UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

PUBLIC SERVICE COMPANY OF COLORADO

DOCKET NO. 50-267

FORT ST. VRAIN NUCLEAR GENERATING STATION

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 77
License No. DPR-34

1. The Nuclear Regulatory Commission (the Commission) has found that:

   A. The application for amendment by Public Service Company of Colorado (the licensee) dated September 14, 1989 as revised October 13, October 30 and December 4, 1989, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's regulations set forth in 10 CFR Chapter I;

   B. The facility will operate in conformity with the application, as amended, the provisions of the Act, and the regulations of the Commission;

   C. There is reasonable assurance: (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;

   D. The issuance of this license amendment will not be inimical to the common defense and security or to the health and safety of the public; and

   E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.

2. Accordingly, the license is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and paragraph 2.D.(2) of Facility Operating License No. DPR-34 is hereby amended to read as follows:

   (2) Technical Specifications

   The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 77 , are hereby incorporated in the license. The licensee shall operate the facility in accordance with the Technical Specifications.

3. The license amendment is effective as of its date of issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

Seymour H. Weiss

Seymour H. Weiss, Director
Non-Power Reactor, Decommissioning and
Environmental Project Directorate
Division of Reactor Projects - III,
IV, V and Special Projects
Office of Nuclear Reactor Regulation

Attachment:
Changes to the Technical
Specifications

Date of Issuance: January 24, 1990

ATTACHMENT TO LICENSE AMENDMENT NO. 77

TO FACILITY OPERATING LICENSE NO. DPR-34

DOCKET NO. 50-267

Replace the following pages of the Appendix A Technical Specifications with the attached pages. The revised pages are identified by amendment number and contain vertical lines indicating the areas of change.

Remove	Insert
2-2	2-2
2-5	2-5
2-9	2-9
---	2-10
4.1-2 (mark out)	4.1-2
4.1-3	through
4.1-4	4.1-11
4.1-5	---
4.1-6	---
4.1-7	---
4.1-8	---
4.1-9	---
4.1-10	---
4.1-11	---
5.1-1	5.1-1
5.1-2	through
5.1-3	5.1-7
5.1-4	---
5.1-5	---
5.1-6	---
5.1-7	---
5.1-8	5.1-8
5.1-9	5.1-9
5.1-10	5.1-10
5.1-11	5.1-11
5.1-12	5.1-12
5.1-13	5.1-13
5.1-14	5.1-14
5.1-15	5.1-15
5.1-16	5.1-16
7.1-16	7.1-16
---	Reactivity Control Section 1-1 through 1-2 3/4 0-1 through 3/4 0-11 3/4 1-1 through 3/4 1-52

2.2 Equipment Surveillance Test

A test of the functional capability of a piece of equipment to determine that it is operable. This may consist of either an on line or off line demonstration of the operability of the equipment.

2.3 Instrumentation Surveillance

a) Channel Check

A qualitative determination that the channel is operable. The determination is made by observation of channel behavior during operation or comparison with other channels monitoring the same variable or related variables.

| b) Channel Test (CHANNEL FUNCTIONAL TEST)

A test of the functional capability of the channel to determine that it is operable. This may consist of the injection of a simulated signal into a channel as close as possible to the primary sensor to verify that it is operable.

c) Channel Calibration

The adjustment of a channel so that it corresponds within acceptable range and accuracy, to known values of the parameter which the channel monitors. Calibration shall encompass the channel and alarms up to the bistable output.

2.4 Irradiated Fuel

Irradiated fuel is fuel that has a radiation level ≥ 100 mr/hr measured one foot from the element surface.

2.5 Low Power Operation

Low Power Operation is any operation with the Wide Range Logarithmetic instrumentation indicating greater than 10E-3 and less than 2% of rated thermal power. |

2.16 Refueling Shutdown

The reactor is considered shut down for refueling purposes when the reactor mode switch is locked in the "Fuel Loading" position simultaneous with either hot shutdown or the cold shutdown reactivity conditions.

2.17 Safe Shutdown Cooling

Safe shutdown cooling refers to cooling of the core with Safe Shutdown Equipment providing for removal of core stored energy and for adequate sustained decay heat removal. The reactivity condition in the core is either hot or cold shutdown.

2.18 Surveillance Interval

A surveillance interval is the interval of time between surveillance check, tests, or calibration. Unless otherwise stated, the surveillance interval can be adjusted by ± 25% to accommodate normal operational schedules. Unless otherwise stated in these specifications, surveillance may be terminated on those instruments or equipment not in normal use during reactor shutdown or refueling shutdown.

2.23 CALCULATED BULK CORE TEMPERATURE

The CALCULATED BULK CORE TEMPERATURE (CBCT) shall be the calculated average temperature of the core, including graphite and fuel, but not the reflector, assuming a loss of all forced circulation of PRIMARY COOLANT FLOW. Use of the CALCULATED BULK CORE TEMPERATURE is explained in LCO 4.0.4.

2.24 CORE AVERAGE INLET TEMPERATURE

The CORE AVERAGE INLET TEMPERATURE shall be the arithmetic average of the operating circulator inlet temperatures, adjusted for circulator power input, steam generator regenerative heat input, and heat transfer to (or from) the PCRV liner cooling system.

2.25 ACTION

ACTION shall be that part of a specification which prescribes remedial measures required under designated conditions.

2.26 CORE ALTERATION(S)

CORE ALTERATION(S) shall be the movement or manipulation of any component within the PCRV that alters the core reactivity (except for insertion of control rod pairs or reserve shutdown material) or activities that could result in damage to the core components, while fuel is in the reactor vessel. Suspension of CORE ALTERATION(S) shall not preclude completion of movement of a component to a safe conservative position or condition.

2.27 CORE AVERAGE TEMPERATURE

a. During SHUTDOWN and REFUELING, CORE AVERAGE TEMPERATURE shall be the arithmetic average of the CORE AVERAGE INLET TEMPERATURE and the CORE AVERAGE OUTLET TEMPERATURE.

b. During STARTUP, LOW POWER, and POWER, CORE AVERAGE TEMPERATURE shall be thermodynamically calculated based on CORE AVERAGE INLET and CORE AVERAGE OUTLET TEMPERATURES, PRIMARY COOLANT FLOW, and THERMAL POWER.

2.28 POWER-TO-FLOW RATIO (P/F)

POWER-TO-FLOW RATIO (P/F) shall be the percentage of RATED THERMAL POWER divided by the percentage of design PRIMARY COOLANT FLOW at RATED THERMAL POWER.

2.29 PRIMARY COOLANT FLOW

The PRIMARY COOLANT FLOW shall be the sum of the helium massflow (lb/hr) for each of the OPERATING circulators. The design PRIMARY COOLANT FLOW at RATED THERMAL POWER is 3.5E+06 lb/hr.

2.30 SHUTDOWN MARGIN

SHUTDOWN MARGIN [illegible]l be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming that all OPERABLE control rod pairs are fully inserted except for the single control rod pair of highest reactivity worth capable of being withdrawn, which is assumed to be fully withdrawn.

2.31 THERMAL POWER

THERMAL POWER shall be the total reactor core heat transferred to the reactor coolant, as determined by an appropriate heat balance calculation, or from calibrated nuclear instrumentation.

REACTOR CORE AND REACTIVITY CONTROL - LIMITING CONDITIONS FOR OPERATION (Continued)

| The following Specifications have been superseded by Specifications
| in the Reactivity Control Section:

| LCO 4.1.2
| LCO 4.1.3
| LCO 4.1.4
| LCO 4.1.5
| LCO 4.1.6

5.1 REACTOR CORE AND REACTIVITY CONTROL - SURVEILLANCE REQUIREMENTS

The following Surveillance Requirements have been superseded by Specifications in the Reactivity Control Section:

SR 5.1.1
SR 5.1.2
SR 5.1.3

Specification SR 5.1.4 - Reactivity Status Surveillance

A surveillance check of the reactivity status of the core shall be performed at each startup and once per week during power operation. If the difference between the observed and the expected reactivity, based on normalization to a base steady state core condition, reaches 0.01 Δk, this discrepancy shall be considered an abnormal occurrence.

The initial base steady state core condition and changes of this base shall be approved by the NFSC.

Basis for Specification SR 5.1.4

The specified frequency of the surveillance check of the core reactivity status will assure that the difference between the observed and expected core reactivity will be evaluated regularly.

This specification is designed to ensure that the core reactivity level is monitored to reveal in a timely manner the existence of potential safety problems or operational problems. An unexpected and/or unexplained change in the observed core reactivity could be indicative of such problems.

The normalization to an initial base steady state core condition will eliminate discrepancies due to manufacturing tolerances, analytical modeling approximations and deficiencies in basic data at the beginning of operation. Changes of the base steady state core conditions are permissible to eliminate explainable discrepancies resulting from long-term reactivity burnup effects and core refuelings.

Comparison of predicted and observed reactivities in a base steady state configuration will ensure the comparison will be easily understood and readily evaluated.

Any reactivity anomaly greater than 0.01 Δk would be unexpected and its occurrence would be thoroughly investigated and evaluated. The value of 0.01 Δk is considered to be a safe limit since a shutdown margin of at least 0.01 Δk with the highest worth rod pair fully withdrawn is always maintained (see LCO 3.1.4).

Specification SR 5.1.5 - Withdrawn Rod Reactivity Surveillance

This Surveillance Requirement has been superseded by Specifications in the Reactivity Control Section.

Specification SR 5.1.6 - Core Safety Limit Surveillance

During power operation the total operating time of the fuel elements within the core at power-to-flow ratios above the curve of Figure 3.1-2 will be evaluated once per week when the plant operation is within the normal operating range, and as soon as practicable after any deviation from the normal operating range. These operating times will be compared to the allowable operating time of Specification SL 3.1 to assure that the Core Safety Limit has not been exceeded.

Basis for Specification SR 5.1.6

Only during operation of the plant outside of the normal operating range is there a potential for accumulating significant operating times at power-to-flow ratios greater than the curve of Figure 3.1-2. Therefore, weekly evaluations of the total accumulated operating time at power-to-flow ratios greater than the curve of Figure 3.1-2 is sufficient during normal operation.

Following any significant deviation from the normal operating range, the operation should be evaluated to determine the degree to which the actual total operation of the core approached the Core Safety Limit.

Specification SR 5.1.7 - Region Peaking Factor Surveillance

The calculated region peaking factors (RPF's) used in determining the individual region outlet temperatures for Regions 20 and 32 through 37 and percent RPF discrepancy (see LCO 4.1.7) for Regions 1 through 19 and 21 through 31 shall be evaluated according to the following schedule for each refueling cycle:

a) Calculated RPF's:

1) Prior to initial power operation after refueling.

2) At the equivalent of 20 (± 5) effective days at rated thermal power after refueling.

3) At the equivalent of 40 (± 5) effective days at rated thermal power after refueling.

4) At monthly intervals thereafter, provided that the core has accumulated an exposure of at least the equivalent of 10 effective days at rated thermal power since the previous evaluation. If the core has accumulated an exposure of less than the equivalent of 10 effective days at rated thermal power since the previous evaluation, the evaluation may be deferred until the next applicable interval.

b) Percent RPF Discrepancy: Within a total elapsed time of 10 calendar days at reactor power levels above 40% of rated thermal power after the completion of any of the

"Calculated RPF" evaluations required above with the following qualifications:

1) A "Percent RPF Discrepancy" evaluation shall be performed prior to exceeding 40% of rated thermal power for the first time after refueling, but at a reactor power above 30% of rated thermal power.

2) If the total elapsed time at reactor power levels above 40% of rated thermal power does not exceed 10 calendar days prior to the subsequent "Calculated RPF" evaluation, the "Percent RPF Discrepancy" evaluation is not required, but the total elapsed time at reactor power levels

above 40% of rated thermal power between "Percent RPF Discrepancy" evaluations shall not exceed 45 calendar days.

Basis for Specification SR 5.1.7

The calculated region peaking factors for Regions 20 and 32 through 37 and their comparison regions will change during the refueling cycle as fission product inventories saturate, fissile material and burnable poison are depleted, and control rods are withdrawn from the core. Evaluations based upon operating experience gained prior to completion of rise-to-power testing (i.e., Cycles 1 and 2 and part of Cycle 3) indicate that the ratio of the calculated region peaking factors in Regions 20 and 32 through 37 to the calculated region peaking factors in comparison regions as a function of control rod configuration, changes gradually in a predictable manner during a refueling cycle. A surveillance check of the calculated region peaking factors at the specified frequency will assure that the appropriate region peaking factors continue to be used in determining the region outlet temperature for Regions 20 and 32 through 37.

The calculated and measured region peaking factors for Regions 1 through 19 and 21 through 31 (candidate comparison regions) will change during the refueling cycle as fission product inventories saturate, fissile material and burnable poison are depleted, control rods are withdrawn from the core, and region flow characteristics change. A surveillance check of the percent region peaking factor discrepancy will provide assurance that the requirements of LCO 4.1.7c are being met for comparison regions. The frequency for surveillance has been established based upon conservative evaluations of potential fuel kernel migration, which could occur if a region with an excessively large, negative region peaking factc discrepancy were used as a comparison region.

SPECIFICATION SR 5.1.8 - MINIMUM HELIUM FLOW/MAXIMUM CORE REGION TEMPERATURE RISE SURVEILLANCE REQUIREMENT

The total helium circulator flow or the helium coolant temperature rise through each core region shall be determined to be within the limits of LCO 4.1.9 at least once per 12 hours.

