TSTF
TECHNICAL SPECIFICATIONS TASK FORCE
A JOINT OWNERS GROUP ACTIVITY

September 13, 2005 TSTF-05-16

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: TSTF-490, Revision 0, "Deletion of E Bar Definition and Revision to RCS Specific Activity Tech Spec"

Dear Sir or Madam:

Enclosed for NRC review is Revision 0 of TSTF-490, "Deletion of E Bar Definition and Revision to RCS Specific Activity Tech Spec." This Traveler revises the Reactor Coolant System Specific Activity specification for pressurized water reactors to utilize a new indicator, Dose Equivalent Xenon-133, instead of the current indicator known as E Bar.

Any NRC review fees associated with the review of TSTF-490, Revision 0 should be billed to the Westinghouse Owners Group.

Should you have any questions, please do not hesitate to contact us.

Wesley Sparkman (WOG)

Michael Crowthers (BWROG)

Brian Woods (WOG/CE)

Paul Infanger (BWOG)

Enclosure

cc: Thomas H. Boyce, Technical Specifications Section, NRC
David E. Roth, Technical Specifications Section, NRC

6014

11921 Rockville Pike, Suite 100, Rockville, MD 20852
Phone: 301-984-4400, Fax: 301-984-7600
Email: tstf@excelservices.com
Administered by EXCEL Services Corporation

The B&W Owners Group

bcc: Wes Sparkman (WOG)
Brian Woods (WOG/CE)
Michael Crowthers (BWROG)
Paul Infanger (BWOG)
Donald Hoffman (EXCEL)
Brian Mann (EXCEL)
Tom Laubham (WOG)
Fred Emerson (GE)
Bob Schomaker (BWOG)

Technical Specification Task Force
Improved Standard Technical Specifications Change Traveler

Deletion of E Bar Definition and Revision to RCS Specific Activity Tech Spec

NUREGs Affected: ☑ 1430 ☑ 1431 ☑ 1432 ☐ 1433 ☐ 1434

Classification: 1) Technical Change | Recommended for CLIIP?: Yes

Correction or Improvement: Correction | NRC Fee Status: Not Exempt

Benefit: Provides Longer Completion Time

Industry Contact: Wes Sparkman, (205) 992-5061, wasparkm@southernco.com

1.0 DESCRIPTION

The current limits on primary coolant gross specific activity are replaced with limits on primary coolant noble gas activity. The noble gas activity would be based on DOSE EQUIVALENT XE-133 and would take into account only the noble gas activity in the primary coolant.

The figure of primary coolant iodine concentration as a function of reactor power is deleted and replaced with a single value that is applicable to any power level.

2.0 PROPOSED CHANGE

The following changes are being proposed to the Improved Standard Technical Specifications (ISTS):

1. Revise the definition of DOSE EQUIVALENT I-131
2. Delete the definition of "E-Bar," AVERAGE DISINTEGRATION ENERGY
3. Add a new definition for DOSE EQUIVALENT XE-133
4. LCO 3.4.16, "RCS Specific Activity," is revised to delete references to gross specific activity, and reference limits on DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133, and delete Figure 3.4.16-1, "Reactor Coolant DOSE EQUIVALENT I-131 Specific Activity Limit versus Percent of RATED THERMAL POWER."
5. The Applicability of LCO 3.4.16 is revised to indicate the LCO is applicable in MODES 1, 2, 3, and 4.
6. The ACTIONS Table is modified as follows:
   a. Condition A is modified to delete the reference to Figure 3.4.16-1, and define an upper limit that is applicable at all power levels.
   b. NUREG-1430 and NUREG-1432 ACTIONS are reordered, moving Condition C to Condition B to be consistent with the Writer's Guide.
   c. Condition B (was Condition C in NUREG-1430 and NUREG-1432) is modified to provide a Condition and Required Action for DOSE EQUIVALENT XE-133 instead of gross specific activity. The Completion Time is changed from 6 hours to 48 hours. A Note allowing the applicability of LCO 3.0.4.c is added, consistent with the Note to Required Action A.1.
   d. Condition C (was Condition B in NUREG-1430 and NUREG-1432) is modified based on the changes to Conditions A and B and to reflect the change in the LCO Applicability.
7. SR 3.4.16.1 is revised to verify the limit for DOSE EQUIVALENT XE-133. A Note is added, consistent with SR 3.4.16.2 to allow entry into MODES 4, 3, and 2 prior to performance of the SR.
8. SR 3.4.16.3 is deleted.

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

3.0 BACKGROUND

The primary coolant specific activity level is used in design basis accident analyses to determine the radiological consequences of accidents that involve the release of primary coolant activity. For events that also include fuel damage, the contribution from the initial activity in the primary coolant is insignificant.

The current definition for DOSE EQUIVALENT I-131 is based on thyroid dose conversion factors and reflects a licensing model in which the radiological consequences of iodine releases for accidents are reported as thyroid and whole body doses. A fourth thyroid dose conversion factor reference is added to this definition. In addition, for plants converting to the use of the Alternate Source Term methodology (as described in Regulatory Guide 1.183), thyroid and whole body doses are not reported; instead, the doses are reported as Total Effective Dose Equivalent (TEDE). The TEDE dose is a summation of the Committed Effective Dose Equivalent (CEDE) dose and the whole body dose. It is more appropriate for those plants using the Alternative Source Term methodology to use a definition of DOSE EQUIVALENT I-131 based on the CEDE dose conversion factors instead of the thyroid dose conversion factors.

The term, "'E-Bar' AVERAGE DISINTEGRATION ENERGY," is being replaced by the term, "DOSE EQUIVALENT XE-133." This change is being made to implement an LCO that is more attuned to the whole body radiological consequence analyses which are sensitive to the noble gas activity in the primary coolant but not to other, non-gaseous activity currently captured in the E-Bar definition.

LCO 3.4.16 specifies the limit for primary coolant gross specific activity as 100/E-Bar μCi/gm. E-Bar is defined as:

> E-Bar shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.

In performing accident dose analysis in which primary coolant is released, the concentration of noble gas activity in the coolant is assumed to be that level associated with 1% failed fuel, which closely approximates the LCO limit of 100/E-Bar μCi/gm, as discussed in the Bases.

The primary coolant iodine concentration is used in design basis accident analyses to determine the thyroid radiological consequences of accidents that involve the release of primary coolant activity. For events that also include fuel damage, the contribution from the initial activity in the primary coolant is insignificant.

LCO 3.4.16 specifies a limit for primary coolant iodine concentration during equilibrium operation. In recognition of the potential for exceeding the equilibrium iodine concentration due to iodine spiking following power transients, the LCO also permits the equilibrium value to be exceeded for a period of ≤ 48 hours. As currently presented, the value for the maximum allowable iodine concentration during the 48-hour period of elevated activity is a function of power level as provided in Figure 3.4.16-1. In accordance with the figure, as power is reduced below 80% of Rated Thermal Power, the allowable primary coolant iodine concentration increases from 60 μCi/gm Dose Equivalent (DE) I-131, to as high as 275 μCi/gm DE I-131 at 25% of rated thermal power. Below 25% of Rated Thermal Power, no further increase is defined.

The earliest identifiable appearance of the curve contained in Figure 3.4.16-1 was in a letter from the Atomic Energy Commission letter dated June 12, 1974 on the subject, "Proposed Standard Technical Specifications for Primary Coolant Activity." However, this letter does not provide the technical basis for the curve.

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

4.0 TECHNICAL ANALYSIS

When E-Bar is determined using a design basis approach in which it is assumed that 1.0% of the power is being generated by fuel rods having cladding defects and it is also assumed that there is no removal of fission gases from the letdown flow, the value of E-Bar is dominated by Xe-133. The other nuclides have relatively small contributions. However, during normal plant operation there are typically only a small amount of fuel defects and the radioactive nuclide inventory can become dominated by tritium and corrosion and/or activation products, resulting in the determination of a value of E-Bar that is very different than would be calculated using the design basis approach. The accident dose analyses become disconnected from plant operation and the LCO becomes essentially meaningless. It also results in a Tech Spec limit that can vary during operation as different values for E-Bar are determined.

Additionally, since the concern associated with the coolant activity is the acute dose that the operators and the public might receive in the event of a postulated accident, the manner in which E-Bar is calculated gives undue importance to nuclides that are primarily beta-emitters. Beta radiation will contribute to a skin dose, but not to the whole body dose. Dose limits for the general population do not include consideration of the beta-skin dose.

