associated system inoperable.

ACTION 36 - With the number of OPERABLE channels one less than required by the Minimum OPERABLE Channels per Trip Function, place the inoperable channel in the tripped condition within 1 hour; operation may then continue until performance of the next required CHANNEL FUNCTIONAL TEST.

## TABLE 4.2-B

## CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| Trip Function | Channel Check | Channel Functional Test | Channel Calibration | Operating Modes for Which Surveillance Required |
|---|---|---|---|---|
| **CORE SPRAY SYSTEM** | | | | |
| Reactor Water Level-Low-Low-Low | D | Q | Q | 1, 2, 3, 4*, 5* |
| Drywell Pressure-High | NA | Q | Q | 1, 2, 3 |
| Reactor Pressure-Low (Permissive) | NA | Q | Q | 1, 2, 3, 4*, 5* |
| Core Spray Pump Start Time Delay | NA | NA | A | 1, 2, 3, 4*, 5* |
| **LOW PRESSURE COOLANT INJECTION MODE OF RHR** | | | | |
| Reactor Water Level-Low-Low-Low | D | Q | Q | 1, 2, 3, 4*, 5* |
| Drywell Pressure-High | NA | Q | Q | 1, 2, 3 |
| Reactor Pressure-Low (Permissive) | NA | Q | Q | 1, 2, 3, 4*, 5* |
| LPCI Pump Start Time Delay | NA | NA | A | 1, 2, 3, 4*, 5* |
| LCPI Loop Select | | | | |
| Reactor Water Level-Low-Low | D | M | Q | 1, 2, 3, 4*, 5* |
| Reactor Pressure-Low | NA | M | Q | 1, 2, 3, 4*, 5* |
| Recirculation Pump Differential Pressure | D | M | Q | 1, 2, 3, 4*, 5* |
| Recirculation Riser Differential Pressure | D | M | Q | 1, 2, 3, 4*, 5* |

TABLE 4[illegible] (Continued)

CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| | | | | |
|---|---|---|---|---|
| **HIGH PRESSURE COOLANT INJECTION SYSTEM** (#) | | | | |
| Reactor Water Level-Low-Low | D | Q | Q | 1, 2, 3 |
| Drywell Pressure-High | NA | Q | Q | 1, 2, 3 |
| Reactor Vessel Water Level-High | D | Q | Q | 1, 2, 3 |
| Condensate Storage Tank Level-Low | NA | Q | Q | 1, 2, 3 |
| Suppression Pool Water Level-High | NA | Q | Q | 1, 2, 3 |
| **REACTOR CORE ISOLATION COOLING SYSTEM** (#) | | | | |
| Reactor Water Level-Low-Low | D | Q | Q | 1, 2, 3 |
| Reactor Water Level-High | D | Q | Q | 1, 2, 3 |
| Condensate Storage Tank Level-Low | NA | Q | Q | 1, 2, 3 |
| **AUTOMATIC DEPRESSURIZATION SYSTEM** (##) | | | | |
| Reactor Water Level-Low-Low-Low | D | Q | Q | 1, 2, 3 |
| Reactor Vessel Water Level-Low (Confirmatory) | D | Q | Q | 1, 2, 3 |
| ADS Timer | NA | Q | R | 1, 2, 3 |
| Core Spray Pump Discharge Pressure-High (Permissive) | NA | Q | Q | 1, 2, 3 |
| RHR(LCPI) Pump Discharge Pressure-High (Permissive) | NA | Q | Q | 1, 2, 3 |
| **Low-Low Set** | | | | |
| Low-Low Set Function Setpoints | D | M | SA | 1, 2, 3 |

TABLE 4[illegible] (Continued)

CORE AND CONTAINMENT COOLING SYSTEMS INITIATION/CONTROL INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| Trip Function | Channel Check | Channel Functional Test | Channel Calibration | Operating Modes for Which Surveillance Required |
|---|---|---|---|---|
| CONTAINMENT COOLING | | | | |
| Reactor Water Level-Low (Inside Shroud) | D | M | Q | 1, 2, 3 |
| Containment Pressure-High | NA | M | Q | 1, 2, 3 |
| LOSS OF POWER | | | | |
| 4.16 kv Emergency Bus Undervoltage (Loss of Voltage) | NA | A | A | 1, 2, 3, 4**, 5** |
| 4.16 kv Emergency Bus Degraded Voltage | NA | M | A | 1, 2, 3, 4**, 5** |
| 4.16 kv Emergency Transformer Supply-Undervoltage | NA | A | A | 1, 2, 3, 4**, 5** |
| 4.16 kv Emergency Bus Sequential Loading Relay | NA | A | A | 1, 2, 3, 4**, 5** |

* When the system is required to be OPERABLE per Specification 3.5.A.
** Required OPERABLE when ESF equipment is required to be OPERABLE.
\# Not required to be OPERABLE when reactor steam dome pressure is less than or equal to 150 psig.
\## Not required to be OPERABLE when reactor steam dome pressure is less than or equal to 100 psig.

| LIMITING CONDITION FOR OPERATION | SURVEILLANCE REQUIREMENT |
|---|---|
| C. CONTROL ROD BLOCK INSTRUMENTATION | C. CONTROL ROD BLOCK INSTRUMENTATION |
| 1. The control rod block instrumentation channels shall be OPERABLE as shown in Table 3.2-C.<br><br>Applicability:<br><br>As shown in Table 3.2-C.<br><br>Action:<br><br>With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, take the ACTION required by Table 3.2-C. | 1. Each of the required control rod block instrumentation channels shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATING MODES and at the frequencies shown in Table 4.2-C. |
| 2. Rod Block Monitor (RBM)<br><br>a. Both RBM channels shall be demonstrated to be OPERABLE prior to control rod withdrawal when a Limiting Control Rod Pattern exists; otherwise, control rod withdrawal may take place with the RBM bypassed. A Limiting Control Rod Pattern exists when:<br><br>i) core thermal power is greater than or equal to 30% of rated and less than 90% of rated (30% $\leq$ P < 90%) and the Minimum Critical Power Ratio (MCPR) is less than 1.70, or<br><br>ii) core thermal power is greater than or equal to 90% of rated (P $\geq$ 90%) and the MCPR is less than 1.40.<br><br>When a Limiting Control Rod Pattern exists:<br><br>With one RBM channel inoperable, control rod withdrawal shall be blocked within 24 hours, unless OPERABILITY is restored within this time period.<br><br>With both RBM channels inoperable, control rod withdrawal shall be blocked until OPERABILITY of at least one channel is restored. | 2. When a LIMITING CONTROL ROD PATTERN exists, a CHANNEL FUNCTIONAL TEST of the RBM shall be performed prior to withdrawal of the designated rod(s). |

LIMITING CONDITION FOR OPERATION | SURVEILLANCE REQUIREMENT

b. The RBM control rod block setpoints are given in Table 3.2-C. The upscale High Power Trip Setpoint shall be applied when the core thermal power is greater than or equal to 85% of rated (P $\geq$ 85%). The upscale Intermediate Power Trip Setpoint shall be applied when the core thermal power is greater than or equal to 65% of rated and less than 85% of rated (65% $\leq$ P < 85%). The upscale Low Power Trip Setpoint shall be applied when the core thermal power is greater than or equal to 30% of rated and less than 65% of rated (30% $\leq$ P < 65%). The RBM can be bypassed when core thermal power is less than 30% of rated. The RBM bypass time delay ($t_{d2}$) shall be less than or equal to 2.0 seconds.