BASIS for SPECIFICATION SR 5.1.8

Surveillance of the helium circulator flow or helium coolant temperature rise once per 12 hours ensures that the requirements of LCO 4.1.9 are met. In addition, plant procedures require that the flow rate, core outlet temperatures, and power level be monitored continuously whenever the power level is being changed or orifice valves are being adjusted. In performance of the surveillance, the total reactor helium coolant flow is determined by calculation consistent with the method used to determine the required flow for the analysis

ASSOCIATED LCO: LCO 4.1.9

(7) All Reportable Events.

(8) Any indication that there may be a deficiency in some aspect of design or operation of structures, systems, or components, that affect nuclear safety.

(9) Reports and meeting minutes of the PORC.

b. The Nuclear Facility Safety Committee shall approve:

(1) The control rod withdrawal sequence as required by Technical Specification 3/4.1.5.

(2) The initial base (reactivity) steady state core condition and changes to the base (reactivity) as required by Technical Specification LCO 4.1.8. NFSC permission is required before reactor operations may resume if a reactivity anomaly of 0.01 Delta K is reached.

(3) Proposed changes to facility, operating procedures and tests or experiments that are determined to involve an unreviewed environmental question.

c. Audits of facility activities shall be performed under the cognizance of the Nuclear Facility Safety Committee. These audits shall encompass:

(1) The conformance of facility operation to all provisions contained within the Technical Specifications and applicable license conditions at least once per year.

(2) The performance, training, and qualifications, of the facility staff at least once per year.

(3) The results of actions taken to correct deficiencies occurring in facility equipment, structures, systems, or method of operation that affect nuclear safety at least once per six months.

REACTIVITY CONTROL SECTION

| 1.0 DEFINITIONS

| The definitions of OPERATIONAL MODES shown in Table 1.0-1 for the
| Reactivity Control Technical Specifications are different from the
| definitions of various power levels for the Non-Reactivity Control
| Section Technical Specifications.

| OPERATIONAL MODE- MODE

| 1.1 An OPERATIONAL MODE (i.e. MODE) shall correspond to any one
| inclusive combination of Reactor Mode Switch Setting, Interlock
| Sequence Switch Setting, and % RATED THERMAL POWER, specified
| in Table 1.0-1.

TABLE 1.0-1

OPERATIONAL MODES

MODE	INTERLOCK SEQUENCE SWITCH SETTING	REACTOR MODE SWITCH SETTING	% RATED THERMAL POWER*
POWER OPERATION (P)	Power	Run	> 30%
LOW POWER (L)	Low Power @	Run	> 5% and ≤ 30%
STARTUP (S/U)	Startup	Run	≤ 5%
SHUTDOWN (S/D)	**	Off #	0
REFUELING (R) ***	**	Fuel Loading	0

* Excluding decay heat.

** Interlock Sequence Switch (ISS) may be in any position in SHUTDOWN and REFUELING.

*** Includes Reactor Internal Maintenance.

\# The Reactor Mode Switch setting may be changed for the purpose of performing surveillances or other tests, provided the control rods are verified to remain fully inserted (or as otherwise required for Refueling operations or surveillance testing) by a second licensed operator or other qualified member of the unit technical staff.

@ The Interlock Sequence Switch setting may be changed to the POWER position and power may be increased to no greater than 40%, for the purpose of performing surveillances or other tests, for up to 72 hours, without being considered a change in OPERATIONAL MODES.

3/4.0 REACTIVITY APPLICABILITY

These Applicability Specifications are specifically applicable to Reactivity Control Specifications 3/4.1.1 through 3/4.1.9 and shall not be used for any Non-Reactivity Control Section Specifications.

3.0 REACTIVITY LIMITING CONDITIONS FOR OPERATION

3.0.1 Compliance with the Limiting Conditions for Operation contained in the succeeding specifications is required during the OPERATIONAL MODES or other conditions specified therein, except that upon failure to meet the Limiting Conditions for Operation, the associated ACTION requirements shall be met.

3.0.2 Noncompliance with a specification shall exist when the requirements of the Limiting Condition for Operation and associated ACTION requirements are not met within the specified time intervals. If the Limiting Condition for Operation is restored prior to expiration of the specified time interval, completion of the ACTION requirements is not required.

3.0.3 When a Limiting Condition for Operation is not met, except as provided in the associated ACTION requirements, ACTION shall be initiated within 1 hour to place the unit in an OPERATIONAL MODE in which the specification does not apply by placing it, as applicable, in at least LOW POWER within the next 12 hours and in at least SHUTDOWN within the following 12 hours. This requirement is not applicable in SHUTDOWN or REFUELING.

3.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made when the conditions for the Limiting Condition for Operation are not met <u>and</u> the associated ACTION requires a shutdown if they are not met within a specified time interval. Entry into an OPERATIONAL MODE or specified condition may be made in accordance with ACTION requirements when conformance to them permits continued operation of the facility for an unlimited period of time. This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements, or as required by automatic or manual protective ACTION. Exceptions to these requirements are stated in the individual specifications.

3.0 LIMITING CONDITIONS FOR OPERATION (Continued)

3.0.5 Specifications identifying requirements in terms of CALCULATED BULK CORE TEMPERATURE (CBCT) shall be in accordance with the discussion in LCO 4.0.4.

4.0 REACTIVITY SURVEILLANCE REQUIREMENTS

4.0.1 Surveillance Requirements shall be applicable only during the OPERATIONAL MODES or other conditions specified for individual Limiting Conditions for Operation unless otherwise stated in an individual Surveillance Requirement.

4.0.2 Each Surveillance Requirement shall be performed within the specified time interval per Definition 2.18, "SURVEILLANCE INTERVAL".

4.0.3 Failure to perform a Surveillance Requirement within the allowed SURVEILLANCE INTERVAL, defined by SR 4.0.2, shall constitute noncompliance with the OPERABILITY requirements for a Limiting Condition for Operation. The time limits of the ACTION requirements are applicable at the time it is identified that a Surveillance Requirement has not been performed. The ACTION requirements may be delayed for up to 24 hours to permit the completion of the surveillance when the allowable outage time limits of the ACTION requirements are less than 24 hours. Surveillance Requirements do not have to be performed on inoperable equipment.

4.0.4 Entry into an OPERATIONAL MODE or other specified condition shall not be made unless the Surveillance Requirement(s) associated with the Limiting Condition for Operation have been performed within the stated SURVEILLANCE INTERVAL. This provision shall not prevent passage through or to OPERATIONAL MODES as required to comply with ACTION requirements. Exceptions to these requirements are stated in the individual specifications.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0

The specifications of this section provide the general requirements applicable to each of the Limiting Conditions for Operation and Surveillance Requirements within the Reactivity Control Section. These requirements are based on the requirements for Limiting Conditions for Operation stated in the Code of Federal Regulations, 10 CFR 50.36(c)(2):

"Limiting conditions for operation are the lowest functional capability or performance levels of equipment required for safe operation of the facility. When a limiting condition for operation of a nuclear reactor is not met, the licensee shall shut down the reactor or follow any remedial action permitted by the technical specification until the condition can be met."

These Limiting Conditions for Operation provide for operation with sufficient redundancy and/or diversity to meet the single-failure criterion as relied upon in the plant's safety analysis. The Limiting Conditions for Operation do not replace plant operating procedures. Plant operating procedures establish plant operating conditions with at least the capability and performance specified in these Limiting Conditions for Operation.

3.0.1 This specification defines the applicability of each specification in terms of defined OPERATIONAL MODES or other specified conditions and is provided to delineate specifically when each specification is applicable.

The ACTION requirements establish those remedial measures that must be taken within specified time limits when the requirements of a Limiting Condition for Operation are not met.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

There are two basic types of ACTION requirements. The first specifies the remedial measures that permit continued operation of the facility which is not further restricted by the time limits of the ACTION requirements. An example of this is the ACTION to be taken for inoperable seismic monitors. In this case, conformance to the ACTION requirements provides an acceptable level of safety for unlimited continued operation as long as the ACTION requirements continue to be met. The second type of ACTION requirement specifies a time limit in which conformance to the conditions of the Limiting Condition for Operation must be met. This time limit is the allowable outage time to restore an inoperable system or component to OPERABLE status or for restoring parameters within specified limits. If these actions are not completed within the allowable outage time limits, a shutdown is required to place the facility in a MODE or condition in which the specification no longer applies. It is not intended that the shutdown ACTION requirements be used as an operational convenience which permits (routine) voluntary removal of a system(s) or component(s) from service in lieu of other alternatives that would not result in redundant systems or components being inoperable.

The specified time limits of the ACTION requirements are applicable from the point in time it is identified that a Limiting Condition for Operation is not met. The time limits of the ACTION requirements are also applicable when a system or component is removed from service for surveillance testing, including investigation, maintenance, repairs, or modifications to resolve operational problems. Individual specifications may include a specified time limit for the completion of a Surveillance Requirement when equipment is removed from service. In this case, the allowable outage time limits of the ACTION requirements are applicable when this limit expires if the surveillance has not been completed. When a shutdown is required to comply with ACTION requirements, the plant may have entered a MODE in which a new specification becomes applicable. In this case, the time limits of the ACTION requirements would apply from the point in time that the new specification becomes applicable if the requirements of the Limiting Condition for Operation are not met.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

3.0.2 This specification establishes that noncompliance with a specification exists when the requirements of the Limiting Condition for Operation are not met and the associated ACTION requirements have not been implemented within the specified time interval. The purpose of this specification is to clarify that (1) implementation of the ACTION requirements within the specified time interval constitutes compliance with a specification and (2) completion of the remedial measures of the ACTION requirements is not required when compliance with a Limiting Condition of Operation is restored within the time interval specified in the associated ACTION requirements.

This concept also applies to progressive ACTIONS. For example, if an ACTION allows 72 hours to repair one SLRDIS valve and 24 hours to repair all but one SLRDIS valve (in the event several valves are inoperable), once the equipment is restored to only one inoperable valve the original 72 hour clock is applicable.

3.0.3 This specification delineates the measures to be taken for those circumstances not directly provided for in the ACTION statements and whose occurrence would violate the intent of a specification.

The purpose of this specification is to delineate the time limits for placing the unit in a SHUTDOWN MODE when plant operation cannot be maintained within the limits for safe operation defined by the Limiting Conditions for Operation and its ACTION requirements. It is not intended to be used as an operational convenience which permits (routine) voluntary removal of redundant systems or components from service in lieu of other alternatives that would not result in redundant systems or components being inoperable. One hour is allowed to prepare for an orderly shutdown before initiating a change in plant operation. This time permits the operator to coordinate the reduction in electrical generation with the load dispatcher to ensure the stability and availability of the electrical grid. The time limits specified to reach lower MODES of operation permit the shutdown to proceed in a controlled and orderly manner that is well within the specified maximum cooldown rate and within the cooldown capabilities of the facility assuming only the minimum required equipment is OPERABLE. This reduces thermal stresses on components and the potential for a plant upset that could challenge safety systems under conditions for which this specification applies.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

If remedial measures permitting limited continued operation of the facility under the provisions of the ACTION requirements are completed, the shutdown may be terminated. The time limits of the ACTION requirements are applicable from the point in time there was a failure to meet a Limiting Condition for Operation. Therefore, the shutdown may be terminated if the ACTION requirements have been met or the time limits of the ACTION requirements have not expired, thus providing an allowance for the completion of the required actions.

The time limits of LCO 3.0.3 allow 24 hours for the plant to be in SHUTDOWN when a shutdown is required during plant operation. However, if a lower MODE of operation is reached in less time than allowed, the total allowable time to reach SHUTDOWN, or other applicable MODE, is not reduced. For example, if LOW POWER is reached in 8 hours, the time allowed to reach SHUTDOWN is the next 16 hours because the total time to reach SHUTDOWN is not reduced from the allowable limit of 24 hours. Therefore, if remedial measures are completed that would permit a return to POWER operation, a penalty is not incurred for having reached a lower MODE of operation in less than the total time allowed.

The ACTION to be in LOW POWER in 12 hours and in SHUTDOWN in the following 12 hours defines an orderly shutdown at Fort St. Vrain. 12 hours to reduce to LOW POWER (30%) is allowed to minimize unnecessary transients on the steam generator tubing that would result from going through boilout (approximately 18-22%) during reductions to lower power levels. The process of reducing power in an orderly manner from less than 30% (LOW POWER) to SHUTDOWN is complicated and time consuming in that all of the core orifices must be adjusted from an equal temperature configuration to an equal flow configuration, which requires approximately 4 to 6 hours. Orifice adjustments are continuously performed during a power reduction and the change in configuration is initiated about 12-14% power. In addition, the auxiliary boiler(s) is brought on-line to provide sufficient drive capability for the helium circulators when adequate nuclear generated steam is not available (approximately 8% power).

The shutdown requirements of LCO 3.0.3 do not apply in SHUTDOWN and REFUELING because the ACTION requirements of individual specifications define the remedial measures to be taken.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

3.0.4 This specification provides that entry into an OPERATIONAL MODE or other specified applicability conditions must be made with: (1) the full compliment of required systems, equipment, or components OPERABLE and (2) all other parameters as specified in the Limiting Condition for Operation being met without regard for allowable deviations and out-of-service provisions contained in the ACTION statements.

The purpose of this specification is to ensure that facility operation is not initiated or that higher MODES of operation are not entered when corrective action is being taken to obtain compliance with a specification by restoring equipment to OPERABLE status or parameters to specified limits. Compliance with ACTION requirements that permit continued operation of the facility for an unlimited period of time provides an acceptable level of safety for continued operation without regard to the status of the plant before or after a MODE change. Therefore, in this case, entry into an OPERATIONAL MODE or other specified condition may be made in accordance with the provisions of the ACTION requirements. The provisions of this specification should not, however, be interpreted as endorsing the failure to exercise good practice in restoring systems or components to OPERABLE status before plant startup.