Since the purpose of the LCO on gross activity is to support the dose analyses for design basis accidents, it would be more appropriate to have the LCO apply to the noble gas concentration in the primary coolant. Thus, it is recommended that the current LCO on gross coolant activity be replaced by an LCO on reactor coolant noble gas activity, which is based on Dose Equivalent Xe-133. The determination of Dose Equivalent Xe-133 will be performed in a similar manner to that currently used in determining DE I-131, except that the calculation of Dose Equivalent Xe-133 is based on the acute dose to the whole body and considers the noble gases which are significant in terms of contribution to whole body dose. Some noble gas isotopes are not included due to low concentration, short half life, or small dose conversion factor. The calculation of Dose Equivalent Xe-133 would use either the average gamma disintegration energies for the nuclides or the effective dose conversion factors from Table III.1 of EPA Federal Guidance Report No. 12. Using this approach, the limit on the amount of noble gas activity in the primary coolant would not fluctuate with variations in the calculated values of E-Bar.

The Technical Specifications developed for the AP600 advanced reactor utilized an LCO for primary coolant Dose Equivalent Xe-133 activity in place of the LCO on gross specific activity based on E-Bar. This approach was approved by the NRC.

Typically, the radiological consequence analyses for accidents that take into account the pre-existing iodine spike do not use the elevated primary coolant iodine concentrations permitted by the LCO for operation at power levels below 80% Rated Thermal Power. Instead, the analyses use the primary coolant concentration associated with 100% power operation (typically this is 60 μCi/gm Dose Equivalent I-131, however in some instances, the value has been reduced to a lower limit in the LCO).

It is not expected that plant operation at the reduced power levels would result in iodine concentrations that exceed the upper limit defined for full power operation. However, the current LCO allows operation at higher iodine concentrations than that at which the plant analyses are performed.

The curve in Figure 3.4.16-1 was not included in the Technical Specifications developed for the AP600, and the LCO for primary coolant iodine activity was approved by the NRC without the curve.

The Completion Time for revised TS 3.4.16 Required Action B.1 will require restoration of Dose Equivalent Xe-133 to within limit in 48 hours. This is consistent with the Completion Time for current Required Action A.2 for Dose Equivalent I-131. The Completion Time of 48 hours for revised Required Action B.1 is

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

acceptable since it is expected that, if there were a noble gas spike, the normal coolant noble gas concentration would be restored within this time period. Also, there is a low probability of an accident occurring during this time period.

The Applicability is changed from MODES 1, 2, and MODE 3 with RCS Temperature ≥ 500 F to MODES 1, 2, 3 and 4. In MODES 1, 2, 3, and 4, operation within the LCO limits for DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 is necessary to limit the potential consequences of a steam line break or steam generator tube rupture. In Modes 5 and 6, the steam generators are not being used for decay heat removal, the RCS and steam generators are depressurized, and primary to secondary leakage is minimal. Therefore, the monitoring of RCS specific activity is not required.

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

5.0 REGULATORY ANALYSIS

5.1 No Significant Hazards Consideration

The TSTF has evaluated whether or not a significant hazards consideration is involved with the proposed generic change by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated.

Response: No

Reactor coolant specific activity is not an initiator for any accident previously evaluated. The Completion Time when primary coolant gross activity is not within limit is not an initiator for any accident previously evaluated. The current variable limit on primary coolant iodine concentration is not an initaitor to any accident previously evaluated. As a result, the proposed change does not significantly increase the probability of an accident. The proposed change will limit primary coolant noble gases to concentrations consistent with the accident analyses. The proposed change to the Completion Time has no impact on the consequences of any design basis accident since the conseqeunces of an accident during the extended Completion Time are the same as the consequences of an accident during the current Completion Time. As a result, the consequences of any accident previously evaluated are not significantly increased.

Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated.

Response: No

The proposed change in specific activity limits does not alter any physical part of the plant nor does it affect any plant operating parameter. The change does not create the potential for a new or different kind of accident from any previously calculated.

Therefore, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed change involve a significant reduction in a margin of safety?

The proposed change revises the limits on noble gas radioactivity in the primary coolant. The proposed change is consistent with the assumptions in the safety analyses and will ensure the monitored values protect the initial assumptions in the safety analyses.

Therefore, the proposed change does not involve a significant reduction in a margin of safety.

5.2 Applicable Regulatory Requirements/Criteria

There are no specific regulatory requirements or criteria on primary coolant radioactivity affected by this change. Based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the approval of the proposed change will not be inimical to the common defense and security or to the health and safety of the public.

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

6.0 ENVIRONMENTAL CONSIDERATIONS

A review has determined that the proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area as defined in 10 CFR 20, or would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

None

Revision History

OG Revision 0 Revision Status: Closed

Revision Proposed by: Wolf Creek

Revision Description:
Original Issue

Owners Group Review Information

Date Originated by OG: 27-Jul-04

Owners Group Comments:
(No Comments)

Owners Group Resolution: Approved Date: 27-Jul-04

TSTF Review Information

TSTF Received Date: 05-Nov-04 Date Distributed for Review: 29-Nov-04

OG Review Completed: ☐ BWOG ☑ WOG ☑ CEOG ☐ BWROG

TSTF Comments:
Withdrawn by WOG for revision.

TSTF Resolution: Withdrawn Date:

OG Revision 1 Revision Status: Active

Revision Proposed by: WOG

Revision Description:
Clarified differences between AST plants and 10 CFR 100.11 plants.

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

OG Revision 1 Revision Status: Active

Owners Group Review Information

Date Originated by OG: 08-Dec-04

Owners Group Comments:
(No Comments)

Owners Group Resolution: Approved Date: 08-Dec-04

TSTF Review Information

TSTF Received Date: 01-Mar-05 Date Distributed for Review: 02-Mar-05

OG Review Completed: ☑ BWOG ☑ WOG ☑ CEOG ☑ BWROG

TSTF Comments:
(No Comments)

TSTF Resolution: Approved Date: 13-Sep-05

NRC Review Information

NRC Received Date: 13-Sep-05

Affected Technical Specifications

1.1	Definitions	
	Change Description:	Definition of "E - Average Disintegration Energy" replaced with "Dose Equivalent XE-133"
1.1	Definitions	
	Change Description:	Definition of "Dose Equivalent I-131"
Bkgnd 3.4.16 Bases	RCS Specific Activity	
S/A 3.4.16 Bases	RCS Specific Activity	
LCO 3.4.16	RCS Specific Activity	
	Change Description:	Figure 3.4.16-1 deleted
LCO 3.4.16	RCS Specific Activity	
LCO 3.4.16 Bases	RCS Specific Activity	
Appl. 3.4.16	RCS Specific Activity	
Appl. 3.4.16 Bases	RCS Specific Activity	

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

Ref. 3.4.16 Bases	RCS Specific Activity	
Action 3.4.16.A	RCS Specific Activity	
Action 3.4.16.A Bases	RCS Specific Activity	
Action 3.4.16.B	RCS Specific Activity	
Action 3.4.16.B Bases	RCS Specific Activity	
Action 3.4.16.C	RCS Specific Activity	
Action 3.4.16.C Bases	RCS Specific Activity	
SR 3.4.16.1	RCS Specific Activity	
SR 3.4.16.1 Bases	RCS Specific Activity	
SR 3.4.16.2 Bases	RCS Specific Activity	
SR 3.4.16.3	RCS Specific Activity Change Description:	Deleted
SR 3.4.16.3 Bases	RCS Specific Activity Change Description:	Deleted

Traveler Rev. 3. Copyright (C) 2005, EXCEL Services Corporation. Use by EXCEL Services associates, utility clients, and the U.S. Nuclear Regulatory Commission is granted. All other use without written permission is prohibited.

1.1 Definitions

CHANNEL CHECK (continued)

the channel indication and status to other indications or status derived from independent instrument channels measuring the same parameter.

CHANNEL FUNCTIONAL TEST

A CHANNEL FUNCTIONAL TEST shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY.

The ESFAS CHANNEL FUNCTIONAL TEST shall also include testing of ESFAS safety related bypass functions for each channel affected by bypass operation. The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total steps.

CONTROL RODS

CONTROL RODS shall be all full length safety and regulating rods that are used to shut down the reactor and control power level during maneuvering operations.

CORE ALTERATION

CORE ALTERATION shall be the movement of any fuel, sources, or reactivity control components, within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.

CORE OPERATING LIMITS REPORT (COLR)

The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific limits shall be determined for each reload cycle in accordance with Specification 5.6.5. Plant operation within these limits is addressed in individual Specifications.