## Table 3.2-C
## CONTROL ROD BLOCK INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | MINIMUM OPERABLE CHANNELS PER TRIP FUNCTION | APPLICABLE OPERATING MODES | ACTION |
|---|---|---|---|---|
| **Rod Block Monitor**[a] | | | | |
| Upscale (Power Referenced) | | | | |
| a) Low Power Trip Setpoint | ≤ 115/125 of full scale | 2 | 1* | 40 |
| b) Intermediate Power Trip Setpoint | ≤ 109/125 of full scale | | | |
| c) High Power Trip Setpoint | ≤ 105/125 of full scale | | | |
| Downscale | ≥ 94/125 of full scale | 2 | 1* | 40 |
| Inoperative | NA | 2 | 1* | 40 |
| **APRM** | | | | |
| Flow-Biased Upscale | Two loop operation: ≤ (0.58W + 50%)# Single loop operation: ≤ (0.58W + 46.5%)# | 4 | 1 | 41 |
| Upscale in Startup | ≤ 12% of RATED THERMAL POWER | 4 | 2,5 | 41 |
| Inoperative | NA | 4 | 1,2,5 | 41 |
| Downscale | ≥ 5% of RATED THERMAL POWER | 4 | 1 | 41 |
| **Intermediate Range Monitors** | | | | |
| Detector not full in | NA | 4 | 2,5 | 41 |
| Upscale | ≤ 108/125 of full scale | 4 | 2,5 | 41 |
| Inoperative | NA | 4 | 2,5 | 41 |
| Downscale[e] | ≥ 5/125 of full scale | 4 | 2,5 | 41 |
| **Source Range Monitors** | | | | |
| Detector not full in[b] | NA | 3 | 2 | 41 |
| | | 2 | 5 | 41 |
| Upscale[c] | ≤ $10^5$ cps | 3 | 2 | 41 |
| | | 2 | 5 | 41 |
| Inoperative[c] | NA | 3 | 2 | 41 |
| | | 2 | 5 | 41 |
| Downscale[d] | ≥ 3 cps | 3 | 2 | 41 |
| | | 2 | 5 | 41 |
| **Scram Discharge Volume** | | | | |
| Water Level - High | ≤ 24 gallons | 1 | 1,2,5** | 42 |
| **Recirculation Flow** | | | | |
| Upscale | ≤ 110% | 2 | 1 | 42 |
| Inoperative | NA | 2 | 1 | 42 |
| Comparator | ≤ 10% flow deviation | 2 | 1 | 42 |
| **Reactor Mode Switch-Shutdown Position** | NA | 2 | 3,4 | 43 |

Table 3.2-C (Continued)

CONTROL ROD BLOCK INSTRUMENTATION

ACTION

ACTION 40 - Declare the RBM inoperable and take the ACTION required by Specification 3.2.C.2.a.

ACTION 41 - With the number of OPERABLE Channels:

a. One less than required by the Minimum OPERABLE Channels per Trip Function requirement, restore the inoperable channel to OPERABLE status within 7 days or place the inoperable channel in the tripped condition within the next hour.

b. Two or more less than required by the Minimum OPERABLE Channels per Trip Function requirement, place at least one inoperable channel in the tripped condition within one hour.

ACTION 42 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, place the inoperable channel in the tripped condition within one hour.

ACTION 43 - With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels per Trip Function requirement, initiate a rod block.

NOTES

* With THERMAL POWER $\geq$ 30% of RATED THERMAL POWER.

** With more than one control rod withdrawn. Not applicable to control rods removed or withdrawn per Specification 3.9.A.5 or 3.9.A.6.

\# W is the recirculation loop flow in percent of design.

(a) The RBM shall be automatically bypassed when a peripheral control rod is selected.

(b) This function shall be automatically bypassed if detector count rate is > 100 cps or the IRM channels are on range 3 or higher.

(c) This function shall be automatically bypassed when the associated IRM channels are on range 8 or higher.

(d) This function shall be automatically bypassed when the IRM channels are on range 3 or higher.

(e) This function shall be automatically bypassed when the IRM channels are on range 1.

Table 4.2-C

CONTROL ROD BLOCK INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| TRIP FUNCTION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION[a] | OPERATIONAL CONDITIONS FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| Rod Block Monitor | | | | |
| Upscale (Power Referenced) | D | S/U[b][c],Q[c] | SA | 1* |
| Downscale | D | S/U[b][c],Q[c] | SA | 1* |
| Inoperative | NA | S/U[b][c],Q[c] | NA | 1* |
| APRM | | | | |
| Flow Biased Upscale | D | S/U[b],Q | Q | 1 |
| Upscale in Startup | D | S/U[b],Q | Q | 2,5 |
| Inoperative | NA | S/U[b],Q | NA | 1,2,5 |
| Downscale | D | S/U[b],Q | Q | 1 |
| Intermediate Range Monitors | | | | |
| Detector not full in | NA | S/U[b],W | R | 2,5 |
| Upscale | D | S/U[b],W | Prior to Startup or Controlled Shutdown | 2,5 |
| Inoperative | NA | S/U[b],W | NA | 2,5 |
| Downscale | D | S/U[b],W | Prior to Startup or Controlled Shutdown | 2,5 |
| Scurce Range Monitors | | | | |
| Detector not full in | NA | S/U[b],W | R | 2,5 |
| Upscale | D | S/U[b],W | Prior to Startup or Controlled Shutdown | 2,5 |
| Inoperative | NA | S/U[b],W | NA | 2,5 |
| Downscale | D | S/U[b],W | Prior to Startup or Controlled Shutdown | 2,5 |
| Scram Discharge Volume Water Level-High | NA | Q | R | 1,2,5** |
| Recirculation Flow | | | | |
| Upscale | NA | S/U[b],Q | SA | 1 |
| Inoperative | NA | S/U[b],Q | NA | 1 |
| Ccmparator | NA | S/U[b],Q | SA | 1 |
| Reactor Mode Switch - Shutdown Position | NA | R | NA | 3,4 |

Table 4.2-C (Continued)

CONTROL ROD BLOCK INSTRUMENTATION SURVEILLANCE REQUIREMENTS

NOTES

(a) Neutron detectors may be excluded from CHANNEL CALIBRATION.

(b) Within 24 hours prior to startup, if not performed within the previous 7 days.

(c) Includes reactor manual control multiplexing system input.

* With THERMAL POWER ≥ 30% of RATED THERMAL POWER.

** With more than one control rod withdrawn. Not applicable to control rods remcved or withdrawn per Specification 3.9.A.5 or 3.9.A.6.

LIMITING CONDITIONS FOR OPERATION

D. RADIATION MONITORING INSTRUMENTATION

1. The radiation monitoring instrumentation channels shall be OPERABLE as shown in Table 3.2-D.

Applicability:

As shown in Table 3.2-D.

Action:

a. With one or more radiaticn monitoring channels inoperable, take the ACTION required by Table 3.2-D.

2. In the event the noble gas flow in the air ejector offgas exceeds the equivalent of 1.0 Ci/sec after 30 minutes delay in the offgas holdup line as indicated on the offgas pre-treatment radiation monitor, restore the rate to less than this limit within 72 hours or be in at least HOT STANDBY within the next 12 hour.