When a shutdown is required to comply with ACTION requirements, the provisions of LCO 3.0.4 do not apply because they would delay placing the facility in a lower MODE of operation.

Exceptions to this provision have been provided for a limited number of specifications when startup with inoperable equipment would not affect plant safety. These exceptions are stated in the ACTION statements of the appropriate specifications.

3.0.5 The CALCULATED BULK CORE TEMPERATURE (CBCT) is used in the FSV Technical Specification as an indicator of decay heat levels that determines the applicability of LCO or ACTION requirements. LCO 4.0.4 describes the procedure for calculating Bulk Core Temperature. Refer to this Specification and its Basis.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

4.0.1 The Surveillance Requirements specified in these Technical Specifications define the tests, calibrations, and inspections which ensure the performance and OPERABILITY of equipment essential to safety or equipment required to prevent or mitigate the consequences of abnormal situations.

These requirements are based on the Surveillance Requirements stated in the Code of Federal Regulations, 10 CFR 50.36(c)(3):

"Surveillance Requirements are requirements relating to test, calibration, or inspection to ensure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions of operation will be met."

This specification provides that surveillance activities necessary to ensure that the Limiting Conditions for Operation are being met and that they will be performed during the OPERATIONAL MODES or other conditions for which the Limiting Conditions for Operation are applicable.

Surveillance Requirements do not have to be performed when the facility is in an OPERATIONAL MODE for which the requirements of the associated Limiting Condition for Operation do not apply unless otherwise specified.

Provisions for additional surveillance activities to be performed without regard to the applicable OPERATIONAL MODES or other conditions are provided in the individual Surveillance Requirements. Surveillance Requirements for Special Test Exceptions need only be performed when the Special Test Exception is being utilized as an exception to an individual specification.

4.0.2 The provisions of this specification provide allowable tolerances for performing surveillance activities beyond those specified in the nominal SURVEILLANCE INTERVAL. These tolerances are necessary to provide operational flexibility because of scheduling and performance considerations. The phrase "at least" associated with a surveillance frequency does not negate this allowable tolerance value and permits the performance of more frequent surveillance activities.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

Specification 4.0.2 establishes the limit for which the specified time interval for Surveillance Requirements may be extended. It permits an allowable extension of the normal surveillance interval to facilitate surveillance scheduling and consideration of plant operating conditions that may not be suitable for conducting the surveillance; e.g., transient conditions or other ongoing surveillance or maintenance activities. It also provides flexibility to accommodate the length of a fuel cycle for surveillances that are performed at each refueling outage and are specified with an 18 month surveillance interval. It is not intended that this provision be used repeatedly as a convenience to extend surveillance intervals beyond that specified for surveillances that are not performed during refueling outages. The limitation of Specification 4.0.2 is based on engineering judgement and the recognition that the most probable result of any particular surveillance being performed is the verification of conformance with the Surveillance Requirements. This provision is sufficient to ensure that the reliability ensured through surveillance activities is not significantly degraded beyond that obtained from the specified surveillance interval.

4.0.3 The provisions of this specification set forth the criteria for determination of compliance with the OPERABILITY requirements of the Limiting Conditions for Operation. Under these criteria, equipment, systems, or components are assumed to be OPERABLE if the associated surveillance activities have been satisfactorily performed within the specified time interval. Nothing in this provision is to be construed as defining equipment, systems or components OPERABLE when such items are found or known to be inoperable although still meeting the Surveillance Requirements.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

This specification also clarifies that the ACTION requirements are applicable when Surveillance Requirements have not been completed within the allowed SURVEILLANCE INTERVAL and that the time limits of the ACTION requirements apply from the point in time it is identified that a surveillance has not been performed and not at the time that the allowed SURVEILLANCE INTERVAL was exceeded. Completion of the Surveillance Requirement within the allowable outage time limits of the ACTION requirements restores compliance with the requirements of SR 4.0.3. However, this does not negate the fact that the failure to have performed the surveillance within the allowed SURVEILLANCE INTERVAL, defined by SR 4.0.2, was a violation of the OPERABILITY requirements of a Limiting Condition for Operation that is subject to possible enforcement action. Further, the failure to perform a surveillance per SR 4.0.2 is a violation of a Technical Specification requirement and is, therefore, a reportable event under the requirements of 10 CFR 50.73(a)(2)(i)(B) because it is a condition prohibited by the plant's Technical Specifications.

If the allowable outage time limits of the ACTION requirements are less than 24 hours or a shutdown is required to comply with ACTION requirements, e.g., SR 3.0.3, a 24-hour allowance is provided to permit a delay in implementing the ACTION requirements. This provides an adequate time limit to complete Surveillance Requirements that have not been performed. The purpose of this allowance is to permit the completion of a surveillance before a shutdown is required to comply with ACTION requirements or before other remedial measures would be required that may preclude completion of a surveillance. The basis for this allowance includes consideration for plant conditions, adequate planning, availability of personnel, the time required to perform the surveillance, and the safety significance of the delay in completing the required surveillance. This provision also provides a time limit for the completion of Surveillance Requirements that become applicable as a consequence of MODE changes imposed by ACTION requirements and for completing Surveillance Requirements that are applicable when an exception to the requirements of SR 4.0.4 is allowed, unless a longer exception is specifically allowed. If a surveillance is not completed within the 24-hour allowance, the time limits of the ACTION requirements are applicable at that time. When a surveillance is performed within the 24-hour allowance and the Surveillance Requirements are not met, the time limits of the ACTION requirements are applicable at the time that the surveillance is terminated.

BASIS FOR SPECIFICATION LCO 3.0/SR 4.0 (Continued)

Surveillance Requirements do not have to be performed on inoperable equipment because the ACTION requirements define the remedial measures that apply. However, the Surveillance Requirements have to be met to demonstrate that inoperable equipment has been restored to OPERABLE status.

4.0.4 This specification ensures that the surveillance activities associated with a Limiting Condition for Operation have been performed within the specified time interval prior to entry into an OPERATIONAL MODE or other applicable condition. The intent of this provision is to ensure that surveillance activities have been satisfactorily demonstrated on a current basis as required to meet the OPERABILITY requirements of the Limiting Condition for Operation.

Under the terms of this specification, for example, during initial plant STARTUP or following extended plant outages, the applicable surveillance activities must be performed within the stated SURVEILLANCE INTERVAL prior to placing or returning the system or equipment into OPERABLE status.

When a shutdown is required to comply with ACTION requirements, the provisions of SR 4.0.4 do not apply because this would delay placing the facility in a lower MODE of operation.

REACTIVITY CONTROL

3/4.1.1 CONTROL ROD PAIR OPERABILITY

LIMITING CONDITION FOR OPERATION

3.1.1 All control rod pairs not fully inserted shall be OPERABLE with:

A. A scram time less than or equal to 152 seconds from the fully withdrawn position,

B. A control rod drive (CRD) motor temperature less than or equal to 250 degrees F,

C. A helium purge flow not carrying condensed water to each CRD penetration when reactor pressure is above 100 psia, and

D. The absence of a slack cable alarm.

APPLICABILITY: POWER, LOW POWER, and STARTUP

ACTION:

A. With one or more control rod pairs inoperable due to being immovable (i.e., not capable of being fully inserted), within 10 minutes initiate a reactor shutdown and an assessment of the SHUTDOWN MARGIN, and be in at least SHUTDOWN within the next 12 hours.

B. With one control rod pair inoperable due to having a scram time greater than 152 seconds, operation may continue provided that within 24 hours:

1. The control rod pair is restored to OPERABLE status, or

2. The control rod pair is fully inserted, or

3. The SHUTDOWN MARGIN requirement of LCO 3.1.4 is satisfied with the control rod pair considered inoperable in its present position.

If none of the above conditions can be met, be in at least SHUTDOWN within the next 12 hours.

SPECIFICATION LCO 3.1.1 (Continued)

C. With two or more control rod pairs inoperable due to having a scram time greater than 152 seconds, within 10 minutes initiate a reactor shutdown and be in at least SHUTDOWN within 12 hours.

D. With one or more control rod pairs having a CRD motor temperature greater than 250 degrees F, operation may continue provided that within 24 hours:

1. The control rod pair(s) is restored to OPERABLE status, or

2. Surveillance testing per SR 4.1.1.A is performed on the control rod pair(s) once every 24 hours when the CRD motor temperature exceeds 250 degrees F. With one or more control rod pairs exceeding a scram time of 152 seconds, comply with ACTIONS B or C above. With scram times less than or equal to 152 seconds, up to four control rod pairs with CRD motor temperatures greater then 250 degrees F may be considered OPERABLE for SHUTDOWN MARGIN determination.

E. With no purge flow to one CRD penetration, operation may continue provided that within 24 hours:

1. Purge flow is restored to the CRD penetration, or

2. The control rod pair is fully inserted, or

3. The SHUTDOWN MARGIN requirement of Specification 3.1.4 is satisfied with the control rod pair considered inoperable in its present position.

If one of the above conditions cannot be met, be in at least SHUTDOWN within 12 hours.

F. With no purge flow to two or more CRD penetrations:

1. Restore purge flow within 2 hours, or

2. Be in at least SHUTDOWN within the next 12 hours.

SPECIFICATION LCO 3.1.1 (Continued)

G. With the water level in the knock-out pot for the CRD purge flow lines greater than 6 inches, but with the knock-out pot not flooded:

1. Within 1 hour drain the knock-out pot and establish a helium purge flow not carrying condensed water, or

2. Be in at least SHUTDOWN within the next 12 hours.

H. With the knock-out pot for the CRD purge flow lines flooded:

1. Be in at least SHUTDOWN within the next 12 hours, and

2. Perform surveillance SR 4.1.9.E.

I. With a slack cable alarm, within 24 hours determine whether a slack cable condition exists (i.e., a parted cable, detached cable, or failed instrumentation that is inaccessible for repair during operation). If an actual slack cable condition exists, be in at least SHUTDOWN within the next 24 hours. If the alarm is due to some other condition, restore the alarm to OPERABLE status within the next 24 hours or declare the affected control rod pair inoperable and comply with the requirements of Action B.

J. The provisions of Specification 3.0.4 are not applicable for changes between STARTUP, LOW POWER, and POWER. Prior to entry into STARTUP from SHUTDOWN, all requirements of this LCO must be met, without reliance on provisions contained in the ACTION statements.

SURVEILLANCE REQUIREMENTS

4.1.1 Each control rod pair shall be demonstrated OPERABLE:

A. Once per 24 hours by:

1. Verifying that all CRD motor temperatures are less than or equal to 250 degrees F.

   a. With one or more CRD motor temperature(s) exceeding 215 degrees F:

      1) The temperature of any CRD motor exceeding 215 degrees F shall be recorded,

      2) A partial scram test as described in SR 4.1.1.B shall be performed at least once per 24 hours on the control rod pair with the highest motor temperature and for all control rod pairs greater than 250 degrees F, and

      3) A report on the partial scram test results and the maximum daily temperature of any control rod pairs with motor temperatures exceeding 215 degrees F shall be submitted to the NRC once every 31 days.

   b. If CRD motor temperature instrumentation is inoperable, an engineering evaluation shall be performed to determine CRD motor temperature by comparison.

2. Verifying purge flow to each CRD by verifying flow in each subheader, when reactor pressure is above 100 psia; and

3. Verifying that the purge flow is not carrying condensed water by verifying that the water level in the knock-out pot is less than 6 inches.

4. Verifying that the slack cable alarm is not actuated.

SPECIFICATION SR 4.1.1 (Continued)

B. Once per 7 days by:

1. Performing a partial scram test of at least 10 inches on all partially inserted and fully withdrawn control rod pairs, except the regulating rod pair, and verifying that the extrapolated scram time is less than or equal to 152 seconds; and

2. Performing a partial scram test of approximately 2 inches on the regulating rod pair and verifying control rod pair movement.

C. Prior to withdrawal of control rod pair(s) if not performed in the previous 7 days:

1. By performing a partial scram test of at least 10 inches and verifying that the control rod pair inserts freely and can be considered scrammable, or

2. If withdrawal is to achieve criticality by performing a partial scram test of at least 10 inches on all control rod pairs being withdrawn, and verifying that the extrapolated scram time is less than or equal to 152 seconds.

D. During each shutdown of 10 days or longer (if not performed during the previous 31 days) by performing a full stroke scram test on all control rod pairs and verifying a scram time less than or equal to 152 seconds.

E. Following any maintenance on a CRD mechanism which could affect the control rod pair scram time, by performing a full stroke scram test and verifying a scram time of less than or equal to 152 seconds.