DOSE EQUIVALENT I-131

~~DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries/gram) that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in [Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or those listed in Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or ICRP-30, Supplement to Part 1, page 192-212, table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity"].~~ DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries per gram) that alone would produce the same dose when inhaled as the combined activities of iodine isotopes I-131, I-132, I-133, I-134, and I-135

actually present. The determination of DOSE EQUIVALENT I-131 shall be performed using

---------- Reviewer's Note ----------
The first set of thyroid dose conversion factors shall be used for plants licensed to 10 CFR 100.11. The following Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) conversion factors shall be used for plants licensed to 10 CFR 50.67.

[thyroid dose conversion factors from:

a. Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or

b. Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or

c. ICRP-30, 1979, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity," or

d. Table 2.1 of EPA Federal Guidance Report No. 11, 1988, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion."

OR

Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) dose conversion factors from Table 2.1 of EPA Federal Guidance Report No. 11.]

DOSE EQUIVALENT XE-133

DOSE EQUIVALENT XE-133 shall be that concentration of Xe-133 (microcuries per gram) that alone would produce the same acute dose to the whole body as the combined activities of noble gas nuclides [Kr-85m, Kr-85, Kr-87, Kr-88, Xe-131m, Xe-133m, Xe-133, Xe-135m, Xe-135, and Xe-138] actually present. If a specific noble gas nuclide is not detected, it should be assumed to be present at the minimum detectable activity. The determination of DOSE EQUIVALENT XE-133 shall be performed using [effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12, 1993, "External Exposure to Radionuclides in Air, Water, and Soil" or the average gamma disintegration energies as provided in ICRP Publication 38, "Radionuclide Transformations" or similar source].

1.1 Definitions

~~Ē - AVERAGE DISINTEGRATION ENERGY~~	~~Ē shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.~~
EMERGENCY FEEDWATER INITIATION AND CONTROL (EFIC) RESPONSE TIME	The EFIC RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its EFIC actuation setpoint at the channel sensor until the emergency feedwater equipment is capable of performing its function (i.e., valves travel to their required positions, pumps discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured.
ENGINEERED SAFETY FEATURE (ESF) RESPONSE TIME	The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ESF actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured.
LEAKAGE	LEAKAGE shall be: a. <u>Identified LEAKAGE</u> 1. LEAKAGE, such as that from pump seals or valve packing (except RCP seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank, 2. LEAKAGE into the containment atmosphere from sources that are both specifically located and known either not to interfere with the operation of leakage detection systems or not to be pressure boundary LEAKAGE, or

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.16 RCS Specific Activity

LCO 3.4.16 ~~The specific activity of the reactor coolant shall be within limits.~~ RCS DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 specific activity shall be within limits.

APPLICABILITY: MODES ~~1 and 2,~~ 1, 2, 3, and 4.
~~MODE 3 with RCS average temperature (T_{avg}) ≥ 500°F.~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. DOSE EQUIVALENT I-131 ~~> 1.0 μCi/gm~~ not within limit.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	A.1 Verify DOSE EQUIVALENT I-131 ~~within the acceptable region of Figure 3.4.16-1~~ ≤ [60] μCi/gm.	Once per 4 hours
	AND	
	A.2 Restore DOSE EQUIVALENT I-131 to within limit.	48 hours
B. DOSE EQUIVALENT XE-133 not within limit.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	B.1 Restore DOSE EQUIVALENT XE-133 to within limit.	48 hours

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B~~C. Required Action and associated Completion Time of Condition A or B not met. OR DOSE EQUIVALENT I-131 > [60] µCi/gm~~in unacceptable region of Figure 3.4.16-1~~.	~~B~~C.1 Be in MODE 3~~with T_{avg} < 500°F~~. AND C.2 Be in MODE 5.	6 hours 36 hours
~~C. Gross specific activity of the coolant not within limit.~~	~~C.1 Be in MODE 3 with T_{avg} < 500°F.~~	~~6 hours~~

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.16.1	~~Verify reactor coolant gross specific activity ≤ 100/Ē µCi/gm.~~ ----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity ≤ [280] µCi/gm.	7 days

SURVEILLANCE		FREQUENCY
SR 3.4.16.2	----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT I-131 specific activity ≤ [1.0] μCi/gm.	14 days <u>AND</u> Between 2 and 6 hours after THERMAL POWER change of ≥ 15% RTP within a 1 hour period
~~SR 3.4.16.3~~	~~----------NOTE----------~~ ~~Not required to be performed until 31 days after a minimum of 2 EFPD and 20 days of MODE 1 operation have elapsed since the reactor was last subcritical for ≥ 48 hours.~~ ~~----------~~ ~~Determine Ē.~~	~~184 days~~

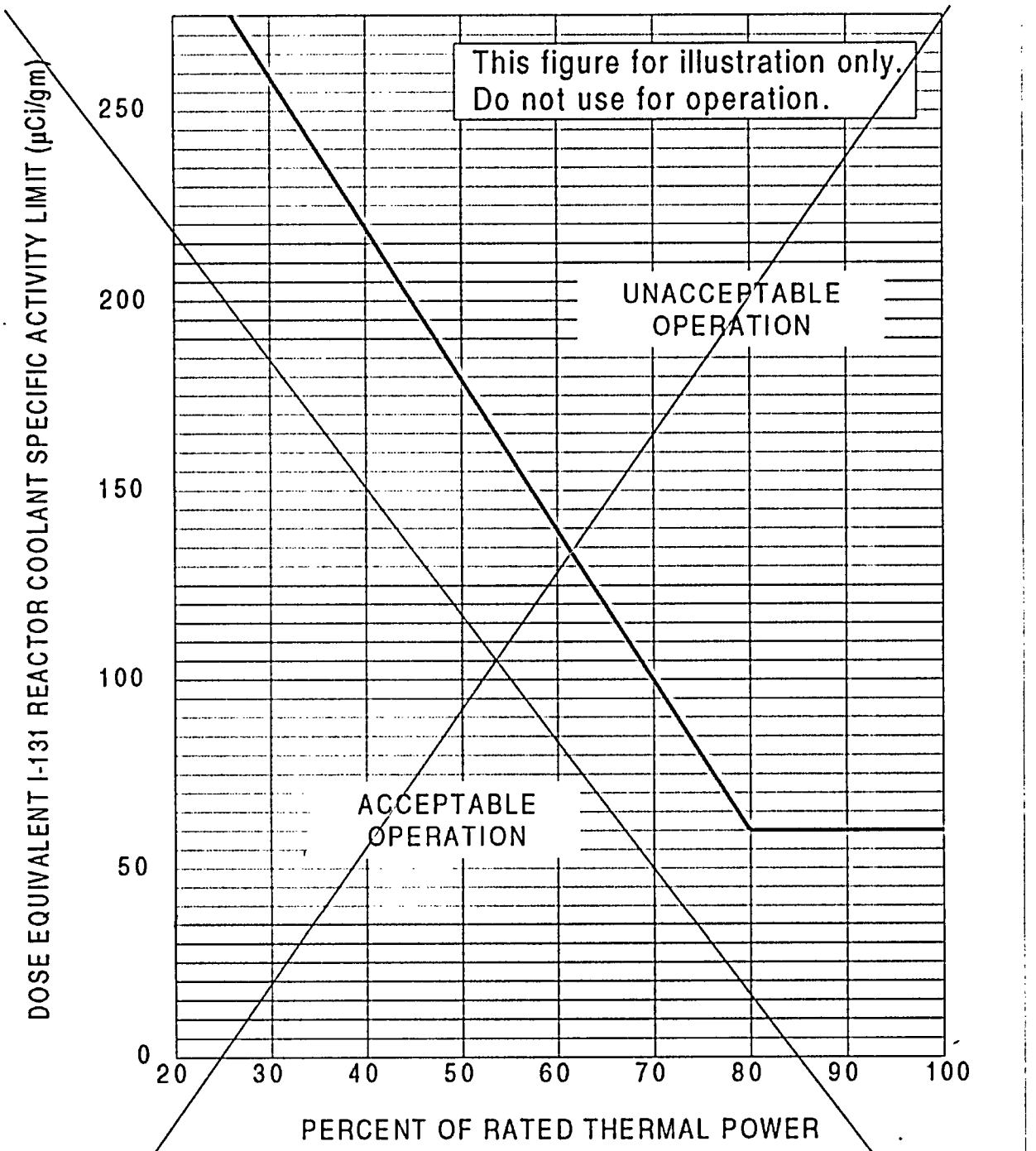

Figure 3.4.16-1 (page 1 of 1)
Reactor Coolant DOSE EQUIVALENT I-131 Specific Activity Limit Versus Percent of RATED THERMAL POWER With Reactor Coolant Specific Activity >1.0 µCi/gm DOSE EQUIVALENT I-131

Complete Replacement of the Existing 3.4.16 Bases

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.16 RCS Specific Activity

BASES

BACKGROUND

The maximum dose that an individual at the exclusion area boundary can receive for 2 hours following an accident, or at the low population zone outer boundary for the radiological release duration, is specified in [10 CFR 100.11][10 CFR 50.67] (Ref. 1). Doses to control room operators must be limited per GDC 19. The limits on specific activity ensure that the offsite and control room doses are appropriately limited during analyzed transients and accidents.