SURVEILLANCE REQUIREMENT

D. RADIATION MONITORING INSTRUMENTATION

1. Each radiation monitoring instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST, CHANNEL CALIBRATION and SOURCE CHECK operations for the OPERATING MODES and at the frequencies shown in Table 4.2-D.

2. LOGIC SYSTEM FUNCTIONAL TESTS and simulated automatic operation of all channels shall be performed at least once per operating cycle for the following:

a. Steam Jet Air Ejector Offgas Line Isolation

b. Steam Jet Air Ejector Charcoal Bed Bypass

Table 3.2-D

RADIATION MONITORING INSTRUMENTATION

| INSTRUMENTATION | MINIMUM CHANNELS OPERABLE | APPLICABLE OPERATING MODES | ALARM/TRIP SETPOINT | VALVE(s) OPERATED BY SIGNAL | ACTION |
|---|---|---|---|---|---|
| Offgas Post-Treatment Radiation Monitors | 1 | * | (a) | (a) | 50 |
| Offgas Pre-Treatment Radiation Monitors | 1 | * | (b) | NA | 51 |

* When the offgas system is operating.

(a) The monitors shall be set to initiate immediate closure of the charcoal bed bypass valve and the air ejector offgas isolation valve at a setting equivalent to or below the dose rate limits in Specification 3.15.B.1.

(b) The monitors shall be set to initiate an alarm if the monitor exceeds a trip setting equivalent to 1.0 Ci/sec of noble gases after 30 minutes delay in the offgas holdup line.

ACTION

RADIATION MONITORING INSTRUMENTATION

ACTION 50 - With the number of OPERABLE channels less than required by the Minimum Channels Operable requirement, gases from the steam air ejector offgas system may be released to the environment for up to 72 hours provided (1) the charcoal bed of the offgas system is not bypassed, and (2) the offgas stack noble gas activity monitor is cperable.

Otherwise, be in at least HOT STANDBY within the following 24 hours.

ACTION 51 - With the number of OPERABLE channels less than required by the Minimum Channels Operable requirement, gases from the steam air ejector offgas system may be released for up to 30 days provided (1) the charcoal bed of the offgas system is not bypassed, (2) Grab samples are collected and analyzed weekly, and (3) the offgas stack noble gas activity monitcr is OPERABLE or at least 1 post-treatment monitor is OPERABLE.

Otherwise, be in at least HOT STANDBY within the following 24 hours.

## Table 4.2-D

## RADIATION MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| INSTRUMENTATION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | SOURCE CHECK | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|---|
| Offgas Post-Treatment Radiation Monitors | D | Q** | R | M | * |
| Offgas Pre-Treatment Radiation Monitors | D | Q** | R | M | * |

---

* When the offgas system is operating

** The CHANNEL FUNCTIONAL TEST shall also demonstrate that control room alarm annunciation occurs if any of the following conditions exist:

a. Instrument indicates measured levels above the alarm/trip setpoint
b. Instrument indicates a downscale failure
c. Instrument controls not set in the operate mode.

## LIMITING CONDITIONS FOR OPERATION

E. DRYWELL LEAK DETECTION INSTRUMENTATION

1. The drywell leak detection instrumentation channels shall be OPERABLE as shown in Table 3.2-E.

Applicability

As shown in Table 3.2-E.

Action

With the number of OPERABLE channels less than required by the Minimum OPERABLE Channels requirement, take the ACTION required by Specification 3.6.C.

## SURVEILLANCE REQUIREMENT

E. DRYWELL LEAK DETECTION INSTRUMENTATION

1. Each drywell leak detection instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION operations for the OPERATING MODES and at the frequencies shown in Table 4.2-E.

## Table 3.2-E

## DRYWELL LEAK DETECTION INSTRUMENTATION

| INSTRUMENT | MINIMUM OPERABLE CHANNELS | APPLICABLE OPERATING MODES | ACTION |
|---|---|---|---|
| Sump System[a] | 1 | 1,2,3* | 60 |
| Air Sampling System[b] | 1 | 1,2,3* | 60 |

* When irradiated fuel is in the vessel.

(a) The Sump System is comprised of the Equipment Drain Sump and Floor Drain Sump Sub-systems.

The Equipment Drain Sump Sub-system consists of one Equipment Drain Sump Flow Integrator and two Equipment Drain Sump Flow Timers. The Floor Drain Sump Sub-system likewise consists of one Floor Drain Sump Flow Integrator and two Floor Drain Sump Flow Timers. The Sump System is OPERABLE when any one of these six devices is OPERABLE.

(b) The Air Sampling System provides a backup system to the Sump System. The Air Sampling System is OPERABLE when any one of the six available channels is OPERABLE.

### ACTION

ACTION 60 - See Specification 3.6.C.

## Table 3.2-E

## DRYWELL LEAK DETECTION INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| INSTRUMENT | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| Equipment Drain Sump Flow Integrator | D | NA | Q | 1,2,3* |
| Floor Drain Sump Flow Integrator | D | NA | Q | 1,2,3* |
| Equipment Drain Sump Flow Timer | NA | Q | A | 1,2,3* |
| Floor Drain Sump Flow Timer | NA | Q | A | 1,2,3* |
| Air Sampling System | D | M | Q | 1,2,3* |

---

* When irradiated fuel is in the vessel.

LIMITING CONDITIONS FOR OPERATION

F. SURVEILLANCE INSTRUMENTATION

1. The surveillance instrumentation channels shall be OPERABLE as shown in Table 3.2-F.

Applicability

As shown in Table 3.2-F.

Action

With the number of OPERABLE channels less than required by the Minimum Operable Channels requirement, take the ACTION required by Table 3.2-F.

SURVEILLANCE REQUIREMENT

F. SURVEILLANCE INSTRUMENTATION

1. Each surveillance instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK and CHANNEL CALIBRATION operations at the frequencies shown in Table 4.2-F.

## Table 3.2-F

## SURVEILLANCE INSTRUMENTATION

| INSTRUMENT | TYPE/RANGE | MINIMUM OPERABLE CHANNELS | TOTAL CHANNELS PROVIDED | ACTION |
|---|---|---|---|---|
| Reactor Water Level | Recorder, indicator 158 to 218 Inches | 2 | 3 | 90 |
| Reactor Pressure | Recorder, indicator 0-1200 psig | 2 | 3 | 90 |
| Drywell Pressure | Recorder -10 to +90 psig | 2 | 2 | 90 |
| Drywell Temperature | Recorder 0-350°F | 2 | 8 | 90 |
| Torus Water Temperature | Recorder 20-220°F | 2 | 2 | 90 |
| Torus Water Level | Recorder -10 to +10 Inches $H_2O$ | 2 | 2 | 90 |
| Source Range Monitoring | $10^{-1}$ to $10^{6}$ cps | 3[a][b] | 4 | 90 |
| IRM/APRM | 0 to 125% | 2/Trip System[a][b] | 3/Trip System | 90 |

(a) The Source Range Monitors and Intermediate Range Monitors are not required in Operating Mode 1.

(b) These instruments are considered to be redundant to each other.

### ACTIONS

ACTION 90 - a. From and after the date that one of these parameters is reduced to one indication, when required, continued operation is permissible during the succeeding thirty days unless such instrumentation is sooner made OPERABLE.

b. From and after the date that one of these parameters is not indicated in the Control Room, continued operation is permissible during the succeeding seven days unless such instrumentation is sooner made OPERABLE.

c. If the requirements of (a) and (b) cannot be met, an orderly shutdown shall be initiated and the reactor shall be in a COLD SHUTDOWN condition within 24 hours.