F. Once per 18 months:

1. By performing a CHANNEL CALIBRATION and a CHANNEL FUNCTIONAL TEST of the eight subheader CRD purge flow measurement channels,

2. By performing a CHANNEL FUNCTIONAL TEST of the CRD motor temperature and cavity temperature instrumentation,

SPECIFICATION SR 4.1.1 (Continued)

3. By performing preventive maintenance on each CRD in a scheduled sequence such that none of the drives installed in the reactor will have gone more than 6 REFUELING CYCLES without receiving preventive maintenance. During these 6 REFUELING CYCLES, no CRD shall be in regulating rod pair service (without receiving preventive maintenance) for more than one REFUELING CYCLE. The preventive maintenance shall consist of inspecting and replacing as necessary the CRD gears, bearings, brake pads, cables, and position instrumentation, and

4. By performing a CHANNEL CALIBRATION of the CRD motor and cavity temperature instrumentation on those CRDs undergoing preventive maintenance as described in SR 4.1.1.F.3 above.

| BASIS FOR SPECIFICATION LCO 3.1.1/SR 4.1.1

| Control rod pair OPERABILITY ensures that a minimum SHUTDOWN MARGIN is capable of being maintained.

| The control rod pair withdrawal accident analyses described in FSAR Sections 14.2.2.6 and 14.2.2.7 were performed assuming a scram insertion time of 152 seconds and a ramp reactivity insertion of 0.080 delta k and 0.058 delta K, respectively.

| Requiring the scram time to be less than or equal to 152 seconds will ensure that the ramp reactivity rate is consistent with that assumed in the accident analyses. The full insertion scram time can be determined either directly from a full insertion scram test or indirectly from a partial scram test of 10 inches or more. For the partial scram test, the estimate of an extrapolated scram time of less than or equal to 152 seconds is always based on assuming a scram from the fully withdrawn position and not from the actual rod position.

| The total calculated reactivity worth of all 37 control rod pairs is 0.210 delta k, which is significantly greater than the scram reactivities assumed in the accident analyses. Therefore, a single control rod pair with a scram time greater than 152 seconds, as allowed in ACTION B of the specifications, will have no impact on the calculated consequences of the control rod pair withdrawal accident.

| Temperature Limitation

| Control Rod Drive Mechanism (CRDM) qualification tests were performed in a 180 degree F helium environment. The motor and brake were energized and deenergized in severe duty cycles up to once every 5 seconds for 630,000 jog cycles and 5000 scrams of the CRDM. CRDM motor temperatures ranged from 200 degrees F to 230 degrees F with an average of 215 degrees F during these tests. During power ascension testing, CRDM temperatures up to 213 degrees F were experienced at power levels up to 70%. Using data obtained during power ascension testing, a CRDM temperature of 260 degrees F was predicted for 100% power conditions with an orifice valve fully closed. The minimum predicted open position for an orifice valve at 100% power is about 10%, for which the predicted CRDM temperature is 250 degrees F. Tests conducted to 100% power indicated these predictions to be conservative because the maximum measured CRDM motor temperature was 218 degrees F. The operating temperature of the CRDM is limited by the motor insulation which is derated to 272 degrees F to account for motor temperature rise, frictional torque increase, and winding life expectancy. See Section 3.8.1.1 of the FSAR.

| BASIS FOR SPECIFICATION LCO 3.1.1/SR 4.1.1

| CRDM motor temperatures are monitored to verify that they are less than or equal to 250 degrees F. CRDM motor temperatures are alarmed at 215 and 250 degrees F, and are recorded on a multi-point recorder when they exceed 215 degrees F (FSAR 3.8.1.1). This recorder provides frequent monitoring (at least one reading per minute) and the data is retrievable as required. Any CRDM with a motor temperature greater than 215 degrees F shall be recorded every 24 hours to document that the temperature is less than 250 degrees F. In addition, the partial scram test frequency is increased from once per 7 days to once per 24 hours on the control rod pair with the highest motor temperature. A partial scram test will be performed once every 24 hours on all control rod pairs with motor temperatures exceeding 250 degrees F, to verify that the extrapolated scram time is less than or equal to 152 seconds. Verifying a control rod pair extrapolated scram time of less than or equal to 152 seconds, will ensure CRDM reliability with a motor temperature greater than 250 degrees F. These surveillances ensure that CRDM motor temperatures exceeding 250 degrees F do not degrade the CRDM's reliability to perform its design function when required and up to four of these control rod pairs may be considered OPERABLE in SHUTDOWN MARGIN determination.

| If the CRDM motor temperature instrumentation is inoperable, an engineering evaluation will be completed within 24 hours from the time the instrumentation is found to be inoperable, to verify that the CRDM motor temperature is currently less than 250 degrees F. Additional temperature instrumentation located on the underside primary closure plate and the orifice valve motor plate can be used to infer the CRDM motor temperature by comparing these temperatures with those on another CRDM in a similar region. Other factors such as orifice valve position and historical temperature data may be used to determine CRDM motor temperatures by comparison.

| Purge Flow

| The purge flow into the CRD assembly limits the upward flow of contaminated primary system helium coolant. Purge flow to each CRD penetration is ensured by verifying that purge flow is maintained to each subheader and by sealing all the valves between the subheaders and the CRD penetrations in an open position.

BASIS FOR SPECIFICATION LCO 3.1.1/SR 4.1.1 (Continued)

A knock-out pot, moisture element, and pressure transmitter are installed in the CRD purge line, between the purified helium header and the CRD purge flow valve (FSAR 3.8.1.1). Just before the knock-out pot, an independent source of dry helium is connectible in the event the purified helium header becomes unavailable. The pressure in the helium header will be maintained above reactor pressure. The knock-out pot reduces the probability of moisture in the helium purge header entering the CRD penetrations by trapping any entrained water in the helium. An alarm indicates that water is collecting in the pot.

The loss of purge flow to any CRD assembly could result in elevated CRDM temperatures that would require the appropriate monitoring and its associated partial scram testing.

The knock-out pot is approximately 10 inches deep. Verifying that the water level in the knock-out pots is less than 6 inches once every 24 hours ensures that the helium purge flow is not carrying condensed water.

Slack Cable Alarm

The tension of the cables supporting each pair of control rods is monitored by means of slack cable sensing switches (FSAR section 7.2.2.2). A slack cable alarm for a region may indicate a control rod stuck in the guide channels of the core, a parted control rod cable, dropped control rod absorber sections, or a failure of the alarm instrumentation. There are provisions to allow limited motion of the affected control rods (up to 3 inches) to determine whether a rod or cable is stuck or a cable is broken, and various diagnostic techniques can be used to determine the OPERABILITY of the instrumentation.

Actions

The ACTION to initiate a reactor shutdown within 10 minutes if one or more control rod pairs are inoperable due to being immovable (e.g., resulting from excess friction or mechanical interference) is implemented because the cause of the problem may be indicative of a generic control rod pair problem which may affect the ability to safely shut down the reactor. When ACTIONS are to be taken within 10 minutes, no restoration is intended. The ACTION should be taken without delay and in accordance with established procedures.

BASIS FOR SPECIFICATION LCO 3.1.1/SR 4.1.1 (Continued)

The ACTIONS providing for continued operation with one control rod pair inoperable due to causes other than being immovable are less restrictive because the SHUTDOWN MARGIN can be met with the highest worth control rod pair fully withdrawn (FSAR Section 3.5.3). Continued operation with CRD motor temperatures greater than 250 degrees F is acceptable provided continued OPERABILITY is demonstrated once per 24 hours by partial scram tests.

Because the SHUTDOWN MARGIN can be met with the highest worth control rod pair fully withdrawn, an exception to LCO 3.0.4 (which prevents moving up to a higher OPERATIONAL MODE while in an ACTION statement) can be made in this case.

If purge flow is not maintained to two or more CRD penetrations, 2 hours is provided to restore purge flow to the penetrations. This restoration time will provide time to change out a helium bottle or clear any blockage in the subheader, in order to restore purge flow to the CRD penetrations. Degradation of the CRD assembly due to lack of purge flow is a long term effect, and will not occur over a short period of time.

If a slack cable alarm is received, an actual slack cable condition must be confirmed or ruled out within 24 hours. An immovable control rod pair is subject to the SHUTDOWN requirements of Action A and is not considered a slack cable condition in Action I. For the identified slack cable conditions, the affected control rod absorber sections would be inserted into the core or else unaffected as in the case of an instrumentation problem. The consequences of these conditions are conservative, the condition is local, and a 24 hour determination time is acceptable. In the event of an actual slack cable condition, the ACTION to shut down in a controlled manner is acceptable since this is indicative of a local and not generic problem and since determination and resolution will require the removal of that CRDM assembly from the reactor.

Surveillances

The regulating rod pair is the only control rod pair with automatic response capability to a change in flux and is used to offset the negative effects of partial scram tests performed on other control rod pairs. A partial scram test of 2 inches on the regulating rod pair does not induce unacceptable power transients and demonstrates that the control rod pair is moveable.

| BASIS FOR SPECIFICATION LCO 3.1.1/SR 4.1.1 (Continued)

| Performing a partial scram test prior to achieving criticality | ensures control rod pair OPERABILITY prior to entering into a higher | OPERATIONAL MODE. The full stroke scram test performed during each | shutdown is the most accurate method of determining the scram time | because the actual scram time is measured over the whole length of | the control rod pair versus being extrapolated from a partial | distance.

| For control rod pairs that are withdrawn later in the operational | schedule, a partial scram test prior to withdrawal is performed to | ensure scrammability; no extrapolated scram time is determined. A 10 | inch withdrawal from the fully inserted position does not produce | consistently meaningful extrapolated scram times due to the CRD | mechanism inertia, but it does establish ease of movement. | Performing this 10 inch test also minimizes the compensating | movements of the regulating rod that would be required for partial | scram tests from greater distances.

| Performing a full stroke scram test following any CRD maintenance | ensures that the OPERABILITY and scram time of the control rod pair | was not affected by the maintenance.

| The specified CHANNEL CALIBRATION and CHANNEL FUNCTIONAL TEST assures | that the instrumentation monitoring the eight subheaders providing | purge flow to the control rod drive penetrations is OPERABLE and loss | of purge flow is detectable.

| The specified CHANNEL FUNCTIONAL TEST of the CRD motor temperature | and cavity temperature instrumentation will assure that the | instrumentation monitoring the CRD temperatures is OPERABLE and | capable of detecting any increase in CRD motor temperature.

| The preventive maintenance program performed on those CRDs replaced | each REFUELING CYCLE ensures that by inspecting and replacing as | necessary any degraded parts the potential for CRD failure is | significantly reduced. Since the regulating rod pair CRD is used | more than any other CRD, it will be substituted with another CRD | after each REFUELING.

REACTIVITY CONTROL

3/4.1.2 CONTROL ROD PAIR POSITION INDICATION SYSTEMS - OPERATING

LIMITING CONDITION FOR OPERATION

3.1.2 The position indication instrumentation listed in Table 3.1.2-1 for each control rod pair shall be OPERABLE and capable of determining control rod pair position within 10 inches.

APPLICABILITY: POWER, LOW POWER, and STARTUP

ACTION: As shown in Table 3.1.2-1

SURVEILLANCE REQUIREMENTS

4.1.2 A. Control rod pair position instrumentation OPERABILITY shall be verified by performing a CHANNEL CHECK on the control rod pair position instrumentation, as follows:

1. Prior to withdrawal from the fully inserted position,
2. Upon full withdrawal, and
3. Once per 7 days on all fully withdrawn, partially inserted, and fully inserted control rod pairs except for fully inserted control rod pairs incapable of being withdrawn.

   a. During partial scram surveillances on fully withdrawn and partially inserted control rod pairs, the analog rod position indication shall be demonstrated OPERABLE by verifying that the change in analog indication is consistent with the direction of control rod pair travel. The analog and digital position indications must agree within 10 inches of each other. If a larger difference is observed, it shall be assumed that the analog indication is the inoperable channel, unless the analog indication can be proven to be accurate and OPERABLE by another means, and

SPECIFICATION SR 4.1.2 (Continued)

b. During partial scram surveillances on fully withdrawn control rod pairs, the rod-out limit indications shall be demonstrated OPERABLE by verifying that the rod-out indication clears when the control rod pair is inserted less than or equal to 6 inches and is on when the control rod pair is fully withdrawn following the partial scram test.

B. Prior to each reactor startup and the first time during or after startup when the control rod pair is withdrawn from the fully inserted position, the OPERABILITY of the rod-in limit indication shall be verified for each control rod pair by:

1. Verifying that the rod-in limit light is on, when the control rod pair is fully inserted, and

2. Verifying that the rod-in limit light clears, when the control rod pair is withdrawn less than or equal to 6 inches.

C. Prior to each reactor start-up, and during the first outward motion of a control rod pair, the OPERABILITY of the analog and digital position indications shall be verified for each control rod pair by:

1. Verifying that the rod-in limit light is on, when the control rod pair is fully inserted, and

2. Verifying that when the control rod pair is withdrawn a short distance, the rod-in limit light clears, when the analog and digital instrumentation indicates less than 6 inches.

   If the analog and digital position indications indicate 6 or more inches, an engineering evaluation shall be performed to determine the maximum insertion limit for that control rod pair.

Table 3.1.2-1

CONTROL ROD PAIR POSITION INDICATION SYSTEMS

POSITION OF CONTROL ROD PAIR	POSITION INDICATION INSTRUMENTATION SYSTEMS AVAILABLE	MINIMUM POSITION INDICATION INSTRUMENTATION SYSTEMS OPERABLE	ACTION
Fully Inserted	Rod-in Limit, Independent Means (Watt Meter Test)	1	1, 2
Partially Inserted	Rod-in Limit*, Analog, Digital	2	1, 2
Fully Withdrawn	Rod-out Limit, Analog, Digital	2	1, 2

ACTION STATEMENTS

ACTION 1 With the number of OPERABLE position instrumentation systems less than the Minimum Position Indication Instrumentation Systems OPERABLE requirements, restore the required number of inoperable position indication system(s) to OPERABLE status within 12 hours, or be in SHUTDOWN within the next 12 hours.

ACTION 2 The provisions of LCO 3.0.4 are not applicable for changes between STARTUP, LOW POWER, and POWER. Prior to entry into STARTUP from SHUTDOWN, all the requirements of the LCO must be met, without reliance on the provisions contained in the ACTION statement.

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* Demonstrated OPERABLE when last tested.