The RCS specific activity LCO limits the allowable concentration level of radionuclides in the reactor coolant. The LCO limits are established to minimize the dose consequences in the event of a steam line break (SLB) or steam generator tube rupture (SGTR) accident.

The LCO contains specific activity limits for both DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133. The allowable levels are intended to ensure that offsite and control room doses meet the appropriate acceptance criteria in the Standard Review Plan (Ref. 2).

APPLICABLE SAFETY ANALYSES

The LCO limits on the specific activity of the reactor coolant ensure that the resulting offsite and control room doses meet the appropriate SRP acceptance criteria following a SLB or SGTR accident. The safety analyses (Refs. 3 and 4) assume the specific activity of the reactor coolant is at the LCO limits, and an existing reactor coolant steam generator (SG) tube leakage rate of [1 gpm] exists. The safety analyses assume the specific activity of the secondary coolant is at its limit of [0.1] μCi/gm DOSE EQUIVALENT I-131 from LCO 3.7.17, "Secondary Specific Activity."

The analyses for the SLB and SGTR accidents establish the acceptance limits for RCS specific activity. Reference to these analyses is used to assess changes to the unit that could affect RCS specific activity, as they relate to the acceptance limits.

The safety analyses consider two cases of reactor coolant iodine specific activity. One case assumes specific activity at [1.0] μCi/gm DOSE EQUIVALENT I-131 with a concurrent large iodine spike that increases the rate of release of iodine from the fuel rods containing cladding defects to the primary coolant immediately after a SLB (by a factor of 500), or SGTR (by a factor of 335), respectively. The second case assumes the initial reactor coolant iodine activity at [60.0] μCi/gm DOSE EQUIVALENT I-131 due to an iodine spike caused by a reactor or an RCS transient prior

BASES

APPLICABLE SAFETY ANALYSES (continued)

to the accident. In both cases, the noble gas specific activity is assumed to be [280] µCi/gm DOSE EQUIVALENT XE-133.

The SGTR analysis assumes a rise in pressure in the ruptured SG causes radioactively contaminated steam to discharge to the atmosphere through the atmospheric dump valves or the main steam safety valves. The atmospheric discharge stops when the turbine bypass to the condenser removes the excess energy to rapidly reduce the RCS pressure and close the valves. The unaffected SG removes core decay heat by venting steam until the cooldown ends and the Decay Heat Removal (DHR) system is placed in service.

The SLB radiological analysis assumes that offsite power is lost at the same time as the pipe break occurs outside containment. The affected SG blows down completely and steam is vented directly to the atmosphere. The unaffected SG removes core decay heat by venting steam to the atmosphere until the cooldown ends and the DHR system is placed in service.

Operation with iodine specific activity levels greater than the LCO limit is permissible, if the activity levels do not exceed [60.0] µCi/gm for more than 48 hours.

The limits on RCS specific activity are also used for establishing standardization in radiation shielding and plant personnel radiation protection practices.

RCS specific activity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The iodine specific activity in the reactor coolant is limited to [1.0] µCi/gm DOSE EQUIVALENT I-131, and the noble gas specific activity in the reactor coolant is limited to [280] µCi/gm DOSE EQUIVALENT XE-133. The limits on specific activity ensure that offsite and control room doses will meet the appropriate SRP acceptance criteria (Ref. 2).

The SLB and SGTR accident analyses (Refs. 3 and 4) show that the calculated doses are within acceptable limits. Violation of the LCO may result in reactor coolant radioactivity levels that could, in the event of a SLB or SGTR, lead to doses that exceed the SRP acceptance criteria (Ref. 2).

BASES

APPLICABILITY

In MODES 1, 2, 3, and 4, operation within the LCO limits for DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 is necessary to limit the potential consequences of a SLB or SGTR to within the SRP acceptance criteria (Ref. 2).

In MODES 5 and 6, the steam generators are not being used for decay heat removal, the RCS and steam generators are depressurized, and primary to secondary leakage is minimal. Therefore, the monitoring of RCS specific activity is not required.

ACTIONS

A.1 and A.2

With the DOSE EQUIVALENT I-131 greater than the LCO limit, samples at intervals of 4 hours must be taken to demonstrate that the specific activity is ≤ [60.0] μCi/gm. The Completion Time of 4 hours is required to obtain and analyze a sample. Sampling is continued every 4 hours to provide a trend.

The DOSE EQUIVALENT I-131 must be restored to within limit within 48 hours. The Completion Time of 48 hours is acceptable since it is expected that, if there were an iodine spike, the normal coolant iodine concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODE(S), relying on Required Actions A.1 and A.2 while the DOSE EQUIVALENT I-131 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

B.1

With the DOSE EQUIVALENT XE-133 greater than the LCO limit, DOSE EQUIVALENT XE-133 must be restored to within limit within 48 hours. The allowed Completion Time of 48 hours is acceptable since it is expected that, if there were a noble gas spike, the normal coolant noble gas concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

BASES

ACTIONS (continued)

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODES(S), relying on Required Action B.1 while the DOSE EQUIVALENT XE-133 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

C.1 and C.2

If the Required Action and associated Completion Time of Condition A or B is not met, or if the DOSE EQUIVALENT I-131 is > [60.0] μCi/gm, the reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.16.1

SR 3.4.16.1 requires performing a gamma isotopic analysis as a measure of the noble gas specific activity of the reactor coolant at least once every 7 days. This measurement is the sum of the degassed gamma activities and the gaseous gamma activities in the sample taken. This Surveillance provides an indication of any increase in the noble gas specific activity.

Trending the results of this Surveillance allows proper remedial action to be taken before reaching the LCO limit under normal operating conditions. The 7 day Frequency considers the low probability of a gross fuel failure during this time.

Due to the inherent difficulty in detecting Kr-85 in a reactor coolant sample due to masking from radioisotopes with similar decay energies, such as F-18 and I-134, it is acceptable to include the minimum detectable activity for Kr-85 in the SR 3.4.16.1 calculation. If a specific noble gas nuclide listed in the definition of DOSE EQUIVALENT XE-133 is not detected, it should be assumed to be present at the minimum detectable activity.

A Note modifies the SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.16.2

This Surveillance is performed to ensure iodine specific activity remains within the LCO limit during normal operation and following fast power changes when iodine spiking is more apt to occur. The 14 day Frequency is adequate to trend changes in the iodine activity level, considering noble gas activity is monitored every 7 days. The Frequency, between 2 and 6 hours after a power change ≥ 15% RTP within a 1 hour period, is established because the iodine levels peak during this time following iodine spike initiation; samples at other times would provide inaccurate results.

The Note modifies this SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

REFERENCES

---------- Reviewer's Note ----------
The first listed References 1 and 2 are for plants that are licensed to 10 CFR 100.11. The second set of References are for plants that are licensed to 10 CFR 50.67.

[1. 10 CFR 100.11.

2. Standard Review Plan (SRP) Section 15.1.5 Appendix A (SLB) and Section 15.6.3 (SGTR).

1. 10 CFR 50.67.

2. Standard Review Plan (SRP) Section 15.0.1 "Radiological Consequence Analyses Using Alternative Source Terms."]

3. FSAR, Section [15.1.5].

4. FSAR, Section [15.6.3].

1.1 Definitions

CHANNEL CHECK	A CHANNEL CHECK shall be the qualitative assessment, by observation, of channel behavior during operation. This determination shall include, where possible, comparison of the channel indication and status to other indications or status derived from independent instrument channels measuring the same parameter.
CHANNEL OPERATIONAL TEST (COT)	A COT shall be the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY. The COT shall include adjustments, as necessary, of the required alarm, interlock, and trip setpoints required for channel OPERABILITY such that the setpoints are within the necessary range and accuracy. The COT may be performed by means of any series of sequential, overlapping, or total channel steps.
CORE ALTERATION	CORE ALTERATION shall be the movement of any fuel, sources, or reactivity control components, within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.
CORE OPERATING LIMITS REPORT (COLR)	The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific parameter limits shall be determined for each reload cycle in accordance with Specification 5.6.5. Plant operation within these limits is addressed in individual Specifications.
DOSE EQUIVALENT I-131	~~DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries/gram) that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in [Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or those listed in Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or ICRP 30, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity"].~~ DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries per gram) that alone would produce the same dose when inhaled as the combined activities of iodine isotopes I-131, I-132, I-133, I-134, and I-135 actually present. The determination of DOSE EQUIVALENT I-131 shall be performed using

---------- Reviewer's Note ----------
The first set of thyroid dose conversion factors shall be used for plants licensed to 10 CFR 100.11. The following Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) conversion factors shall be used for plants licensed to 10 CFR 50.67.