Table 4.2-F

SURVEILLANCE INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| INSTRUMENT | CHANNEL CHECK | CHANNEL CALIBRATION |
|---|---|---|
| Reactor Water Level | Once/Shift | SA |
| Reactor Pressure | Once/Shift | SA |
| Drywell Pressure | Once/Shift | SA |
| Drywell Temperature | Once/Shift | SA |
| Torus Water Temperature | Once/Shift | SA |
| Torus Water Level | Once/Shift | SA |
| Control Rod Position | Once/Shift | NA |
| Average Power Range Monitoring | Once/Shift* | (a) |

* In STARTUP or RUN Mode only.

(a) Prior to reaching 20% power and once per day when in RUN Mode (APRM Gain Adjust when in RUN Mode).

LIMITING CONDITIONS FOR OPERATION

G. RECIRCULATION PUMP TRIP (RPT) AND ALTERNATE ROD INSERTION (ARI) INSTRUMENTATION

1. (ATWS) - RPT/ARI

The instrumentation that trips the recirculation pumps and initiates ARI as a means of limiting the consequences of a failure to scram during an anticipated transient shall be OPERABLE as shown in Table 3.2-G.

(EOC)-RPT

The instrumentation that trips the recirculation pumps during stop valve or control valve fast closure for transient margin improvement (especially at end-of-cycle) shall be OPERABLE as shown in Table 3.2-G with the RPT SYSTEM TIME RESPONSE as shown in Table 4.2-G.

Applicability:

As shown in Table 3.2-G

Action:

With one or more (ATWS)RPT/ARI or (EOC)-RPT instrument channels inoperable, take the ACTION required by Table 3.2-G.

SURVEILLANCE REQUIREMENT

G. RECIRCULATION PUMP TRIP (RPT) AND ALTERNATE ROD INSERTION (ARI) INSTRUMENTATION

1. Each RPT and ARI instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK, FUNCTIONAL TEST and CHANNEL CALIBRATION operations at the frequencies shown in Table 4.2-G.

2. LOGIC SYSTEM FUNCTIONAL TESTS and simulated automatic operation of all ATWS-RPT/ARI instrumentation channels shall be performed at least once per operating cycle.

3. Time response testing of the RPT breakers shall be performed at least once per operating cycle.

## Table 3.2-G

## (ATWS)RPT/ARI AND EOC-RPT INSTRUMENTATION

| TRIP FUNCTION | TRIP LEVEL SETTING | MINIMUM OPERABLE CHANNELS PER TRIP SYSTEM[a] | APPLICABLE OPERATING MODE | ACTION |
|---|---|---|---|---|
| (ATWS) RPT/ARI Reactor High Pressure | ≤ 1140 psig | 2[b][c] | 1 | 80 |
| (ATWS) RPT/ARI Reactor Water Level-Low-Low | ≥ +119.5 inches | 2[b][c] | 1 | 80 |
| (EOC) RPT Logic | NA | 1[d][e] | 1 | 81 |

(a) There shall be one OPERABLE trip system for each parameter. If this cannot be met, the indicated ACTION shall be taken.

(b) There are 2 trip systems. The instruments are arranged in a two-out-of-two once logic.

(c) If an instrument(s) is(are) inoperable, it may be considered to be OPERABLE if placed in a tripped condition.

(d) Two (EOC)RPT systems exist, either of which will trip both recirculation pumps.

(e) If the duration of required surveillance testing for a RPT system exceeds two consecutive hours, the RPT system shall be declared inoperable.

## ACTION

ACTION 80 - a. With one instrument channel inoperable, restore the inoperable instrument channel to OPERABLE status within 7 days or be in at least HOT STANDBY within the next 24 hours.

b. With both instrument channels inoperable, restore at least one instrument channel to OPERABLE status within 72 hours or be in at least HOT STANDBY within the next 24 hours.

ACTION 81 - If both RPT systems are inoperable or if one RPT system is inoperable for more than 72 consecutive hours, an orderly power reduction shall be initiated and reactor power shall be less than 85% within 4 hours.

Table 4.2-G

(ATWS)RPT/ARI AND EOC-RPT INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| TRIP FUNCTION | CHANNEL CHECK | CHANNEL FUNCTIONAL TEST | CHANNEL CALIBRATION | OPERATING MODES FOR WHICH SURVEILLANCE REQUIRED |
|---|---|---|---|---|
| (ATWS) RPT/ARI Reactor High Pressure | NA | A | A | 1 |
| (ATWS) RPT/ARI Reactor Water Level-Low-Low | NA | A | A | 1 |
| (EOC) RPT Logic | NA | M | NA | 1 |
| RPT Breaker | NA | R | NA | 1 |

END-OF-CYCLE (EOC) RECIRCULATION PUMP TRIP SYSTEM RESPONSE TIME

| TRIP FUNCTION | RESPONSE TIME |
|---|---|
| RPT System | ≤ 140 msec * |

* This response time is from initiation of Turbine Control Valve Fast Closure or Turbine Stop Valve Closure to actuation of the breaker secondary (auxiliary) contact.

| LIMITING CONDITIONS FOR OPERATION | SURVEILLANCE REQUIREMENT |
|---|---|
| H. ACCIDENT MONITORING INSTRUMENTATION | H. ACCIDENT MONITORING INSTRUMENTATION |
| 1. The accident monitoring instrumentation channels shown shall be OPERABLE as shown in Table 3.2-H. | 1. Each accident monitoring instrumentation channel shall be demonstrated OPERABLE by the performance of the CHANNEL CHECK and CHANNEL CALIBRATION operations at the frequencies shown in Table 4.2-H. |
| Applicability:<br>As shown in Table 3.2-H. | |
| Action:<br>With one or more accident monitoring instrumentation channels inoperable, take the ACTION required by Table 3.2-H. | |

## Table 3.2-H

## ACCIDENT MONITORING INSTRUMENTATION

| INSTRUMENT | MINIMUM CHANNELS OPERABLE | APPLICABLE OPERATING MODES | ACTION |
|---|---|---|---|
| Safety/Relief Valve Position Indicator (Primary Detector) | 1/Valve[a] | 1,2,3 | 90 |
| Safety Valve Position Indicator (Primary Detector) | 1/Valve[a] | 1,2,3 | 90 |
| Reactor Coolant, Containment Atmosphere, and Torus Water Post-Accident Sampling | 1(each) | 1,2,3 | 91 |
| Extended Range Effluent Radiation Monitors: | | | |
| a) Reactor Building Exhaust Stack | 1 | 1,2,3 | 92 |
| b) Turbine Building Exhaust Stack | 1 | 1,2,3 | 92 |
| c) Offgas Stack | 1 | 1,2,3 | 92 |
| Drywell Radiation Monitor | 1 | 1,2,3 | 92 |
| Torus Radiation Monitor | 1 | 1,2,3 | 92 |
| Drywell Pressure Monitor (0-250 psig) | 2 | 1,2,3 | 93 |
| Drywell Pressure Monitor (-5 to +5 psig) | 2 | 1,2,3 | 93 |
| Torus Water Level Monitor (1.5 to 16 feet) | 2 | 1,2,3 | 94 |
| Containment Hydrogen/Oxygen In-line Monitor | 2[b] | 1,2,3 | 95 |

(a) Each channel is comprised of three instruments (pressure switches) which are arranged in a "two out of three" logic.