BASIS FOR SPECIFICATION LCO 3.1.2/SR 4.1.2

FSAR Section 7.2.2 assumes a long term misalignment of plus or minus 12 inches on control rod pair position to ensure an acceptable power distribution for core burnup. This allows for a 2 foot separation distance for the control rod pairs of any partially inserted shim group. Assuring a position accuracy of plus or minus 10 inches is consistent with this misalignment allowance and provides for a 4 inch margin for operation when manually adjusting the control rod pairs of the shim group. Each shim control rod pair is normally moved in approximately 2 inch increments during operation to adjust the regulating rod pair to its mid operating position. A 10 inch position accuracy for all control rod pairs is also consistent with a reactivity uncertainty of about 0.003 delta k, which allows for detecting core irregularities, such as an inadvertant release of reserve shutdown material within a single core region. Control rod pair withdrawal procedures require an evaluation if the actual critical control rod pair position differs from the predicted position during initial criticality by this reactivity worth.

Control rod pair position indication system OPERABILITY is required to determine control rod pair positions and to ensure compliance with control rod pair alignment and position requirements of LCO's 3.1.5 and 3.1.6.

Rod-out and rod-in position indication is provided by cam-actuated switches. The cams are mounted on the same shaft as the rod position potentiometer. The shaft is directly coupled to a cable drum through a gear train and rotates as required for the full length of control rod pair travel. When a control rod pair is withdrawn from the fully inserted position, the limit switch cams release the rod-in switch causing the rod-in light to extinguish. Rod position is transmitted to the console by a potentiometer coupled directly to the drum gearing. The rod-in and rod-out limit switches and the rod position potentiometer transmitters are duplicated to protect against the loss of position indication.

ACTIONS

If analog and rod-in limit indications are OPERABLE but digital and/or rod-out limit indications are inoperable, operation may continue. Since both the analog and digital indications are taken from the same shaft and potentiometer, control rod pair position is still capable of being established with only the analog indication. Rod-in limit indication capability is more critical than rod-out limit indication for the purpose of determining SHUTDOWN MARGIN.

BASIS FOR SPECIFICATION LCO 3.1.2/SR 4.1.2 (Continued)

If the analog indication is inoperable, operation may continue with one of the following conditions satisfied:

a. If the control rod pair is fully inserted, the position can be established by the rod-in limit indication or verified by an independent means such as the watt-meter test. Since the control rod pair is fully inserted, any other position indication is not required because its position of being fully inserted can be verified and used in the SHUTDOWN MARGIN calculation.

b. For the case when the control rod pair is partially inserted and the digital and rod-in limit indications OPERABLE, control rod pair position can still be established by digital indication and if the control rod pair were to be fully inserted its position could be verified. Rod-in indication OPERABILITY is demonstrated when last tested.

c. For the case with the control rod pair fully withdrawn and rod-out and rod-in limit indications OPERABLE, the control rod pair's position can be established (i.e. fully withdrawn) or if the control rod pair were to be fully inserted, its position could be verified for the SHUTDOWN MARGIN calculation.

If rod-in limit indication were inoperable, operation may continue, because a fully inserted control rod pair's position can be established by an independent means such as the watt-meter test. At a partially inserted or fully withdrawn position, the control rod pair's position can be determined by both digital and analog indications.

If control rod pair position cannot be determined within 12 hours, reactor shutdown is required within the next 12 hours. This ACTION is required to satisfy the control rod pair worth and position requirements of LCO 3.1.5, which prevents an unacceptable power distribution.

Surveillances

Control rod pair position indication instrumentation OPERABILITY is verified by performing a CHANNEL CHECK before the control rod pair is withdrawn from the fully inserted position, when it is fully withdrawn, and once per 7 days. This surveillance ensures position indication OPERABILITY prior to a reactor startup and during operation.

| BASIS FOR SPECIFICATION LCO 3.1.2/SR 4.1.2 (Continued)

| During the partial scram test (once per 7 days during operation) analog indication is verified OPERABLE by confirming that the change in analog indication is consistent with the direction of control rod pair travel.

| If a difference of greater than 10 inches exists between the analog and digital position indications, the analog indication is considered inoperable, unless proven accurate by another means. The analog indication may be proven to be accurate and OPERABLE by fully inserting the control rod pair and verifying that the analog indication is more accurate than the digital indication at the fully inserted position as determined by the rod-in limit indication or the watt-meter test.

| The rod-in limit indication is verified to be OPERATING at the fully inserted position when the control rod pair is withdrawn a short distance. This surveillance ensures that a fully inserted control rod pair's position can be established during operation by verifying OPERABILITY of each control rod pair prior to each startup and also when the control rod pair is first withdrawn from the fully inserted position.

| To ensure position indication is capable of being established at the partially inserted to fully withdrawn position (during operation) both the analog and digital positions are verified OPERABLE at the fully inserted position when the control rod pair is withdrawn a short distance. This surveillance is performed prior to startup or during the first outward control rod pair motion.

| The position indication potentiometers and associated coupling can be damaged by an overtravel of minus 6 inches. This damage is prevented by initially requiring the control rod pair position indication to indicate less than 6 inches when the rod-in limit indication clears and then by procedurally preventing control rod pair insertion past zero, even if rod-in limit indication is not received. The requirement for position indication to be less than 6 inches when rod-in limit indication is received imposes an enhanced accuracy requirement at this position. The result is that since procedurally the control rod pair is not inserted past a zero indication, and if the position indication is within 6 inches of the actual position, then the control rod pair will not be inserted beyond the minus 6 inch damage limit, even if the rod-in limit instrumentation fails. Since control rod pair position instrumentation cannot be recalibrated without removing the CRD from the PCRV, the engineering evaluation provides the necessary procedural controls to establish individual control rod pair insertion limits for control rod pairs whose position indications exceed 6 inches.

REACTIVITY CONTROL

3/4.1.3 CONTROL ROD PAIR POSITION INDICATION SYSTEMS - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.3 The position indication instrumentation shall be OPERABLE for each control rod pair in fueled regions capable of being withdrawn and capable of determining control rod pair position within 12 inches with:

A. A rod-out limit indication or analog or digital position indication, when the control rod pair is fully withdrawn, or

B. A rod-in limit indication and either an analog or digital position indication, when the control rod pair is fully inserted.

APPLICABILITY: SHUTDOWN and REFUELING

ACTION: With any of the above required position indication instrumentation inoperable, within 12 hours either:

A. Restore the inoperable position indication instrumentation to OPERABLE status, or

B. Verify full insertion of the control rod pair by other independent means (e.g., watt-meter testing), or

C. Consider the control rod pair fully withdrawn and meet the SHUTDOWN MARGIN requirements of LCO 3.1.4.

SURVEILLANCE REQUIREMENTS

4.1.3 A. Control rod pair position instrumentation required by LCO 3.1.3 shall be demonstrated OPERABLE by performing a CHANNEL CHECK as follows:

1. Prior to withdrawal from the fully inserted position,

2. Upon full withdrawal,

| SPECIFICATION SR 4.1.3 (Continued)

3. Once per 7 days on all control rod pairs except for fully inserted control rod pairs which are incapable of being withdrawn, and

4. After an OPERATIONAL MODE change to SHUTDOWN from STARTUP.

   The analog and digital position indications shall be within 12 inches of each other. If a larger difference is observed, it shall be assumed that the analog indication is the inoperable channel, unless the analog indication can be proven to be accurate and OPERABLE by another means.

B. Once per 18 months for control rod pairs in fueled regions, a CHANNEL FUNCTIONAL TEST of each control rod pair's redundant "in" and "out" limit switches and analog and digital rod position indication systems, shall be performed.

C. A CHANNEL CALIBRATION of the control rod pair redundant "in" and "out" limit switches, and the analog and digital rod position indication systems, shall be performed on all CRDs removed for repair or maintenance.

D. When in REFUELING, prior to each control rod pair withdrawal (unless the surveillance has been performed within the previous 7 days) the OPERABILITY of the analog and digital position indications shall be verified for that control rod pair by:

1. Verifying that the rod-in limit light is on, when the control rod pair is fully inserted, and

2. Verifying that when the control rod pair is withdrawn a short distance, the rod-in limit indication clears when the analog and digital instrumentation indicates less than 6 inches.

   If the analog and digital instrumentation indicates 6 or more inches, an engineering evaluation shall be performed to determine the maximum insertion limit for that control rod pair.

BASIS FOR SPECIFICATION LCO 3.1.3/SR 4.1.3

This specification involves control rod pairs that are either fully inserted or fully withdrawn in fueled regions; therefore, the accuracy requirements are different from those in LCO 3.1.2 for operational considerations. The relative reactivity worth for the total control rod pair bank as a function of withdrawal position is given in FSAR Section 3.5.3 (Figure 3.5-2). Experimental results on control rod pair worth versus withdrawal position have indicated a reduced worth for the first portion of control rod pair withdrawal and has been substantiated with new analyses. From this revised calculated data and a calculated bank worth of 0.210 delta k, it can be shown that a reactivity uncertainty of 0.003 delta k results in the total bank position uncertainty of 17 inches at full insertion and 13 inches at full withdrawal. The reactivity uncertainty of 0.003 delta k is acceptable for the SHUTDOWN MARGIN and is consistent with that used to detect core irregularities, such as occasions of inadvertant release of reserve shutdown material within a single core region. Control rod pair withdrawal procedures require an evaluation if the actual critical control rod pair position differs from the predicted position during the approach to criticality by the reactivity worth of 0.003 delta k. Verifying position accuracy within 12 inches is consistent with these control rod pair position uncertainties.

If position indication instrumentation is inoperable, a 12 hour ACTION time is allowed because the SHUTDOWN MARGIN requirements have been met prior to position indication instrumentation inoperability.

Control rod pair position indication instrumentation OPERABILITY is verified by performing a CHANNEL CHECK before the control rod pair is withdrawn from the fully inserted position, when it is fully withdrawn, once per 7 days, and after an OPERATIONAL MODE change to SHUTDOWN from STARTUP on those control rod pairs capable of being withdrawn. The Basis for Specification 3/4.1.6 describes the methods of making a control rod pair incapable of being withdrawn. This surveillance ensures position indication OPERABILITY when the reactor is shutdown and during any refueling operations.

Once per 18 months for control rod pairs in fueled regions, a CHANNEL FUNCTIONAL TEST will be performed on the control rod pair redundant "in" and "out" limit switches and the analog and digital rod position indication systems. This surveillance ensures that the entire position indication system is OPERABLE prior to a reactor startup.

| BASIS FOR SPECIFICATION LCO 3.1.3/SR 4.1.3 (Continued)

| In conjunction with CRD removal from the PCRV, a CHANNEL CALIBRATION will be performed on the control rod pair redundant "in" and "out" limit switches, and the analog and digital rod position indication systems. A CHANNEL CALIBRATION on the CRD position indication instrumentation cannot be performed while the control rod pairs are installed in the PCRV; therefore, a calibration is performed only on the control rod pairs removed for repair or maintenance.

| During REFUELING, the rod-in limit indication, and analog and digital indications will be verified OPERABLE (for those control rod pairs capable of being withdrawn) within 7 days prior to control rod pair withdrawal.

| Control rod pairs physically cannot be inserted into defueled regions. For this reason, this specification applies only to control rod pairs in fueled regions.

REACTIVITY CONTROL

3/4.1.4 SHUTDOWN MARGIN

LIMITING CONDITION FOR OPERATION

3.1.4 The reactor SHUTDOWN MARGIN shall be greater than or equal to 0.01 delta k.

APPLICABILITY: At all times

ACTION:

A. When in POWER, LOW POWER, and STARTUP, with the SHUTDOWN MARGIN less than 0.01 delta k:

1. Within 1 hour, insert sufficient control rod pairs to achieve the specified SHUTDOWN MARGIN, or

2. Be in at least SHUTDOWN within the next 12 hours.

B. When in SHUTDOWN, with the SHUTDOWN MARGIN less than 0.01 delta k, within 1 hour, either:

1. Insert sufficient control rod pairs in fueled regions to achieve the specified SHUTDOWN MARGIN, or

2. Actuate sufficient reserve shutdown material in fueled regions to achieve the specified SHUTDOWN MARGIN.

C. When in REFUELING, with the SHUTDOWN MARGIN less than 0.01 delta k:

1. Immediately suspend all control rod pair or fuel manipulations involving positive reactivity changes, and

2. Within 1 hour either:

a. Fully insert sufficient control rod pairs into fueled regions to achieve the specified SHUTDOWN MARGIN, or

b. Actuate sufficient reserve shutdown material into fueled regions to achieve the specified SHUTDOWN MARGIN.

SURVEILLANCE REQUIREMENTS

4.1.4 SHUTDOWN MARGIN shall be assessed as follows:

A. When in POWER, LOW POWER, or STARTUP:

1. Once per 7 days,

2. In assessing the SHUTDOWN MARGIN the following conditions shall be assumed:

   a. The highest worth control rod pair is fully withdrawn,

   b. All OPERABLE control rod pairs are fully inserted with all inoperable control rod pairs in their pre-scram position,

   c. The CORE AVERAGE TEMPERATURE is equal to 220 degrees F, and

   d. Full decay of Xe-135, no buildup of Sm-149, and no decay of Pa-233 beyond that present at shutdown.

B. When in SHUTDOWN:

1. Within 12 hours after each reactor shutdown when all control rod pairs cannot be verified fully inserted in fueled regions,

2. Prior to control rod pair withdrawal, if all control rod pairs are not fully inserted in fueled regions prior to withdrawal action, and

3. Prior to control rod pair withdrawal to achieve criticality, to confirm that upon reaching criticality the SHUTDOWN MARGIN requirement can be met.