[thyroid dose conversion factors from:

a. Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or

b. Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or

c. ICRP-30, 1979, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity," or

d. Table 2.1 of EPA Federal Guidance Report No. 11, 1988, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion."

OR

Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) dose conversion factors from Table 2.1 of EPA Federal Guidance Report No. 11.]

DOSE EQUIVALENT XE-133

DOSE EQUIVALENT XE-133 shall be that concentration of Xe-133 (microcuries per gram) that alone would produce the same acute dose to the whole body as the combined activities of noble gas nuclides [Kr-85m, Kr-85, Kr-87, Kr-88, Xe-131m, Xe-133m, Xe-133, Xe-135m, Xe-135, and Xe-138] actually present. If a specific noble gas nuclide is not detected, it should be assumed to be present at the minimum detectable activity. The determination of DOSE EQUIVALENT XE-133 shall be performed using [effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12, 1993, "External Exposure to Radionuclides in Air, Water, and Soil" or the average gamma disintegration energies as provided in ICRP Publication 38, "Radionuclide Transformations" or similar source].

1.1 Definitions

~~Ē - AVERAGE DISINTEGRATION ENERGY~~	~~Ē shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.~~
ENGINEERED SAFETY FEATURE (ESF) RESPONSE TIME	The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.
LEAKAGE	LEAKAGE shall be: a. <u>Identified LEAKAGE</u> 1. LEAKAGE, such as that from pump seals or valve packing (except reactor coolant pump (RCP) seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank, 2. LEAKAGE into the containment atmosphere from sources that are both specifically located and known either not to interfere with the operation of leakage detection systems or not to be pressure boundary LEAKAGE, or 3. Reactor Coolant System (RCS) LEAKAGE through a steam generator (SG) to the Secondary System;

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.16 RCS Specific Activity

LCO 3.4.16 ~~The specific activity of the reactor coolant shall be within limits.~~ RCS DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 specific activity shall be within limits.

APPLICABILITY: MODES ~~1 and 2,~~ 1, 2, 3, and 4.
~~MODE 3 with RCS average temperature (T_{avg}) ≥ 500°F.~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. DOSE EQUIVALENT I-131 not within limit ~~> 1.0 µCi/gm~~.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	A.1 Verify DOSE EQUIVALENT I-131 ~~within the acceptable region of Figure 3.4.16-1~~ ≤ [60] µCi/gm.	Once per 4 hours
	AND	
	A.2 Restore DOSE EQUIVALENT I-131 to within limit.	48 hours
B. ~~Gross specific activity of the reactor coolant not within limit.~~ DOSE EQUIVALENT XE-133 not within limit.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	B.1 ~~Be in MODE 3 with T_{avg} < 500°F.~~ Restore DOSE EQUIVALENT XE-133 to within limit.	~~6~~48 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required Action and associated Completion Time of Condition A or B not met. OR DOSE EQUIVALENT I-131 > [60] µCi/gm~~in the unacceptable region of Figure 3.4.16-1~~.	C.1 Be in MODE 3 ~~with T_{avg} < 500°F~~. AND C.2 Be in MODE 5.	6 hours 36 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.16.1	~~Verify reactor coolant gross specific activity ≤ 100/Ē µCi/gm.~~ ----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity ≤ [280] µCi/gm.	7 days
SR 3.4.16.2	----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT I-131 specific activity ≤ [1.0] µCi/gm.	14 days AND Between 2 and 6 hours after a THERMAL POWER change of ≥ 15% RTP within a 1 hour period

SURVEILLANCE REQUIREMENTS (continued)

SURVEILLANCE		FREQUENCY
~~SR 3.4.16.3~~	~~NOTE~~ ~~Not required to be performed until 31 days after a minimum of 2 effective full power days and 20 days of MODE 1 operation have elapsed since the reactor was last subcritical for ≥ 48 hours.~~	
	~~Determine Ē from a sample taken in MODE 1 after a minimum of 2 effective full power days and 20 days of MODE 1 operation have elapsed since the reactor was last subcritical for ≥ 48 hours.~~	~~184 days~~

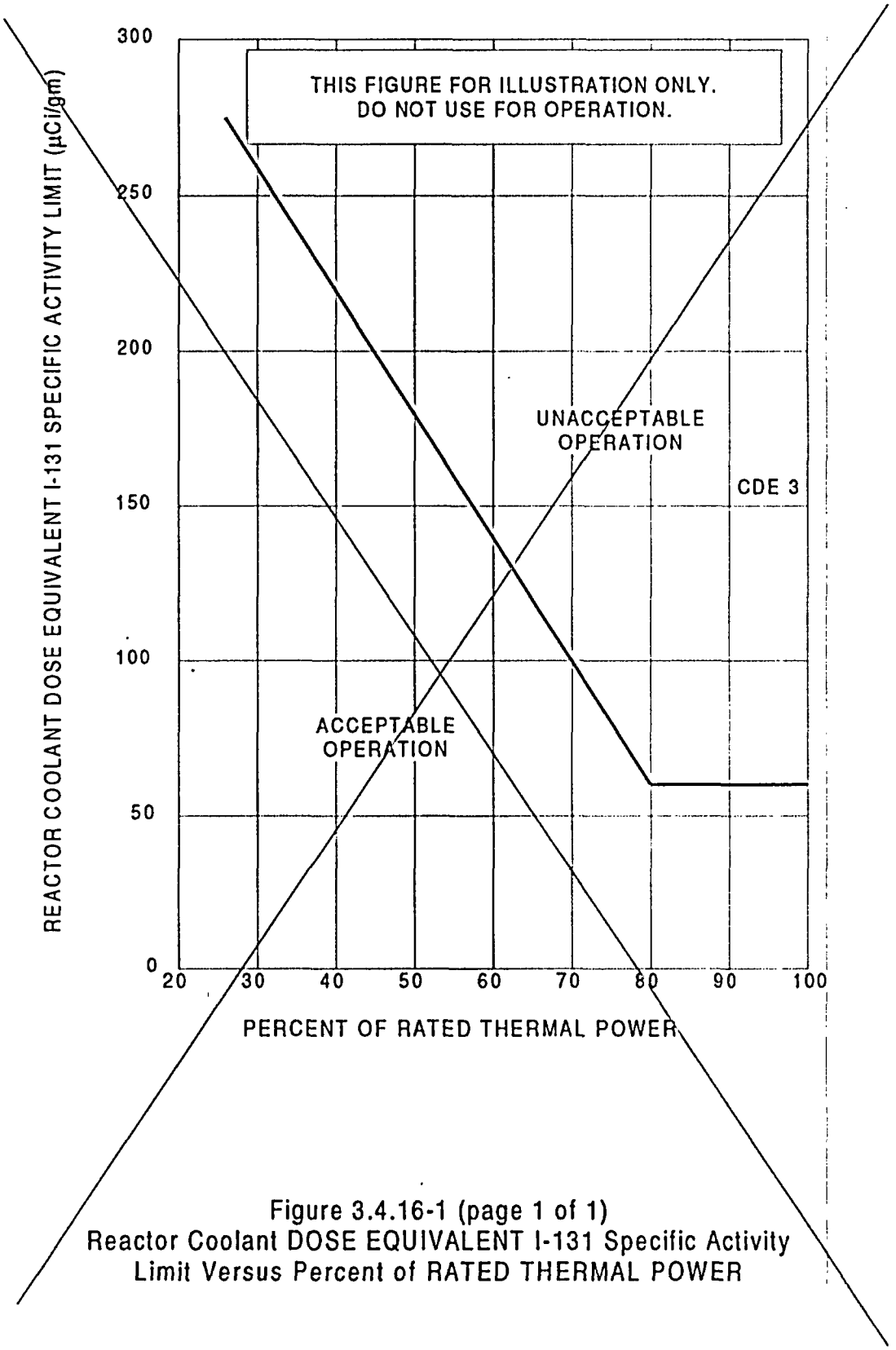

Figure 3.4.16-1 (page 1 of 1)
Reactor Coolant DOSE EQUIVALENT I-131 Specific Activity Limit Versus Percent of RATED THERMAL POWER

Complete Replacement of the Existing 3.4.16 Bases

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.16 RCS Specific Activity

BASES

BACKGROUND

The maximum dose that an individual at the exclusion area boundary can receive for 2 hours following an accident, or at the low population zone outer boundary for the radiological release duration, is specified in [10 CFR 100.11][10 CFR 50.67] (Ref. 1). Doses to control room operators must be limited per GDC 19. The limits on specific activity ensure that the offsite and control room doses are appropriately limited during analyzed transients and accidents.