(b) Normal condition is with monitor in Standby Mode.

ACTION

ACTION 90 - From and after the date that a channel is inoperable, the torus temperature will be monitored at least once per shift to observe any unexplained temperature increase which might be indicative of an open SRV; continued reactor operation is permissible only during the succeeding 30 days, unless such channel is sooner made OPERABLE.

ACTION 91 - When the ability to obtain a sample has been lost:

a. Within 7 days, confirm a sample can be obtained within 24 hours of the time a decision is made to sample; and

b. Within 90 days, restore the sampling capability.

Otherwise, be in at least HOT SHUTDOWN within the next 24 hours.

When the ability to analyze a sample has been lost:

a. Within 7 days, confirm that alternative sample analytical support* services can be initiated within 24 hours of the time a decision is made to sample; and

b. Within 90 days, restore sample analysis capability.

Otherwise, be in at least HOT SHUTDOWN within the next 24 hours.

ACTION 92 - With the number of OPERABLE channels (both indicator and recorder inoperable) less than the Minimum Channels Operable requirement, initiate the preplanned alternate method of monitoring the appropriate parameter(s) within 72 hours, and:

a. Either restore the inoperable channel(s) to OPERABLE status within 7 days following the event, or

b. Prepare and submit a Special Report to the Commission within 14 days following the event describing the action taken, the cause of the inoperability and the plans and schedule for restoring the system to OPERABLE status.

ACTION 93 - If the number of OPERABLE channels (both indicator and recorder inoperable) is reduced to one channel, follow either step (a) or (b) below.

a. Operation may continue for the next 30 days provided at least one (1) channel of instrumentation specified in Table 3.2-F for the identical parameter is OPERABLE** or follow step (c) below.

b. Restore the inoperable channel to OPERABLE status within 7 days, should neither channel of instrumentation specified in Table 3.2-F for the identical parameter be OPERABLE, or follow step (c) below.

c. Within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

If the number of OPERABLE channels (both indicator and recorder inoperable) is reduced to zero (e.g., no channels available) restore the inoperable channel(s) to OPERABLE status within 48 hours or within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

* The requirement for alternative analytical support for containment hydrogen and oxygen may be satisfied by verifying that at least one of the $H_2O_2$ in-line monitors is on-line and capable of being lined up to each of the two sampling points (drywell and torus).

** The instruments in Table 3.2-F which measure the identical parameters are the -10 to 90 psig drywell pressure monitors.

## Table 3.2-H (Continued)

## ACCIDENT MONITORING INSTRUMENTATION

## ACTION

ACTION 94 - If the number of OPERABLE channels (both indicator and recorder inoperable) is reduced to one channel, follow either step (a) or (b) below.

a. Operation may continue for the next 30 days provided at least one torus water level channel and one containment water level channel is available.*** If these conditions cannot be met, follow step (b) below.

b. Operation may continue for the next 7 days if one torus water level channel is available and there are no other containment water level channels available. If these conditions cannot be met, follow step (c) below.

c. Within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

If the number of OPERABLE channels (both indicator and recorder inoperable) is reduced to zero (e.g., no channels available) restore at least one channel to OPERABLE status within 48 hours or within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

ACTION - 95 If the number of OPERABLE channels (both indicator and recorder inoperable) is reduced to one channel, follow either step (a) or (b) below .

a. Within 30 days, increase the number of OPERABLE channels to the Minimum Number Channels Required or follow step (c) below.

b. Within 30 days, and at least once every 7 days thereafter, demonstrate the ability to obtain and analyze containment samples for hydrogen and oxygen or follow step (c) below. If this sampling is done, but the number of OPERABLE channels is not increased to the Minimum Number Channels Required within 60 days from the time of initial loss, follow step (c) below.

c. Within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

If the number of Operable channels (both indicator and recorder inoperable) is reduced to zero (e.g., no channels available) follow either step (a) or step (b) below.

a. Restore at least one channel to OPERABLE status within 7 days or follow step (c) below.

b. Within 7 days, and at least every other day thereafter, demonstrate the ability to obtain and analyze containment samples for hydrogen and oxygen or follow step (c) below. If this sampling is done, but the number of OPERABLE channels is not increased to one channel within 14 days from the time of initial loss, follow step (c) below.

c. Within the following 12 hours be in at least HOT STANDBY and within the next 24 hours be in COLD SHUTDOWN.

*** The containment water level monitors provide indication from 0 to +98 feet.

Table 4.2-H

ACCIDENT MONITORING INSTRUMENTATION SURVEILLANCE REQUIREMENTS

| INSTRUMENT | CHANNEL CHECK | CHANNEL CALIBRATION | APPLICABLE OPERATING MODE |
|---|---|---|---|
| Safety/Relief Valve Position Indicator (Primary Detector)[a] | M | R | 1,2,3 |
| Safety/Relief Valve Position Indicator (Backup-Thermocouple) | M | R | 1,2,3 |
| Safety Valve Position Indicator (Primary Detector)[a] | M | R | 1,2,3 |
| Safety Valve Position Indicator (Backup-Thermocouple) | M | R | 1,2,3 |
| Reactor Coolant, Containment Atmosphere, and Torus Water Post-Accident Sampling | NA | A[d] | 1,2,3 |
| Extended Range Effluent Radiation Monitors: | | | |
| a) Reactor Building Exhaust Stack | W | A[c] | 1,2,3 |
| b) Turbine Building Exhaust Stack | W | A[c] | 1,2,3 |
| c) Offgas Stack | W | A[c] | 1,2,3 |
| Drywell Radiation Monitor | M | R[b] | 1,2,3 |
| Torus Radiation Monitor | M | R[b] | 1,2,3 |
| Drywell Pressure Monitor (0 to 250 psig) | M | A | 1,2,3 |
| Drywell Pressure Monitor (-5 to +5 psig) | M | A | 1,2,3 |
| Torus Water Level Monitor (1.5 to 16 feet) | M | R | 1,2,3 |
| Containment Water Level Monitor | M | R | 1,2,3 |
| Containment Hydrogen/Oxygen In-line Monitor | M[e] | SA[e] | 1,2,3 |

NOTES

(a) Functional test of the relay is done once/3 months.
(b) CHANNEL CALIBRATION shall consist of an electronic calibration of the channel for ranges above 10 R/hr and a one point calibration check of the detector below 10 R/hr with a portable gamma source.
(c) Accident range effluent monitors shall be calibrated by means of a built-in check source or a known radioactive source.
(d) Not a calibration, but a demonstration of system operability.
(e) Monitors shall be tested for operability using standard bottled $H_2$ and $O_2$.

## 3.2 BASES

In addition to reactor protection instrumentation which initiates a reactor scram, protective instrumentation has been provided which initiates action to mitigate the consequences of accidents which are beyond the operator's ability to control, or terminates operator errors before they result in serious consequences. The objectives of the Specifications are:

1. To ensure the effectiveness of the protective instrumentation when required including periods when portions of such systems are out of service for maintenance. When necessary, one channel may be made inoperable for brief intervals to conduct required functional tests and calibrations.