4. In assessing the SHUTDOWN MARGIN the following conditions shall be assumed:

   a. The highest worth control rod pair is fully withdrawn,

   b. All OPERABLE control rod pairs are fully inserted in fueled regions and inoperable control rod pairs in their known position or fully withdrawn,

SPECIFICATION SR 4.1.4 (Continued)

c. The CORE AVERAGE TEMPERATURE is equal to 80 degrees F, and

d. Full decay of Xe-135, full buildup of Sm-149, and Pa-233 decay as a function of time after shutdown.

C. When in REFUELING:

1. Prior to control rod pair withdrawal, if all control rod pairs are not fully inserted into fueled regions prior to withdrawal action, and

2. Prior to the removal of the control rod pair in a region to be refueled or repaired.

3. In assessing the SHUTDOWN MARGIN the following conditions shall be assumed:

a. The highest worth control rod pair capable of being withdrawn is fully withdrawn,

b. Control rod pairs being withdrawn for refueling/repair, SHUTDOWN MARGIN assessment, or OPERABILITY test purposes, are fully withdrawn,

c. All other OPERABLE control rod pairs are fully inserted into fueled regions and incapable of being withdrawn,

d. Inoperable control rod pairs are in their known position or fully withdrawn,

e. For planned CORE ALTERATIONS, the core shall be in its most reactive configuration,

SPECIFICATION SR 4.1.4 (Continued)

f. The CORE AVERAGE TEMPERATURE is equal to 80 degrees F, and

g. Full decay of Xe-135, full buildup of Sm-149, and Pa-233 decay as a function of time after shutdown.

BASIS FOR SPECIFICATION LCO 3.1.4/SR 4.1.4

A. SHUTDOWN MARGIN - OPERATING

The purpose of this LCO is to ensure that during operation a sufficient amount of negative reactivity in control rod pairs is capable of being inserted by the automatic and manual scram functions to shutdown the reactor with the highest worth control rod pair fully withdrawn. A SHUTDOWN MARGIN of at least 0.01 delta k has been specified at a CORE AVERAGE TEMPERATURE of 220 degrees F. The CORE AVERAGE TEMPERATURE will normally be significantly above 220 degrees F for several days following a scram from power yielding a SHUTDOWN MARGIN greater than 0.01 delta k.

Changes in the isotopic inventory following a reactor shutdown, of fission product poisons Xe-135 and Sm-149, and heavy metal Pa-233, are also considered. These changes are due to the buildup and decay of precursors as well as decay of their current concentration. For Xe-135, both the precursor and Xenon isotope decay in hours, with half-lives of 6 and 9 hours respectively, and consequently Xe-135 initially builds up to a peak value in about 6 hours, and then fully decays in a few days. Since full decay occurs in a few days, it is conservatively assumed to be fully decayed at the time of shutdown. The precursor for Sm-149 has a half-life of a few days, while the decay of Sm-149 occurs over several years, so the buildup occurs over many days and is conservatively assumed to remain at its current value at shutdown. The decay of Pa-233 to fissile U-233 occurs over a period of about 100 days, and it also is assumed to remain at its current value at shutdown.

Any control rod pair that is demonstrated OPERABLE per SR 4.1.1 will be assumed to be fully inserted and any inoperable control rod pair will be assumed to be at its pre-scram position. This is consistent with FSAR Section 3.5.3, which demonstrates that there is at least 0.014 delta k SHUTDOWN MARGIN with one control rod pair fully withdrawn under any core condition in the equilibrium core and larger for any core condition prior to the equilibrium core.

Assessment of the SHUTDOWN MARGIN requirements once per 7 days ensures that changes in the core reactivity as a result of burnup have not occurred which would make the previous verification invalid. The core reactivity changes as a result of burnup occur slowly and a 7 day surveillance during operation is sufficient. In addition, the ACTION statements of LCO 3.1.1 require more frequent assessment if a control rod pair is determined inoperable, or its exact position is uncertain.

BASIS FOR SPECIFICATION LCO 3.1.4/SR 4.1.4 (Continued)

B. SHUTDOWN and REFUELING

The purpose of this specification is to ensure that during SHUTDOWN and REFUELING a sufficient number of control rod pairs are fully inserted into fueled regions to keep the reactor in a shutdown condition. A SHUTDOWN MARGIN of at least 0.01 delta k has been specified at a CORE AVERAGE TEMPERATURE of 80 degrees F with decay of Xe-135, buildup of Sm-149 and some decay of Pa-233. The CORE AVERAGE TEMPERATURE will normally be significantly above 80 degrees F for many months after shutdown, and the decay of Pa-233 occurs over a few months. Therefore, the SHUTDOWN MARGIN immediately after achieving shutdown will normally be larger than the 0.01 delta k specified, and the 12 hour delay in verification of the SHUTDOWN MARGIN is sufficient for the purpose of this specification.

This specification need only require that the control rod pair be actually inserted to achieve the specified SHUTDOWN MARGIN. Since full insertion can be verified by either rod position indication or another independent means, such as watt-meter testing per LCO 3.1.3, some additional time has been allowed.

The Reserve Shutdown System was provided to ensure shutdown even in the event of failure to insert control rod pairs. It is adequate to ensure shutdown even if all control rod pairs fail to insert (FSAR Section 3.5.3). However, the contribution to the SHUTDOWN MARGIN by the addition of reserve shutdown material to a core region already containing an inserted control rod pair is minimal. Therefore, it is sufficient to activate the reserve shutdown material only in those regions whose control rod pairs are not fully inserted.

For SHUTDOWN, the specified SHUTDOWN MARGIN assumes the full withdrawal of the highest worth control rod pair. For REFUELING, (which can include either fuel or control rod pair manipulations) since all control rod pairs are disabled, except those involved with REFUELING per LCO 3.1.6, the requirement includes the addition of the highest worth control rod pair capable of being withdrawn in the SHUTDOWN MARGIN calculation. Disabling of control rod drives by disabling the electrical supply to the drive motors or placing the reactor mode switch in the "off" position results in the inability to withdraw the control rod pair by action of the drive motor. Therefore, the accidental withdrawal of any control rod pair in this manner does not have to be assumed in the SHUTDOWN MARGIN calculation.

BASIS FOR SPECIFICATION LCO 3.1.4/SR 4.1.4 (Continued)

The ACTION statement of LCO 3.1.6, Control Rod Pair Position Requirements-Shutdown, requires completion of the assessment of the SHUTDOWN MARGIN within 12 hours.

Within the first 24 hours after shutdown, the SHUTDOWN MARGIN is significantly larger than specified due to higher core temperatures and the presence of Xe-135 and Pa-233. A 12 hour delay will not compromise the validity of this specification.

Assessment of the SHUTDOWN MARGIN prior to any control rod pair withdrawal, if all control rod pairs are not fully inserted, prior to withdrawal to achieve criticality, and prior to removal of a control rod pair for refueling/repair, ensures that the requirements of this specification will be met during these ACTIONS.

| REACTIVITY CONTROL

| 3/4.1.5 CONTROL ROD PAIR POSITION AND WORTH REQUIREMENTS - OPERATING

| LIMITING CONDITION FOR OPERATION

| 3.1.5 Control rod pair position and worth requirements shall be as follows:

A. Control rod pairs (except the regulating rod pair) shall be withdrawn or inserted in groups (three control rod pairs per group) except during scrams, control rod pair runbacks, partial scram surveillance, or manipulations of additional control rod pairs permitted by Specification B.2 below.

B. All control rod pairs shall be either fully inserted or fully withdrawn except during partial scram testing and:

1. One shim group and the regulating rod pair may be in any position, and

2. Up to six additional control rod pairs may be inserted up to two feet.

C. The maximum calculated control rod pair worth shall not exceed:

1. 0.047 delta k, with the reactor critical at approximately 1.0 E-07 percent RATED THERMAL POWER (source power), and

2. At full power, that worth which would result in Rod Withdrawal Accident (RWA) consequences equal to those described for the worst case RWA in the AEC Safety Evaluation of Fort St. Vrain dated January 20, 1972.

| APPLICABILITY: POWER, LOW POWER, and STARTUP

SPECIFICATION LCO 3.1.5 (Continued)

ACTION:

A. With any control rod pair or group not in compliance with its position requirements either:

1. Restore the control rod pair(s) to an acceptable configuration within 4 hours, or

2. Be in at least LOW POWER within the next 12 hours, and SHUTDOWN within the following 12 hours.

B. With any control rod pair not in compliance with its worth limits, be in at least SHUTDOWN within 24 hours.

SURVEILLANCE REQUIREMENTS

4.1.5

A. Once every 12 hours, each control rod pair position shall be verified to be in compliance with the above requirements.

B. At the beginning of each REFUELING CYCLE, the reactivity worth of the control rod pair groups withdrawn from LOW POWER to POWER in the withdrawal sequence, shall be measured. The measured group worths shall be compared with the calculated group worths to verify that the calculated criteria upon which the selection of the control rod pair sequence was based has been satisfied. The measured group worth shall agree with the calculated group worth within plus or minus 20% for all groups except groups 4A and 4D, for which the measured group worth shall be within plus 100%, minus 50% of the calculated group worth.

| BASIS FOR SPECIFICATION LCO 3.1.5/SR 4.1.5

| The specification of a control rod pair withdrawal sequence and position requirements during STARTUP and LOW POWER operation is required to:

a. Assist in evaluating the reactivity worth of control rod pairs withdrawn during the approach to criticality by indicated changes in the multiplied source neutrons,

b. Ensure that an acceptable power distribution is maintained (peaking factors within design limits) for the condition when many control rod pairs are still inserted, and

c. Ensure that the calculated maximum worth control rod pair in STARTUP and LOW POWER if assumed accidentally withdrawn, would result in a transient with consequences no more severe than the control rod pair withdrawal accident (RWA) analyzed in the FSAR (Sections 3.5.3.1 and 14.2.2.7).

| The specification of a control rod pair withdrawal sequence and position requirements during POWER are required to yield an acceptable power distribution. In addition, the sequence ensures that the combination of maximum single control rod pair worth and available core temperature coefficients, in the event of an accidental control rod pair withdrawal, will result in a transient with consequences less severe than those analyzed in the FSAR. The RWA analyzed in the FSAR is consistent with the RWA evaluation in the AEC Safety Evaluation of Fort St. Vrain dated January 20, 1972.

| The maximum calculated control rod pair worth limit of 0.047 delta k at approximately 1.0 E-7 percent power is based on the Maximum Worth Control Rod Pair Withdrawal at Source Power analysis in FSAR Section 14.2.2.7.

| BASIS FOR SPECIFICATION LCO 3.1.5/SR 4.1.5 (Continued)

| The RWA analysis at rated power, as described in the FSAR, is based on a maximum control rod pair worth of 0.012 delta k, using temperature coefficients equivalent to a reactivity defect from refueling (220 degrees F) to operating temperature (1500 degrees F) of 0.028 delta k. For operation in the range from 0 to 100 percent power, the fuel temperature may be lower than the full power operating fuel temperature of 1500 degrees F. This results in a greater number of control rod pairs inserted for the critical configuration, and a larger maximum single control rod pair worth. In addition, since the temperature coefficients are greater at the beginning of the cycle, a single control rod pair worth as much as 0.016 delta k is acceptable, i.e., the consequences of an RWA are less severe (FSAR Section 14.2.1). A value larger than 0.012 delta k for a single control rod pair can be safely accommodated if fuel temperatures are lower than 1500 degrees F and/or the temperature defect between refueling temperature (220 degrees F) and operating temperature (1500 degrees F) is greater than 0.028 delta k (FSAR Section 14.2.1.1).

| The presence of too many partially inserted control rod pairs in the core will tend to push the flux into the bottom half of the core and raise the fuel temperatures. The intra-region and axial power peaking factors used in determining the control rod pair withdrawal sequence for each REFUELING CYCLE will be maintained during normal operation if the control rod pairs are inserted and withdrawn in sequence and if partially inserted control rod pairs are limited as noted above (FSAR Section 3.5.4).

| The six additional control rod pairs which may be inserted up to 2 feet into the core will permit the operator to move control rod pairs to assist in regulating the core region outlet temperatures to those specified in LCO's 4.1.7 and 4.1.9. This has a minimal effect on the axial power distribution, resulting in an increase in the average power density in the lower layer of fuel of less than 5%.

| The runback function inserts two pre-selected groups of three control rod pairs during rapid load reduction (FSAR Section 7.2.1.2). The partial insertion of these control rod pairs, (FSAR Section 3.5.4.2) in addition to those noted above would increase the average axial power peaking factor in the lower layer of fuel to about 0.85. Negligible fuel particle kernel migration (SL 3.1) would occur with this condition in the core for up to 4 hours.

BASIS FOR SPECIFICATION LCO 3.1.5/SR 4.1.5 (Continued)

The ACTION to be in at least LOW POWER within the next 12 hours and SHUTDOWN in the following 12 hours requires an orderly shutdown to reduce plant load and temperatures in a controlled manner. Core temperatures are significantly reduced as lower power levels are reached, and in STARTUP negligible fuel particle kernel migration would occur as long as the minimum helium flow requirements (LCO 4.1.9) are maintained.

Verification of control rod pair positions (by monitoring position indication) once per 12 hours ensures rod position changes with any reactor power changes are noted, and is consistent with the verification of INDIVIDUAL REFUELING REGION OUTLET TEMPERATURES once per 12 hours (SR 5.1.8).

The measurement of control rod pair group worths in the normal withdrawal sequence at the beginning of each REFUELING CYCLE will provide an evaluation of calculational methods in determining the control rod pair group worths in the core configuration for that cycle. The criteria used in selecting the control rod pair sequence is based on calculated data for the maximum worth for any individual control rod pair as well as the calculated peaking factors (region, intra-region, and axial) in the normal operating control rod pair configuration. Since the core configuration changes for each REFUELING CYCLE (a new segment includes approximately one sixth of the total core) this evaluation confirms the ability to predict control rod pair worths in that specific configuration.