The RCS specific activity LCO limits the allowable concentration level of radionuclides in the reactor coolant. The LCO limits are established to minimize the dose consequences in the event of a steam line break (SLB) or steam generator tube rupture (SGTR) accident.

The LCO contains specific activity limits for both DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133. The allowable levels are intended to ensure that offsite and control room doses meet the appropriate acceptance criteria in the Standard Review Plan (Ref. 2).

APPLICABLE SAFETY ANALYSES

The LCO limits on the specific activity of the reactor coolant ensure that the resulting offsite and control room doses meet the appropriate SRP acceptance criteria following a SLB or SGTR accident. The safety analyses (Refs. 3 and 4) assume the specific activity of the reactor coolant is at the LCO limits, and an existing reactor coolant steam generator (SG) tube leakage rate of [1 gpm] exists. The safety analyses assume the specific activity of the secondary coolant is at its limit of [0.1] μCi/gm DOSE EQUIVALENT I-131 from LCO 3.7.18, "Secondary Specific Activity."

The analyses for the SLB and SGTR accidents establish the acceptance limits for RCS specific activity. Reference to these analyses is used to assess changes to the unit that could affect RCS specific activity, as they relate to the acceptance limits.

The safety analyses consider two cases of reactor coolant iodine specific activity. One case assumes specific activity at [1.0] μCi/gm DOSE EQUIVALENT I-131 with a concurrent large iodine spike that increases the rate of release of iodine from the fuel rods containing cladding defects to the primary coolant immediately after a SLB (by a factor of 500), or SGTR (by a factor of 335), respectively. The second case assumes the initial reactor coolant iodine activity at [60.0] μCi/gm DOSE EQUIVALENT I-131 due to an iodine spike caused by a reactor or an RCS transient prior

BASES

APPLICABLE SAFETY ANALYSES (continued)

to the accident. In both cases, the noble gas specific activity is assumed to be [280] µCi/gm DOSE EQUIVALENT XE-133.

The SGTR analysis also assumes a loss of offsite power at the same time as the reactor trip. The SGTR causes a reduction in reactor coolant inventory. The reduction initiates a reactor trip from a low pressurizer pressure signal [or an RCS overtemperature ΔT signal].

The loss of offsite power causes the steam dump valves to close to protect the condenser. The rise in pressure in the ruptured SG discharges radioactively contaminated steam to the atmosphere through the SG power operated relief valves [and the main steam safety valves]. The unaffected SGs remove core decay heat by venting steam to the atmosphere until the cooldown ends and the Residual Heat Removal (RHR) system is placed in service.

The SLB radiological analysis assumes that offsite power is lost at the same time as the pipe break occurs outside containment. Reactor trip occurs after the generation of an SI signal on low steam line pressure. The affected SG blows down completely and steam is vented directly to the atmosphere. The unaffected SGs remove core decay heat by venting steam to the atmosphere until the cooldown ends and the RHR system is placed in service.

Operation with iodine specific activity levels greater than the LCO limit is permissible, if the activity levels do not exceed [60.0] µCi/gm for more than 48 hours.

The limits on RCS specific activity are also used for establishing standardization in radiation shielding and plant personnel radiation protection practices.

RCS specific activity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The iodine specific activity in the reactor coolant is limited to [1.0] µCi/gm DOSE EQUIVALENT I-131, and the noble gas specific activity in the reactor coolant is limited to [280] µCi/gm DOSE EQUIVALENT XE-133. The limits on specific activity ensure that offsite and control room doses will meet the appropriate SRP acceptance criteria (Ref. 2).

The SLB and SGTR accident analyses (Refs. 3 and 4) show that the calculated doses are within acceptable limits. Violation of the LCO may result in reactor coolant radioactivity levels that could, in the event of a SLB or SGTR, lead to doses that exceed the SRP acceptance criteria (Ref. 2).

BASES

APPLICABILITY

In MODES 1, 2, 3, and 4, operation within the LCO limits for DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 is necessary to limit the potential consequences of a SLB or SGTR to within the SRP acceptance criteria (Ref. 2).

In MODES 5 and 6, the steam generators are not being used for decay heat removal, the RCS and steam generators are depressurized, and primary to secondary leakage is minimal. Therefore, the monitoring of RCS specific activity is not required.

ACTIONS

A.1 and A.2

With the DOSE EQUIVALENT I-131 greater than the LCO limit, samples at intervals of 4 hours must be taken to demonstrate that the specific activity is ≤ [60.0] μCi/gm. The Completion Time of 4 hours is required to obtain and analyze a sample. Sampling is continued every 4 hours to provide a trend.

The DOSE EQUIVALENT I-131 must be restored to within limit within 48 hours. The Completion Time of 48 hours is acceptable since it is expected that, if there were an iodine spike, the normal coolant iodine concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODE(S), relying on Required Actions A.1 and A.2 while the DOSE EQUIVALENT I-131 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

B.1

With the DOSE EQUIVALENT XE-133 greater than the LCO limit, DOSE EQUIVALENT XE-133 must be restored to within limit within 48 hours. The allowed Completion Time of 48 hours is acceptable since it is expected that, if there were a noble gas spike, the normal coolant noble gas concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

BASES

ACTIONS (continued)

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODES(S), relying on Required Action B.1 while the DOSE EQUIVALENT XE-133 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

C.1 and C.2

If the Required Action and associated Completion Time of Condition A or B is not met, or if the DOSE EQUIVALENT I-131 is > [60.0] µCi/gm, the reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.16.1

SR 3.4.16.1 requires performing a gamma isotopic analysis as a measure of the noble gas specific activity of the reactor coolant at least once every 7 days. This measurement is the sum of the degassed gamma activities and the gaseous gamma activities in the sample taken. This Surveillance provides an indication of any increase in the noble gas specific activity.

Trending the results of this Surveillance allows proper remedial action to be taken before reaching the LCO limit under normal operating conditions. The 7 day Frequency considers the low probability of a gross fuel failure during this time.

Due to the inherent difficulty in detecting Kr-85 in a reactor coolant sample due to masking from radioisotopes with similar decay energies, such as F-18 and I-134, it is acceptable to include the minimum detectable activity for Kr-85 in the SR 3.4.16.1 calculation. If a specific noble gas nuclide listed in the definition of DOSE EQUIVALENT XE-133 is not detected, it should be assumed to be present at the minimum detectable activity.

A Note modifies the SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.16.2

This Surveillance is performed to ensure iodine specific activity remains within the LCO limit during normal operation and following fast power changes when iodine spiking is more apt to occur. The 14 day Frequency is adequate to trend changes in the iodine activity level, considering noble gas activity is monitored every 7 days. The Frequency, between 2 and 6 hours after a power change ≥ 15% RTP within a 1 hour period, is established because the iodine levels peak during this time following iodine spike initiation; samples at other times would provide inaccurate results.

The Note modifies this SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

REFERENCES

---------- Reviewer's Note ----------
The first listed References 1 and 2 are for plants that are licensed to 10 CFR 100.11. The second set of References are for plants that are licensed to 10 CFR 50.67.

[1. 10 CFR 100.11.

2. Standard Review Plan (SRP) Section 15.1.5 Appendix A (SLB) and Section 15.6.3 (SGTR).

1. 10 CFR 50.67.