2. To prescribe the trip settings required to assure adequate performance.

Some of the settings on the instrumentation that initiate or control core and containment cooling have tolerances explicitly stated where the high and low values are both critical and may have a substantial effect on safety. The setpoints of other instrumentation, where only the high or low end of the setting has a direct bearing on safety, are chosen at a level away from the normal operating range to prevent inadvertent actuation of the safety system involved and exposure to abnormal situations.

The instrumentation which initiates primary system isolation is connected in a dual bus arrangement.

The reactor water level trip settings are defined or described in "inches" above the top of active fuel. The term top of active fuel, however, no longer has a precise physical meaning since the length of the fuel pellet columns has changed over time from that of the initial core load. Since the basis of all safety analyses is the absolute level (inches above vessel zero) of the trip settings, the "top of the active fuel" has been arbitrarily defined to be 344.5 inches above vessel zero. This definition is the same as that given by Figure 5.1-1 of the Updated FSAR for the initial core and maintains the consistency between the various level definitions given in the FSAR and the technical specifications.

The low water level instrumentation set to trip at 170" above the top of the active fuel closes all isolation valves except those in Groups 1, 6, 7 and 9 (see notes to Table 3.7-3 for isolation valve groups). Details of valve grouping and required closing times are given in Specification 3.7. For valves which isolate at this level this trip setting is adequate to prevent uncovering the core in the case of a break in the largest line assuming a 60 second valve closing time. Required closing times are less than this.

The low-low reactor water level instrumentation is set to trip when reactor water level is 119.5" above top of the active fuel. This trip initiates the HPCI and RCIC and trips the recirculation pumps. The low-low-low reactor water level instrumentation is set to trip when the water level is 18.5" above the top of the active fuel. This trip activates the remainder of the ECCS subsystems, closes Group 7 valves, closes Main Steam Line Isolation Valves, Main Steam Drain Valves, Recirc Sample Valves (Group 1) and starts the emergency diesel generators. These trip level settings were chosen to be high enough to prevent spurious actuation but low enough to initiate ECCS operation and primary system isolation so that post accident cooling can be accomplished and the guidelines of 10 CFR 100 will not be exceeded. For large breaks up to the complete circumferential break of a 22-inch recirculation line and with the trip setting given above, ECCS initiation and primary system isolation are initiated in time to meet the above criteria. Reference Sections 6.3 and 7.3 of the Updated FSAR.

The high drywell pressure instrumentation is a diverse signal for malfunctions to the water level instrumentation and in addition to initiating ECCS, it causes isolation of Group 2 and 3 isolation valves. For the breaks discussed above, this instrumentation will generally initiate ECCS operation before the low-low-low water level instrumentation; thus the results given above are applicable here also. See Specification 3.7 for Isolation Valve Closure Group. The water level instrumentation initiates protection for the full spectrum of loss-of-coolant accidents and causes isolation of all isolation valves except Group 6.

Venturis are provided in the main steam lines as a means of measuring steam flow and also limiting the loss of mass inventory from the vessel during a steam line break accident. The primary function of the instrumentation is to detect a break in the main steam line. For the worst case accident, main steam line break outside the drywell, a trip setting of 140% of rated steam flow in conjunction with the flow limiters and consequently main steam line valve closure, limits the mass inventory loss such that fuel is not uncovered, fuel clad temperatures peak at approximately 1000°F and release of radioactivity to the environs is below 10 CFR 100 guidelines. Reference Subsection 15.6.5 of the Updated FSAR.

Temperature monitoring instrumentation is provided in the main steam line tunnel and turbine building to detect leaks in this area. Trips are provided on this instrumentation and when exceeded, cause closure of isolation valves. The setting is 200°F for the main steam line tunnel detector. For large breaks, the high steam flow instrumentation is a backup to the temperature instrumentation.

High radiation monitors in the main steam line tunnel have been provided to detect gross fuel failure as in the control rod drop accident. With the established setting of 3 times normal background, and main steam line isolation valve closure, fission product release is limited so that 10 CFR 100 guidelines are not exceeded for this accident. For the performance of a Hydrogen Water Chemistry pre-implementation test, the scram setpoint may be changed based on a calculated value of the radiation level expected during the test. Hydrogen addition will result in an approximate one- to five-fold increase in the nitrogen (N-16) activity in the steam due to increased N-16 carryover in the main steam. Reference Subsection 15.4.7 of the Updated FSAR.

Pressure instrumentation is provided to close the main steam isolation valves in the RUN Mode when the main steam line pressure drops below 850 psig. The Reactor Pressure Vessel thermal transient due to an inadvertent opening of the turbine bypass valves when not in the RUN Mode is less severe than the loss of feedwater analyzed in Subsection 15.6.3 of the Updated FSAR, therefore, closure of the Main Steam Isolation valves for thermal transient protection when not in the RUN Mode is not required.

The HPCI high flow and temperature instrumentation are provided to detect a break in the HPCI steam piping. Tripping of this instrumentation results in actuation of HPCI isolation valves. Tripping logic for the high flow is a 1 out of 2 logic.

Temperature is monitored at two (2) locations with four (4) temperature sensors at each location. Two (2) sensors at each location are powered by "A" direct current control bus and two (2) by "B" direct current control bus. Each pair of sensors, e.g., "A" or "B", at each location are physically separated and the tripping of either "A" or "B" bus sensor will actuate HPCI isolation valves.

The trip settings of +53" $H_2O$ (outboard instrument) and +99" $H_2O$ (inboard instrument) correspond to 300% of design flow for high flow and 175°F and Δ50° for high temperature are such that core uncovery is prevented and fission product release is within limits.

The RCIC high flow and temperature instrumentation are arranged the same as that for the HPCI. The trip setting of 110 ± 5" $H_2O$ for high flow and 175° and Δ50° for temperature are based on the same criteria as the HPCI.

The instrumentation which initiates ECCS action is arranged in a dual bus system. As for other vital instrumentation arranged in this fashion, the Specification preserves the effectiveness of the system even during periods when maintenance or testing is being performed. An exception to this is when logic system functional testing is being performed.

The control rod block functions are provided to prevent excessive control rod withdrawal so that the MCPR does not decrease below the Safety Limit. The trip logic for this function is 1 out of n: e.g., any trip on one of six APRM's, six IRM's, or four SRM's will result in a rod block.

The minimum instrument channel requirements assure sufficient instrumentation to assure the single failure criterion is met. The minimum instrument channel requirements for the RBM may be reduced by one for maintenance, testing, or calibration. This time period is only 3% of the operating time in a month and does not significantly increase the risk of preventing an inadvertent control rod withdrawal.

The APRM rod block function is flow biased and prevents a significant reduction in MCPR, especially during operation at reduced flow. The APRM provides gross core protection; i.e., limits the gross core power increase from withdrawal of control rods in the normal withdrawal sequence. The trips are set so that MCPR is maintained greater than the safety limit.

The RBM rod block function provides local protection of the core; i.e., the prevention of boiling transition in a local region of the core, for a single rod withdrawal error from a Limiting Control Rod Pattern.

The IRM rod block function provides local as well as gross core protection. The scaling arrangement is such that trip setting is less than a factor of 10 above the indicated level.

A downscale indication on an APRM or IRM is an indication the instrument has failed or the instrument is not sensitive enough. In either case the instrument will not respond to changes in control rod motion and thus, control rod motion is prevented. The downscale trips are set at 5 indicated on scale for APRM's and 5/125 full scale for IRM's.