The acceptance criteria for the comparison of measured versus calculated control rod pair group worth within plus or minus 20% includes an allowance for the calculated uncertainty of plus or minus 10% (FSAR Section 3.5.7.4) and uncertainty in the measurement. A larger acceptance criteria is needed for control rod pair groups 4A and 4D because of a larger uncertainty in the calculated values. Groups 4A and 4D are five column regions located at the core-reflector interface, and the analytical model for control rod pair worth calculations was developed for seven column regions. In addition, since the control rod pairs are located in the central column and this column for a five column region is immediately adjacent to the reflector, their reactivity worth is substantially less than the other control rod pair groups. These groups are typically worth less than 0.010 delta k. Because of the low worth and the analytical uncertainty, a larger range for the acceptance criteria is required.

REACTIVITY CONTROL

3/4.1.6 CONTROL ROD PAIR POSITION REQUIREMENTS - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.6 All control rod pairs in fueled regions shall be fully inserted and incapable of being withdrawn except:*

1. Up to two control rod pairs may be removed from fueled regions, and

2. Additional control rod pairs may be withdrawn for SHUTDOWN MARGIN assessment or OPERABILITY tests.

APPLICABILITY: SHUTDOWN AND REFUELING

ACTION:

A. Within 1 hour after each reactor shutdown, if more than two control rod pairs are not verified to be fully inserted, either:

   1. Insert at least all but two control rod pairs to the fully inserted position, or

   2. Insert reserve shutdown material in at least those regions where control rod pairs are not verified to be fully inserted, beyond the allowable two.

B. Subsequent to 1 hour after reactor shutdown, with less than the above requirements:

   1. Immediately suspend all operations involving CORE ALTERATIONS, control rod pair movements resulting in positive reactivity changes or movement of IRRADIATED FUEL.

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* The SHUTDOWN MARGIN requirements of LCO 3.1.4 (for SHUTDOWN and REFUELING) shall be maintained for all these control rod pair configurations.

SPECIFICATION LCO 3.1.6 (Continued)

2. Within 12 hours either:

   a. Insert any control rod pair capable of being inserted into fueled regions and verify the SHUTDOWN MARGIN requirements of LCO 3.1.4 are met, or

   b. Actuate sufficient reserve shutdown material into fueled regions to achieve the specified SHUTDOWN MARGIN.

SURVEILLANCE REQUIREMENTS

4.1.6 A. Control rod pair positions for all control rod pairs capable of being withdrawn shall be monitored for compliance with LCO 3.1.6.A above, once every 12 hours.

B. Following each reactor shutdown, each control rod pair shall be verified to be at the fully inserted position by:

1. The rod-in position indication, or

2. The use of an independent control rod pair position verification method (e.g., watt-meter test).

Control rod pairs known to be fully inserted prior to the shutdown may be excluded from the above verifications.

C. Prior to the removal of more than one control rod drive assembly, the SHUTDOWN MARGIN shall be explicitly calculated per the assumptions specified in SR 4.1.4.

D. Upon full withdrawal of control rod pairs selected for removal, and prior to disabling their scram capabilities, the SHUTDOWN MARGIN shall be assessed by:

1. Withdrawing one or more additional control rod pairs with a calculated worth greater than or equal to 0.01 delta k, plus any calculated positive worth due to the temperature difference between the actual refueling temperature and 80 degrees F,

| SPECIFICATION SR 4.1.6 (Continued)

| 2. Verifying subcriticality, and

| 3. Then reinserting the additional control rod pairs.

| BASIS FOR SPECIFICATION LCO 3.1.6/SR 4.1.6

| This specification ensures that a sufficient number of control rod | pairs are fully inserted into fueled regions to keep the reactor in a | shutdown condition (SHUTDOWN MARGIN greater than or equal to 0.01 | delta k) in SHUTDOWN and REFUELING.

| Prior to refueling a region, the control rod pair in that region and | the control rod pair in the region next in sequence to be refueled | will be withdrawn. Additional predesignated control rod pairs will | also be withdrawn and subcriticality will be verified. The | calculated minimum reactivity worth of the additional predesignated | control rod pairs is 0.01 delta k plus the reactivity difference | between the new and spent fuel in the region to be refueled, plus the | temperature defect between the refueling temperature and 80 degrees | F. After subcriticality has been verified, the predesignated control | rod pairs will be fully reinserted. Withdrawal of the predesignated | control rod pairs ensures a SHUTDOWN MARGIN of greater than or equal | to 0.01 delta k at 80 degrees F with new fuel loaded into the | refueled region. This procedure will be followed until all control | rod pairs have been withdrawn without resulting in reactor | criticality, as determined with a calculated k(eff) not to exceed | 0.95 assuming all conditions specified in Specification 3/4.1.4.

| Making all of the fully inserted control rod pairs incapable of being | withdrawn ensures that an un-analyzed core configuration which might | result in criticality will not exist. In general, this is | accomplished by placing the reactor mode switch in the "off" position | or disabling the electrical supply to the motors. However, for any | specific control rod pair where analysis indicates inadvertent | withdrawal would result in criticality, this control rod pair is made | incapable of withdrawal by physically disconnecting its drive so that | its withdrawal is an incredible event for the purposes of analysis. | This may be accomplished by lifting the power leads or other means | that involve more than just an administratively controlled clearance.

BASIS FOR SPECIFICATION LCO 3.1.6/SR 4.1.6 (Continued)

A SHUTDOWN MARGIN of greater than or equal to 0.01 delta k after reactor shutdown (automatic scram or controlled) is ensured by the 1 hour ACTION to either insert all but two control rod pairs or insert reserve shutdown material in those regions where control rod pairs cannot be verified to be fully inserted, beyond the allowable two. Control rod pairs may be verified fully inserted by rod-in indication (either rod-in limit, analog, or digital position indication), or by other independent means (e.g., watt-meter test) as time permits. The 12 inch limit ensures reactivity control, as discussed in the Bases for LCO 3.1.3. Experience has shown that a control rod pair which is not fully inserted by a scram may still be fully inserted manually with its control rod drive motor. If the control rod pair cannot be fully inserted with its drive motor, reserve shutdown material will be inserted into that region, ensuring a SHUTDOWN MARGIN of greater than or equal to 0.01 delta k.

If any requirements of the LCO are not met while the reactor is in SHUTDOWN or REFUELING, any control rod pair or fuel manipulations which would result in a positive reactivity addition will be suspended immediately and within 12 hours any withdrawn control rod pairs in fueled regions will be fully inserted. If a SHUTDOWN MARGIN of greater than or equal to 0.01 delta k is not met by fully inserting the control rod pairs, sufficient reserve shutdown material will be inserted in fueled regions to achieve the specified SHUTDOWN MARGIN. This ACTION ensures a SHUTDOWN MARGIN of greater than or equal to 0.01 delta k during reactor shutdown or refueling operations.

The reserve shutdown material provides an effective method of reactivity control when inserted into fueled core regions where the control rod pairs have not been fully inserted. Because of the proximity to the control rod pairs, it has almost no additional worth when inserted in regions where the control rod pairs are inserted. Therefore, to ensure an adequate SHUTDOWN MARGIN, it need only be inserted into those fueled core regions where full insertion of the control rod pairs cannot be demonstrated.

Verifying control rod pair positions once every 12 hours, ensures that control rod pair position can be monitored during control rod pair manipulations performed in refueling operations.

After each shutdown, verifying that each control rod pair is fully inserted ensures that the position of each control rod pair is known and that the SHUTDOWN MARGIN assessment is accurate.

| BASIS FOR SPECIFICATION LCO 3.1.6/SR 4.1.6 (Continued)

| Demonstrating that a SHUTDOWN MARGIN of greater than or equal to 0.01 delta k exists prior to removing more than one control rod drive assembly from fueled regions ensures that criticality will not occur and the SHUTDOWN MARGIN requirements will be maintained after the control rod pair is removed.

REACTIVITY CONTROL

3/4.1.7 REACTIVITY CHANGE WITH TEMPERATURE

LIMITING CONDITION FOR OPERATION

3.1.7 The reactivity change due to a CORE AVERAGE TEMPERATURE increase between 220 degrees F and 1500 degrees F, shall be at least as negative as 0.031 delta k, but no more negative than 0.065 delta k throughout the REFUELING CYCLE.

APPLICABILITY: POWER, LOW POWER, and STARTUP

ACTION: With the reactivity change outside of the above limits, be in SHUTDOWN within 12 hours.

SURVEILLANCE REQUIREMENTS

4.1.7 At the beginning of each REFUELING CYCLE the reactivity change as a function of CORE AVERAGE TEMPERATURE change (temperature coefficient) shall be measured and integrated to verify that the measured reactivity change is within the above limits.

| BASIS FOR SPECIFICATION LCO 3.1.7/SR 4.1.7

| The negative temperature coefficient is an inherent safety mechanism that tends to limit power increases during temperature excursions. It is a stabilizing element in flux tilts or oscillations due, for example, to xenon transients.

| Fuel temperatures during a power excursion beginning from a high power level are well within design limits regardless of the magnitude of the negative temperature coefficient, provided protective action is initiated by a power level signal. However, if protective action occurs much later, such as from a manual scram or actuation of the reserve shutdown system, peak fuel temperatures will be sensitive to the magnitude of the negative temperature coefficient.

| Requiring a reactivity change at least as negative as 0.031 delta k for a CORE AVERAGE TEMPERATURE increase from 220 degrees F to the 1500 degree F temperatures associated with the nominal RATED THERMAL POWER value, ensures temperature coefficients at least as negative as those used in the FSAR accident analysis. All control rod pair withdrawal transients assume a reactivity temperature defect of 0.028 delta k which when combined with an uncertainty of plus or minus 10%, yields the specified defect of 0.031 delta k.

| The maximum reactivity temperature defect of 0.065 delta k (0.072 delta k minus 0.007 delta k for uncertainty) assures that there is sufficient reactivity control to ensure reactor SHUTDOWN in the unlikely event that all control rod pairs cannot be inserted and the reserve shutdown system has been actuated.

| The reactivity worth of the reserve shutdown system was calculated to be 0.130 delta k in the equilibrium core (FSAR Section 3.5.3). From calculated excess reactivity data in Table 3.5-4 and Section 3.5.3 of the FSAR it is seen that the maximum excess reactivity in the equilibrium core with the CORE AVERAGE TEMPERATURE of 220 degrees F, Xe-135 decayed, Sm-149 built up, and 2 weeks Pa-233 decay, is 0.102 delta k. Assuming no control rods are inserted and the reserve shutdown system has been activated, the excess SHUTDOWN MARGIN for that excess reactivity is 0.028 delta k, (0.130 delta k minus 0.102 delta k). The calculated reactivity temperature defect for that cycle is 0.044 delta k. Therefore, if the reactivity temperature defect were as large as 0.072 delta k (0.044 delta k plus 0.028 delta k) reactor SHUTDOWN could be ensured for at least 2 weeks even for the unlikely event that all control rods failed to insert, and the reserve shutdown system was actuated.

BASIS FOR SPECIFICATION LCO 3.1.7/SR 4.1.7 (Continued)

The major shifts in reactivity change as a function of core temperature change will occur following refueling. The specified frequency of measurement following each refueling will ensure that the change of reactivity as a function of changes in core temperature will be measured on a timely basis to evaluate the limit provided in LCO 3.1.5.

The maximum value of reactivity temperature defect occurs at the beginning of the cycle and slowly decreases through the cycle to a minimum value at the end of the cycle. Since the measurement is made at the beginning of a cycle and the minimum value occurs at the end of a cycle, a direct evaluation of the minimum reactivity temperature defect cannot be made. However, by comparing the calculated value at the beginning of the cycle with the measured value, an evaluation for compliance can be made using the calculated value at the end of cycle. Performance of the Surveillance Requirement verifies the assumptions used in the analysis.

REACTIVITY CONTROL

3/4.1.8 RESERVE SHUTDOWN SYSTEM - OPERATING

LIMITING CONDITION FOR OPERATION

3.1.8 All reserve shutdown (RSD) units shall be OPERABLE with:

A. At least 1500 psig pressure in their individual helium gas bottle supplies, and

B. At least 500 psig pressure in the Alternate Cooling Method (ACM) nitrogen bottles which provide a backup means of actuating the RSD hopper pressurization valves.

APPLICABILITY: POWER, LOW POWER, and STARTUP

ACTION:

A. With one RSD unit inoperable, operation may continue provided that an OPERABLE spare RSD unit is available.

B. With two or more RSD units inoperable, restore all but one inoperable RSD unit to OPERABLE within 24 hours, or be in at least SHUTDOWN within the next 12 hours.

C. The provisions of LCO 3.0.4 are not applicable for changes between STARTUP, LOW POWER, and POWER. Prior to entry into STARTUP from SHUTDOWN, all the requirements of this LCO must be met, without reliance on the provisions contained in the ACTION statements.

SURVEILLANCE REQUIREMENTS

4.1.8 The reserve shutdown system shall be demonstrated OPERABLE:

A. Once per 7 days by verifying that the pressure of each helium gas bottle is at least 1500 psig.

B. Once per 7 days by verifying that the pressure of each ACM nitrogen bottle is at least 500 psig.

SPECIFICATION SR 4.1.8 (Continued)

C. Once per 92 days by:

1. Pressurizing each of the 37 RSD hoppers above reactor pressure, as indicated by operation of the hopper pressure switch,

2. Operating the ACM quick disconnect couplings, and

3. Performing a CHANNEL FUNCTIONAL TEST of the instrumentation which alarms at low pressure in the RSD actuating pressure lines.