2. Standard Review Plan (SRP) Section 15.0.1 "Radiological Consequence Analyses Using Alternative Source Terms."]

3. FSAR, Section [15.1.5].

4. FSAR, Section [15.6.3].

1.1 Definitions

CHANNEL CHECK	A CHANNEL CHECK shall be the qualitative assessment, by observation, of channel behavior during operation. This determination shall include, where possible, comparison of the channel indication and status to other indications or status derived from independent instrument channels measuring the same parameter.
CHANNEL FUNCTIONAL TEST	A CHANNEL FUNCTIONAL TEST shall be: a. Analog and bistable channels - the injection of a simulated or actual signal into the channel as close to the sensor as practicable to verify OPERABILITY of all devices in the channel required for channel OPERABILITY, and b. Digital computer channels - the use of diagnostic programs to test digital computer hardware and the injection of simulated process data into the channel to verify OPERABILITY of all devices in the channel required for channel OPERABILITY. The CHANNEL FUNCTIONAL TEST may be performed by means of any series of sequential, overlapping, or total channel steps so that the entire channel is tested.
CORE ALTERATION	CORE ALTERATION shall be the movement of any fuel, sources, or reactivity control components [excluding control element assemblies (CEAs) withdrawn into the upper guide structure], within the reactor vessel with the vessel head removed and fuel in the vessel. Suspension of CORE ALTERATIONS shall not preclude completion of movement of a component to a safe position.
CORE OPERATING LIMITS REPORT (COLR)	The COLR is the unit specific document that provides cycle specific parameter limits for the current reload cycle. These cycle specific parameter limits shall be determined for each reload cycle in accordance with Specification 5.6.5. Plant operation within these limits is addressed in individual Specifications.
DOSE EQUIVALENT I-131	~~DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries/gram) that alone would produce the same thyroid dose as the quantity and isotopic mixture of I-131, I-132, I-133, I-134, and I-135 actually present. The thyroid dose conversion factors used for this calculation shall be those listed in~~ DOSE EQUIVALENT I-131 shall be that concentration of I-131 (microcuries per gram) that alone would produce the same dose when inhaled as the combined activities of iodine

isotopes I-131, I-132, I-133, I-134, and I-135 actually present. The determination of DOSE EQUIVALENT I-131 shall be performed using

---------- Reviewer's Note ----------
The first set of thyroid dose conversion factors shall be used for plants licensed to 10 CFR 100.11. The following Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) conversion factors shall be used for plants licensed to 10 CFR 50.67.

[thyroid dose conversion factors from:

a. Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or

b. Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or

c. ICRP-30, 1979, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity," or

d. Table 2.1 of EPA Federal Guidance Report No. 11, 1988, "Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion."

OR

Committed Dose Equivalent (CDE) or Committed Effective Dose Equivalent (CEDE) dose conversion factors from Table 2.1 of EPA Federal Guidance Report No. 11.]

DOSE EQUIVALENT XE-133 — DOSE EQUIVALENT XE-133 shall be that concentration of Xe-133 (microcuries per gram) that alone would produce the same acute dose to the whole body as the combined activities of noble gas nuclides [Kr-85m, Kr-85, Kr-87, Kr-88, Xe-131m, Xe-133m, Xe-133, Xe-135m, Xe-135, and Xe-138] actually present. If a specific noble gas nuclide is not detected, it should be assumed to be present at the minimum detectable activity. The determination of DOSE EQUIVALENT XE-133 shall be performed using [effective dose conversion factors for air submersion listed in Table III.1 of EPA Federal Guidance Report No. 12, 1993, "External Exposure to Radionuclides in Air, Water, and Soil" or the average gamma disintegration energies as provided in ICRP Publication 38, "Radionuclide Transformations" or similar source].

1.1 Definitions

~~DOSE EQUIVALENT I-131 (continued)~~

~~[Table III of TID-14844, AEC, 1962, "Calculation of Distance Factors for Power and Test Reactor Sites," or those listed in Table E-7 of Regulatory Guide 1.109, Rev. 1, NRC, 1977, or ICRP-30, Supplement to Part 1, page 192-212, Table titled, "Committed Dose Equivalent in Target Organs or Tissues per Intake of Unit Activity"].~~

~~Ē - AVERAGE DISINTEGRATION ENERGY~~	~~Ē shall be the average (weighted in proportion to the concentration of each radionuclide in the reactor coolant at the time of sampling) of the sum of the average beta and gamma energies per disintegration (in MeV) for isotopes, other than iodines, with half-lives > [15] minutes, making up at least 95% of the total noniodine activity in the coolant.~~
ENGINEERED SAFETY FEATURE (ESF) RESPONSE TIME	The ESF RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its ESF actuation setpoint at the channel sensor until the ESF equipment is capable of performing its safety function (i.e., the valves travel to their required positions, pump discharge pressures reach their required values, etc.). Times shall include diesel generator starting and sequence loading delays, where applicable. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.
LEAKAGE	LEAKAGE shall be: a. <u>Identified LEAKAGE</u> 1. LEAKAGE, such as that from pump seals or valve packing (except reactor coolant pump (RCP) seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank, 2. LEAKAGE into the containment atmosphere from sources that are both specifically located and known either not to interfere with the operation of leakage detection systems or not to be pressure boundary LEAKAGE, or

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.16 RCS Specific Activity

LCO 3.4.16 ~~The specific activity of the reactor coolant shall be within limits.~~ RCS DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 specific activity shall be within limits.

APPLICABILITY: MODES ~~1 and 2,~~ 1, 2, 3, and 4.
~~MODE 3 with RCS average temperature (T_{avg}) ≥ 500°F.~~

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. DOSE EQUIVALENT I-131 ~~> 1.0 μCi/gm~~ not within limit.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	A.1 Verify DOSE EQUIVALENT I-131 ~~within the acceptable region of Figure 3.4.16-1~~ ≤ [60] μCi/gm.	Once per 4 hours
	AND	
	A.2 Restore DOSE EQUIVALENT I-131 to within limit.	48 hours
B. DOSE EQUIVALENT XE-133 not within limit.	----------NOTE---------- LCO 3.0.4.c is applicable. ----------	
	B.1 Restore DOSE EQUIVALENT XE-133 to within limit.	48 hours

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
~~B~~C. Required Action and associated Completion Time of Condition A or B not met. OR DOSE EQUIVALENT I-131 > [60] µCi/gm~~in the unacceptable region of Figure 3.4.16-1~~.	C~~B~~.1 Be in MODE 3 ~~with T_{avg} < 500°F~~. AND C.2 Be in MODE 5.	6 hours 36 hours
~~C. Gross specific activity of the reactor coolant not within limit.~~	~~C.1 Be in MODE 3 with T_{avg} < 500°F.~~	~~6 hours~~

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.16.1	~~Verify reactor coolant gross specific activity ≤ 100/Ē µCi/gm.~~ ----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT XE-133 specific activity ≤ [280] µCi/gm.	7 days

SURVEILLANCE		FREQUENCY
SR 3.4.16.2	----------NOTE---------- Only required to be performed in MODE 1. ---------- Verify reactor coolant DOSE EQUIVALENT I-131 specific activity ≤ [1.0] μCi/gm.	14 days <u>AND</u> Between 2 and 6 hours after THERMAL POWER change of ≥ 15% RTP within a 1 hour period
~~SR 3.4.16.3~~	~~----------NOTE----------~~ ~~Not required to be performed until 31 days after a minimum of 2 EFPD and 20 days of MODE 1 operation have elapsed since the reactor was last subcritical for ≥ 48 hours.~~ ~~----------~~ ~~Determine Ē from a sample taken in MODE 1 after a minimum of 2 EFPD and 20 days of MODE 1 operation have elapsed since the reactor was last subcritical for ≥ 48 hours.~~	~~184 days~~