Both of the scram discharge volume high level channels provide input to the "B" logic.

The refueling interlocks operate one logic channel, and are required for safety only when the mode switch is in the refueling position.

For effective emergency core cooling for small pipe breaks, the HPCI system must function since reactor pressure does not decrease rapidly enough to allow either core spray or LPCI to operate in time. The Automatic Depressurization System (ADS) is provided as a backup to HPCI. The arrangement of the ADS logic is such as to provide this function when necessary and minimize spurious operation. The trip settings given in the specification are adequate to assure the above criteria are met. The specification preserves the effectiveness of the system during periods of maintenance, testing, or calibration, and also minimizes the risk of inadvertent operation; i.e., only one instrument channel out of service.

Two air ejector offgas post-treatment monitors are provided. They are designed so that an instrument failure gives a downscale trip or an inoperative trip. When both instruments reach an upscale trip point, or when one reaches an upscale trip point and the other reaches a downscale trip point or an inoperative trip, a trip is actuated. The post-treatment monitors have three upscale trip setpoints, one (Hi) to initiate charcoal bed bypass valve closure (CV-4134A open and CV-4134B closing to route offgas through the charcoal) and another (Hi-Hi-Hi) to initiate offgas system isolation valve (CV-4108) closure. The third trip point (Hi-Hi) is for alarm initiation, and will initiate prior to the offgas isolation trip.

Two sets of two radiation monitors are provided which initiate the Reactor Building Isolation function and operation of the standby gas treatment system. Two instrument channels monitor the radiation from the refueling area ventilation exhaust ducts and two instrument channels monitor the building ventilation below the refueling floor.

Trip settings of < 9 mr/hr for the monitors in the refueling area ventilation exhaust ducts are based upon initiating normal ventilation isolation and standby gas treatment system operation so that none of the activity released during the refueling accident leaves the Reactor Building via the normal ventilation path but rather all the activity is processed by the standby gas treatment system.

Flow integrators are used to record the integrated flow of liquid from the drywell sumps. The alarm unit in each timer is set to annunciate before the values specified in Specification 3.6.C are exceeded. An air sampling system is also provided, as a backup to the sump system, to detect leakage inside the primary containment.

For each parameter monitored, as listed in Table 3.2.F, there are at least two (2) channels of instrumentation. By comparing readings between the two (2) channels, a near continuous surveillance of instrument performance is available. Any deviation in readings will initiate an early recalibration, thereby maintaining the quality of the instrument readings.

On July 26, 1984 the NRC published their final rule on Anticipated Transients Without Scram (ATWS), (10 CFR §50.62). This rule requires all BWR's to make certain plant modifications to mitigate the consequences of the unlikely occurrence of a failure to scram during an anticipated operational transient. The bases for these modifications are described in NEDE-31096-P-A, "Anticipated Transients Without Scram; Response to NRC ATWS Rule, 10 CFR 50.62," December, 1985. The Standby Liquid Control System (SLCS) was modified for two-pump operation to provide the minimum required flowrate and boron concentration required by the ATWS rule (see section 3.4 Bases). The existing ATWS Recirculation Pump Trip (RPT) was modified from a one-out-of-two-once logic to trip each recirc. pump to a two-out-of-two-once logic to trip both recirc. pumps, ("Monticello" design). This logic will also initiate the Alternate Rod Insertion (ARI) system, which actuates solenoid valves that bleed the air off the scram air header, causing the control rods to insert. The instrument setpoints are chosen such that the normal reactor protection system (RPS) scram setpoints for reactor high pressure or low water level will be exceeded before the ATWS RPT/ARI setpoints are reached. Because ATWS is considered a very low probability event and is outside the normal design basis for the DAEC, the surveillance frequencies and LCO requirements are less stringent than for safety-related instrumentation.

The End-of-Cycle (EOC) recirculation pump trip was added to the plant to improve the operating margin to fuel thermal limits, in particular Minimum Critical Power Ratio (MCPR). The EOC-RPT trips the recirc. pumps to lessen the severity of the power increases caused by either a closure of turbine stop valves or fast closure of the turbine control valves with reactor power greater than 30% and a simultaneous failure of the turbine bypass valves to open. The operating limit MCPR of section 3.12.C is calculated assuming an operable EOC-RPT system. If the requirements of Table 3.2-G are not met, then the reactor power level is reduced to a level (85% of rated) which will ensure that the full-power MCPR limits of section 3.12.C will not be violated if such a transient were to occur.

The accident monitoring instrumentation listed in Table 3.2-H were specifically added to comply with the requirements of NUREG-0737 and Generic Letter 83-36. The instrumentation listed is designed to provide plant status for accidents that exceed the design basis accidents discussed in Chapter 15 of the DAEC UFSAR.

Action 94 of Table 3.2-H deviates from the guidance of Generic Letter 83-36 as continued operation for 30 days (instead of 7 days as recommended in the generic letter) is allowed with one of two torus water level monitor (TWLM) channels inoperable. Redundancy is available in that at least one channel of the containment water level monitor (CWLM) instrumentation must be available. Since the CWLM envelopes the span measured by the TWLM, the torus water level can be monitored by the CWLM system. Therefore, continued operation is justified.

Main Condenser Offgas

Restricting the gross radioactivity rate of noble gases from the main condenser provides reasonable assurance that the total body exposure to an individual at the exclusion area boundary will not exceed a small fraction of the limits of 10 CFR Part 100 in the event this effluent is inadvertently discharged directly to the environment without treatment. This specification implements the requirements of General Design Criteria 60 and 64 of Appendix A to 10 CFR Part 50.

## 4.2 BASES

The instrumentation listed in Table 4.2-A through 4.2-F will be functionally tested and calibrated at regularly scheduled intervals. The same design reliability goal as the Reactor Protection System of 0.99999 is generally applied for all applications of (1 out of 2) X (2) logic. Therefore, on-off sensors are tested once/3 months, and bi-stable trips associated with analog sensors and amplifiers are tested once/week.

Those instruments which, when tripped, result in a rod block have their contacts arranged in a 1 out of n logic, and all are capable of being bypassed. For such a tripping arrangement with bypass capability provided, there is an optimum test interval that should be maintained in order to maximize the reliability of a given channel (7). This takes account of the fact that testing degrades reliability and the optimum interval between tests is approximately given by:

$$I=\sqrt{\frac{2t}{I}}$$

Where: i = the optimum interval between tests.

t = the time the trip contacts are disabled from performing their function while the test is in progress.

r = the expected failure rate of the relays.

To test the trip relays requires that the channel be bypassed, the test made, and the system returned to its initial state. It is assumed this task requires an estimated 30 minutes to complete in a thorough and workmanlike manner and that relays have a failure rate of $10^{-6}$ failures per hour. Using this data and the above operation, the optimum test interval is:

$$i=\sqrt{\frac{2(0.5)}{10^{-6}}}=1x10^{3}hours$$

$$= 40 \text{ days}$$

For additional margin a test interval of once per month will be used initially.

The sensors and electronic apparatus have not been included here as these are analog devices with readouts in the control room and the sensors and electronic apparatus can be checked by comparison with other like instruments. The checks which are made on a daily basis are adequate to assure operability of the sensors and electronic apparatus, and the test interval given above provides for optimum testing of the relay circuits.