D. Once per 366 days by performing a CHANNEL CALIBRATION of the gas pressure instrumentation.

E. Following entry of condensed water into any RSD system hopper(s) (see LCO 3.1.1 ACTION H), by performing the Surveillance Requirements identified in SR 4.1.9.E.

| BASIS FOR SPECIFICATION LCO 3.1.8/SR 4.1.8

| The reserve shutdown (RSD) system must be capable of achieving | reactor shutdown in the event that the control rod pairs fail to | insert.

| After extended power operation, the RSD system must add sufficient | negative reactivity to overcome the temperature defect between 1500 | and 220 degrees F, the decay of Xe-135, and some decay of Pa-233 to | U-233. The buildup of Sm-149 also adds negative reactivity and is | taken into account in reactivity evaluations.

| The core reactivity increase due to core cooldown and Xe-135 decay | occurs within a few days and was calculated to be between 0.089 delta | k and 0.081 delta k, at the beginning and end of the initial cycle, | respectively, and about 0.076 delta k for the mid cycle of the | equilibrium core. The reactivity increase is largest in the initial | core where the thorium loading is high and decreases through the | first six cycles to a minimum value for the equilibrium core. The | reactivity increase due to Sm-149 buildup and Pa-233 decay occurs | over several weeks to months and increases the core excess reactivity | for the equilibrium core by about 0.007 delta k during the first 14 | days, and by about 0.024 delta k after a few months, including full | Pa-233 decay. Therefore, the reactivity control requirement for the | RSD system, including an allowance of 0.01 delta k for SHUTDOWN | MARGIN, in the absence of any control rod pairs being inserted is | 0.098 delt k for the initial core and 0.093 delta k for the | equilibrium core after 14 days of Pa-233 decay and 0.121 delta k and | 0.110 delta k after full Pa-233 decay. (FSAR Section 3.5).

| The calculated worth for the RSD system as noted in FSAR Section | 3.5.3 is at least 0.14 delta k in the initial core, and 0.13 delta k | in the equilibrium core. The worth of the RSD System with the | maximum worth RSD unit inoperable for those cases is at least 0.12 | delta k in the initial core and 0.11 delta k in the equilibrium core, | which is sufficient to ensure SHUTDOWN during the first 14 days of | Pa-233 decay.

| Generally, inoperable RSD units are capable of being restored to | OPERABLE status within 24 hours. However, in the unlikely event that | an inoperable RSD unit cannot be restored to OPERABLE within this | time, there is adequate time (at least 14 days due to the slow Pa-233 | decay as discussed in the BASIS for Specification 3/4.1.4) following | a shutdown using the RSD system, to allow for corrective action of | changing out a CRD assembly. A spare RSD unit is considered | available if it is on site.

BASIS FOR SPECIFICATION LCO 3.1.8/SR 4.1.8 (Continued)

Two or more RSD units may be inoperable for 24 hours to provide a reasonable time for repair. This is permissible because the control rod pairs are available to shut down the reactor in the unlikely event that a shutdown would be required during this short period of time.

A minimum pressure of 1500 psig in the individual helium gas bottle supplies is adequate because the pressure required to burst the rupture discs is 1100 psig (FSAR Section 3.8.3). The rupture discs are designed and have been tested to burst at a differential pressure of 165 plus or minus 50 psi.

A minimum pressure of 500 psig in the ACM nitrogen bottles is adequate because the required set pressure is 220 psig. A set pressure of 220 psig is based on stroking a bank of 10 RSD valves one time and keeping the regulator fully open. This value also compensates for minor line losses and system leakages.

Each of the 37 RSD hoppers shall be pressurized above reactor pressure once per 92 days. Two redundant pressurizing valves will be opened using local test switches and the corresponding hopper pressure observed to increase. To prevent releasing absorber material, the high pressure gas cylinder is isolated and the pressurized actuating line is vented prior to the test. Pressurization is accomplished using test gas at a pressure differential of approximately 40-70 psi above reactor pressure, which is below the 115 psi differential pressure required to rupture the disc. The hopper pressure should increase at least 10 psi above reactor pressure, as indicated by the hopper high pressure alarm.

A CHANNEL FUNCTIONAL TEST will be performed on the low pressure alarm instrumentation once per 92 days to ensure that the minimum required rupture gas pressure can be monitored.

A CHANNEL CALIBRATION will be performed on the gas pressure instrumentation once per 366 days to ensure reliable monitoring of the helium and nitrogen gas supplies.

In the event that condensed water enters into any RSD system hoppers, two RSD hoppers shall be functionally tested out of the core. One assembly will contain 20 weight percent and the other 40 weight percent boronated material. The RSD hopper will be pressurized to the point of rupturing the disc and releasing the poison material. The material will be visually examined for boric acid crystallization and chemically analyzed for boron carbide and leachable boron content.

REACTIVITY CONTROL

3/4.1.9 RESERVE SHUTDOWN SYSTEM - SHUTDOWN

LIMITING CONDITION FOR OPERATION

3.1.9 Reserve shutdown (RSD) units in control rod drive assemblies for which control rod pairs are capable of being withdrawn from fueled regions shall be OPERABLE (except RSD units in any control rod drive assemblies removed for refueling/repair) with:

A. At least 1500 psig pressure in their individual helium gas bottle supplies, and

B. At least 500 psig pressure in the Alternate Cooling Method (ACM) nitrogen bottles which provide a backup means of actuating the RSD hopper pressurization valves.

APPLICABILITY: SHUTDOWN and REFUELING

ACTION: With less than the above required RSD units OPERABLE, within 24 hours either:

A. Return all control rod pairs in fueled regions (except the ones removed for refueling/repair) to the fully inserted position, or

B. Ensure SHUTDOWN MARGIN requirements are met (LCO 3.1.4), or

C. Insert sufficient RSD material to maintain SHUTDOWN MARGIN requirements.

SURVEILLANCE REQUIREMENTS

4.1.9 The reserve shutdown system in fueled regions shall be demonstrated OPERABLE:

A. Prior to withdrawal and once per 7 days thereafter, for those control rod pairs capable of being withdrawn, by verifying that the pressure of each required individual hopper helium gas bottle is at least 1500 psig.

B. Prior to withdrawal and once per 7 days thereafter, for those control rod pairs capable of being withdrawn, by verifying that the pressure of each required ACM nitrogen bottles is at least 500 psig.

C. Once per 366 days by performing a CHANNEL CALIBRATION of the gas pressure instrumentation.

D. Once per 18 months by:

1. Demonstrating that each subsystem is OPERABLE by actuating each group of pressurizing valves from the control room and verifying that the valves open. The capability of pressurizing the corresponding hoppers need not be demonstrated during this test.

2. Performing a CHANNEL CALIBRATION of the RSD hopper pressure switches at the time of control rod drive preventive maintenance (SR 4.1.1).

3. Visually examining the pipe sections which require disassembly and reassembly within the refueling penetrations, after they have been disassembled for preventive maintenance (SR 4.1.1), and verifying that there is no deformation or corrosion that could affect RSD system OPERABILITY.

4. Functionally testing the RSD assembly most recently removed from the core. The test consists of pressurizing the RSD hopper to the point of rupturing the disc and releasing the RSD material.

   The RSD material from the tested RSD hopper shall be visually examined for evidence of boric acid crystal formation and chemically analyzed for boron carbide and leachable boron content. Failure of a RSD assembly to perform acceptably during functional testing or evidence of extensive boric acid crystal formation will be reported to the Commission within 30 days per Specification 7.5.

SPECIFICATION SR 4.1.9 (Continued)

E. Following entry of condensed water into any RSD system hopper(s) (see LCO 3.1.1 ACTION H), by performing the Surveillance Requirements identified in SR 4.1.9.D.4 on two RSD assemblies, one containing 20 weight percent boronated material and the other containing 40 weight percent boronated material. At the point in time when all of the regions having RSD hoppers with 40 weight percent boronated material have been defueled, one RSD assembly containing 20 weight percent boronated material shall be tested.

BASIS FOR SPECIFICATION LCO 3.1.9/SR 4.1.9

The reserve shutdown (RSD) system must be capable of achieving reactor shutdown in the event that the control rod pairs fail to insert.

After extended power operation, the RSD system must add sufficient negative reactivity to overcome the temperature defect between 1500 and 220 degrees F, the decay of Xe-135, and some decay of Pa-233 to U-233. The buildup of Sm-149 also adds negative reactivity and is taken into account in reactivity evaluations.

The core reactivity increase due to core cooldown and Xe-135 decay occurs within a few days and was calculated to be between 0.089 delta k and 0.081 delta k, at the beginning and end of the initial cycle, respectively, and about 0.076 delta k for the mid cycle of the equilibrium core. The reactivity increase is largest in the initial core where the thorium loading is high and decreases through the first six cycles to a minimum value for the equilibrium core. The reactivity increase due to Sm-149 buildup and Pa-233 decay occurs over several weeks to months and increases the core excess reactivity for the equilibrium core by about 0.007 delta k during the first 14 days, and by about 0.024 delta k after a few months, including full Pa-233 decay. Therefore, the reactivity control requirement for the RSD system, including an allowance of 0.01 delta k for SHUTDOWN MARGIN, in the absence of any control rod pairs being inserted is 0.098 delta k for the initial core and 0.093 delta k for the equilibrium core after 14 days of Pa-233 decay and 0.121 delta k and 0.110 delta k after full Pa-233 decay. (FSAR Section 3.5).

The calculated worth for the RSD system as noted in FSAR Section 3.5.3 is at least 0.14 delta k in the initial core, and 0.13 delta k in the equilibrium core. The worth of the RSD System with the maximum worth RSD unit inoperable for those cases is at least 0.12 delta k in the initial core and 0.11 delta k in the equilibrium core, which is sufficient to ensure SHUTDOWN during the first 14 days of Pa-233 decay.

Generally, inoperable RSD units are capable of being restored to OPERABLE status within 24 hours. However, in the unlikely event that an inoperable RSD unit cannot be restored to OPERABLE within this time, there is adequate time (at least 14 days due to the slow Pa-233 decay as discussed in the BASIS for LCO 3.1.4) following a shutdown using the RSD system, to allow for corrective action of changing out a CRD assembly. A spare RSD unit is considered available if it is on site.

| BASIS FOR SPECIFICATION LCO 3.1.9/SR 4.1.9 (Continued)

| Ensuring SHUTDOWN MARGIN requirements for a CORE AVERAGE TEMPERATURE greater than or equal to 220 degrees F is acceptable and provides for changing out a Control Rod Drive (CRD) assembly, if necessary. Under normal conditions when the reactor has been operated for several months (which is required for Pa-233 buildup), a CORE AVERAGE TEMPERATURE greater than 220 degrees F is retained for a period of 2-4 weeks even with the CORE AVERAGE INLET TEMPERATURE as low as 100 degrees F. This is adequate time for the replacement of a CRD assembly.

| A minimum pressure of 1500 psig in the individual helium gas bottle supplies is adequate because the pressure required to burst the rupture discs is 1100 psig (FSAR Section 3.8.3). The runture discs are designed and have been tested to burst at a differential pressure of 165 plus or minus 50 psi.

| A minimum pressure of 500 psig in the ACM nitrogen bottles is adequate because the required set pressure is 220 psig. A set pressure of 220 psig is based on stroking a bank of 10 RSD valves one time and keeping the regulator fully open. This value also compensates for minor line losses and system leakages.

| A CHANNEL CALIBRATION will be performed on the gas pressure instrumentation once per 366 days to ensure reliable monitoring of the helium and nitrogen gas supplies.

| Once per 18 months, the most recently removed RSD hopper will be functionally tested and examined. The RSD hopper will be pressurized to the point of rupturing the disc and releasing the poison material. The material will be visually examined for boric acid crystallization and chemically analyzed for boron carbide and leachable boron content.

| LCO 3.1.9 only requires RSD units to be OPERABLE for those control rod pairs capable of being withdrawn because the worth of the control rod pair(s) removed from the PCRV has been accounted for in the SHUTDOWN MARGIN and the worth of the RSD material in regions whose control rod pair are inserted adds little to the SHUTDOWN MARGIN.

| The ACTION time of 24 hours is adequate because the reactor has already been shutdown and the SHUTDOWN MARGIN requirements met, versus verifying SHUTDOWN MARGIN requirements immediately after a shutdown.

| Once per 18 months, each group of pressurizing valves will be actuated from the control room to verify that the valves open.

| BASIS FOR SPECIFICATION LCO 3.1.9/SR 4.1.9 (Continued)

| Once per 18 months, the RSD hopper pressure switches which measure the pressure differential between the hoppers and the reactor will be calibrated as individual control and orifice assemblies are removed from the reactor for servicing and maintenance. These switches alarm high pressure for pressurization testing or actual system operation.

| In the event that condensed water enters into any RSD system hoppers, two RSD hoppers shall be functionally tested out of the core. One assembly will contain 20 weight percent and the other 40 weight percent boronated material. The RSD hopper will be pressurized to the point of rupturing the disc and releasing the poison material. The material will be visually examined for boric acid crystallization and chemically analyzed for boron carbide and leachable boron content.

| If there is no RSD assembly containing 40 weight percent boronated material over a fueled region, its negative reactivity is not insertable, and as such, testing it would be meaningless, and testing one assembly containing 20 weight percent boronated material is sufficient.

| The refueling penetration pipe sections will be visually examined for deformation and corrosion following disassembly for refueling or maintenance.