The above calculated test interval optimizes each individual channel, considering it to be independent of all others. As an example, assume that there are two channels with an individual technician assigned to each. Each technician tests his channel at the optimum frequency, but the two technicians are not allowed to communicate so that one can advise the other that his channel is under test. Under these conditions, it is possible for both channels to be under test simultaneously. Now, assume that the technicians are required to communicate and that two channels are never tested at the same time.

Forbidding simultaneous testing improves the availability of the system over that which would be achieved by testing each channel independently. These one out of n trip systems will be tested one at a time in order to take advantage of this inherent improvement in availability.

Optimizing each channel independently may not truly optimize the system considering the overall rules of system operation. However, true system optimization is a complex problem. The optimums are broad, not sharp, and optimizing the individual channels is generally adequate for the system.

The formula given above minimizes the unavailability of a single channel which must be bypassed during testing. The minimization of the availability is illustrated by Curve No. 1 of Figure 4.2-2 which assumes that a channel has a failure rate of 0.1 x $10^{-6}$/hour and that 0.5 hours is required to test it. The unavailability is a minimum at a test interval i, of 3.16 x $10^{3}$ hours.

If two similar channels are used in a 1 out of 2 configuration, the test interval for minimum unavailability changes as a function of the rules for testing. The simplest case is to test each one independent of the other. In this case, there is assumed to be a finite probability that both may be bypassed at one time. This case is shown by Curve No. 2. Note that the unavailability is lower as expected for a redundant system and the minimum occurs at the same test interval. Thus, if the two channels are tested independently, the equation above yields the test interval for minimum unavailability.

A more usual case is that the testing is not done independently. If both channels are bypassed and tested at the same time, the result is shown in Curve No. 3. Note that the minimum occurs at about 40,000 hours, much longer than for cases 1 and 2. Also, the minimum is not nearly as low as Case 2 which indicates that this method of testing does not take full advantage of the redundant channel. Bypassing both channels for simultaneous testing should be avoided.

The most likely case would be to stipulate that one channel be bypassed, tested, and restored, and then immediately following, the second channel be bypassed, tested and restored. This is shown in Curve No. 4. Note that there is no true minimum. The curve does have a definite knee and very little reduction in system unavailability is achieved by testing at a shorter interval than computed by the equation for a single channel.

The best test procedure of all those examined is to perfectly stagger the tests. That is, if the test interval is four months, test one or the other channel every two months. This is shown in Curve No. 5. The difference between Cases 4 and 5 is negligible. There may be other arguments, however, that more strongly support the perfectly staggered tests, including reductions in human error.

The conclusions to be drawn are these:

1. A 1 out of n system may be treated the same as a single channel in terms of choosing a test interval.

2. More than one channel should not be bypassed for testing at any one time.

# ENVIRONMENTAL CONSIDERATION

10 CFR 51.22(c)(9) provides criterion for and identification of licensing and regulatory actions eligible for categorical exclusion from performing an environmental assessment. A proposed amendment to an operating license for a facility requires no environmental assessment if operation of the facility in accordance with the proposed amendment would not: (1) involve a significant hazards consideration; (2) result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite; and (3) result in an increase in individual or cumulative occupational radiation exposure. Iowa Electric Light and Power has reviewed this request and determined that the proposed amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment needs to be prepared in connection with the issuance of the amendment. The basis for this determination follows:

## Basis

The change meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9) for the following reasons:

1. As demonstrated in Attachment 1, the proposed amendment does not involve a significant hazards consideration.

2. The proposed amendment does not result in a significant change in the types or significant increase in the amounts of any effluents that may be released offsite.

3. The proposed amendment does not result in an increase in individual or cumulative occupational radiation exposure.

# GENERAL ELECTRIC COMPANY

## AFFIDAVIT

I, David J. Robare, being duly sworn, depose and state as follows:

1. I am Manager, Plant Licensing Services, General Electric Company, and have been delegated the function of reviewing the information described in paragraph 2 which is sought to be withheld and have been authorized to apply for its withholding.

2. The information sought to be withheld is contained in the report entitled "Technical Specification Improvement Analysis for the Reactor Protection System for Duane Arnold Energy Center," MDE-95-0485, April 1985.

3. In designating material as proprietary, General Electric utilizes the definition of proprietary information and trade secrets set forth in the American Law Institute's Restatement of Torts, Section 757. This definition provides:

   "A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business and which gives him an opportunity to obtain an advantage over competitors who do not know or use it.... A substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring information.... Some factors to be considered in determining whether given information is one's trade secret are: (1) the extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and to his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with the which the information could be properly acquired or duplicated by others."

4. Some examples of categories of information which fit into the definition of proprietary information are:

   a. Information that discloses a process, method or apparatus where prevention of its use by General Electric's competitors without license from General Electric constitutes a competitive economic advantage over other companies;

   b. Information consisting of supporting data and analyses, including test data, relative to a process, method or apparatus, the application of which provide a competitive economic advantage, e.g., by optimization or improved marketability;

c. Information which if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality or licensing of a similar product;

d. Information which reveals cost or price information, production capacities, budget levels or commercial strategies of General Electric, its customers or suppliers;

e. Information which reveals aspects of past, present or future General Electric customer-funded development plans and programs of potential commercial value to General Electric;

f. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection;

g. Information which General Electric must treat as proprietary according to agreements with other parties.

5. Initial approval of proprietary treatment of a document is typically made by the Subsection manager of the originating component, who is most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge. Access to such documents within the Company is limited on a "need to know" basis and such documents are clearly identified as proprietary.

6. The procedure for approval of external release of such a document typically requires review by the Subsection Manager, Project Manager, Principal Scientist or other equivalent authority, by the Subsection Manager of the cognizant Marketing function (or delegate) and by the Legal Operation for technical content, competitive effect and determination of the accuracy of the proprietary designation in accordance with the standards enumerated above. Disclosures outside General Electric are generally limited to regulatory bodies, customers and potential customers and their agents, suppliers and licensees then only with appropriate protection by applicable regulatory provisions or proprietary agreements.

7. The document mentioned in paragraph 2 above has been evaluated in accordance with the above criteria and procedures and has been found to contain information which is proprietary and which is customarily held in confidence by General Electric.

8. The information to the best of my knowledge and belief has consistently been held in confidence by the General Electric Company, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties have been made pursuant to regulatory provisions of proprietary agreements which provide for maintenance of the information in confidence.

9. Public disclosure of the information sought to be withheld is likely to cause substantial harm to the competitive position of the General Electric Company and deprive or reduce the availability of profit making opportunities because it would provide other parties, including competitors, with valuable information regarding the application of reliability based methodology to BWR instrumentation. A substantial effort has been expended by General Electric to develop this information in support of the BWR Owners' Group Technical Specification Improvement Program.

STATE OF CALIFORNIA ) ss:
COUNTY OF SANTA CLARA )

David J. Robare, being duly sworn, deposes and says:

That he has read the foregoing affidavit and the matters stated therein are true and correct to the best of his knowledge, information, and belief.

Executed at San Jose, California, this 2ND day of DECEMBER, 1991.

David J. Robare

David J. Robare
General Electric Company

Subscribed and sworn before me this 2nd day of December 1991.

OFFICIAL SEAL
PAULA F. HUSSEY
NOTARY PUBLIC - CALIFORNIA
SANTA CLARA COUNTY
My comm. expires APR 5, 1994

Paula F. Hussey

NOTARY PUBLIC, STATE OF CALIFORNIA