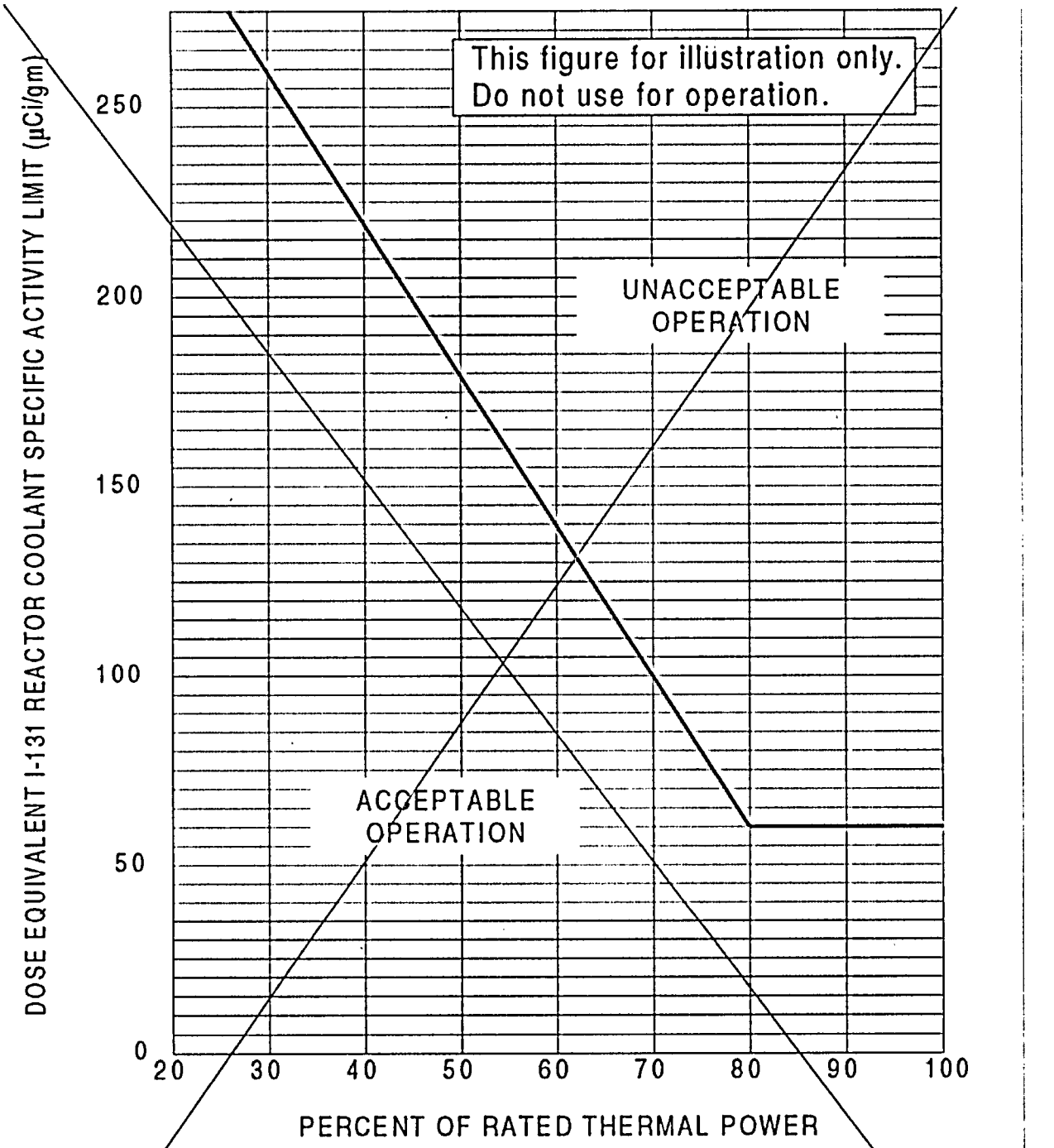

Figure 3.4.16-1 (page 1 of 1)
Reactor Coolant DOSE EQUIVALENT I-131 Specific Activity Limit Versus Percent of RATED THERMAL POWER With Reactor Coolant Specific Activity >1.0 µCi/gm DOSE EQUIVALENT I-131

Complete Replacement of the Existing 3.4.16 Bases

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.16 RCS Specific Activity

BASES

BACKGROUND

The maximum dose that an individual at the exclusion area boundary can receive for 2 hours following an accident, or at the low population zone outer boundary for the radiological release duration, is specified in [10 CFR 100.11][10 CFR 50.67] (Ref. 1). Doses to control room operators must be limited per GDC 19. The limits on specific activity ensure that the offsite and control room doses are appropriately limited during analyzed transients and accidents.

The RCS specific activity LCO limits the allowable concentration level of radionuclides in the reactor coolant. The LCO limits are established to minimize the dose consequences in the event of a steam line break (SLB) or steam generator tube rupture (SGTR) accident.

The LCO contains specific activity limits for both DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133. The allowable levels are intended to ensure that offsite and control room doses meet the appropriate acceptance criteria in the Standard Review Plan (Ref. 2).

APPLICABLE SAFETY ANALYSES

The LCO limits on the specific activity of the reactor coolant ensure that the resulting offsite and control room doses meet the appropriate SRP acceptance criteria following a SLB or SGTR accident. The safety analyses (Refs. 3 and 4) assume the specific activity of the reactor coolant is at the LCO limits, and an existing reactor coolant steam generator (SG) tube leakage rate of [1 gpm] exists. The safety analyses assume the specific activity of the secondary coolant is at its limit of [0.1] μCi/gm DOSE EQUIVALENT I-131 from LCO 3.7.19, "Secondary Specific Activity."

The analyses for the SLB and SGTR accidents establish the acceptance limits for RCS specific activity. Reference to these analyses is used to assess changes to the unit that could affect RCS specific activity, as they relate to the acceptance limits.

The safety analyses consider two cases of reactor coolant iodine specific activity. One case assumes specific activity at [1.0] μCi/gm DOSE EQUIVALENT I-131 with a concurrent large iodine spike that increases the rate of release of iodine from the fuel rods containing cladding defects to the primary coolant immediately after a SLB (by a factor of 500), or SGTR (by a factor of 335), respectively. The second case assumes the initial reactor coolant iodine activity at [60.0] μCi/gm DOSE EQUIVALENT I-131 due to an iodine spike caused by a reactor or an RCS transient prior

BASES

APPLICABLE SAFETY ANALYSES (continued)

to the accident. In both cases, the noble gas specific activity is assumed to be [280] µCi/gm DOSE EQUIVALENT XE-133.

The SGTR analysis assumes a rise in pressure in the ruptured SG causes radioactively contaminated steam to discharge to the atmosphere through the atmospheric dump valves or the main steam safety valves. The atmospheric discharge stops when the turbine bypass to the condenser removes the excess energy to rapidly reduce the RCS pressure and close the valves. The unaffected SG removes core decay heat by venting steam until the cooldown ends and the Shutdown Cooling (SDC) system is placed in service.

The SLB radiological analysis assumes that offsite power is lost at the same time as the pipe break occurs outside containment. The affected SG blows down completely and steam is vented directly to the atmosphere. The unaffected SG removes core decay heat by venting steam to the atmosphere until the cooldown ends and the SDC system is placed in service.

Operation with iodine specific activity levels greater than the LCO limit is permissible, if the activity levels do not exceed [60.0] µCi/gm for more than 48 hours.

The limits on RCS specific activity are also used for establishing standardization in radiation shielding and plant personnel radiation protection practices.

RCS specific activity satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The iodine specific activity in the reactor coolant is limited to [1.0] µCi/gm DOSE EQUIVALENT I-131, and the noble gas specific activity in the reactor coolant is limited to [280] µCi/gm DOSE EQUIVALENT XE-133. The limits on specific activity ensure that offsite and control room doses will meet the appropriate SRP acceptance criteria (Ref. 2).

The SLB and SGTR accident analyses (Refs. 3 and 4) show that the calculated doses are within acceptable limits. Violation of the LCO may result in reactor coolant radioactivity levels that could, in the event of a SLB or SGTR, lead to doses that exceed the SRP acceptance criteria (Ref. 2).

BASES

APPLICABILITY

In MODES 1, 2, 3, and 4, operation within the LCO limits for DOSE EQUIVALENT I-131 and DOSE EQUIVALENT XE-133 is necessary to limit the potential consequences of a SLB or SGTR to within the SRP acceptance criteria (Ref. 2).

In MODES 5 and 6, the steam generators are not being used for decay heat removal, the RCS and steam generators are depressurized, and primary to secondary leakage is minimal. Therefore, the monitoring of RCS specific activity is not required.

ACTIONS

A.1 and A.2

With the DOSE EQUIVALENT I-131 greater than the LCO limit, samples at intervals of 4 hours must be taken to demonstrate that the specific activity is ≤ [60.0] µCi/gm. The Completion Time of 4 hours is required to obtain and analyze a sample. Sampling is continued every 4 hours to provide a trend.

The DOSE EQUIVALENT I-131 must be restored to within limit within 48 hours. The Completion Time of 48 hours is acceptable since it is expected that, if there were an iodine spike, the normal coolant iodine concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODE(S), relying on Required Actions A.1 and A.2 while the DOSE EQUIVALENT I-131 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

B.1

With the DOSE EQUIVALENT XE-133 greater than the LCO limit, DOSE EQUIVALENT XE-133 must be restored to within limit within 48 hours. The allowed Completion Time of 48 hours is acceptable since it is expected that, if there were a noble gas spike, the normal coolant noble gas concentration would be restored within this time period. Also, there is a low probability of a SLB or SGTR occurring during this time period.

BASES

ACTIONS (continued)

A Note permits the use of the provisions of LCO 3.0.4.c. This allowance permits entry into the applicable MODES(S), relying on Required Action B.1 while the DOSE EQUIVALENT XE-133 LCO limit is not met. This allowance is acceptable due to the significant conservatism incorporated into the specific activity limit, the low probability of an event which is limiting due to exceeding this limit, and the ability to restore transient-specific activity excursions while the plant remains at, or proceeds to, power operation.

C.1 and C.2

If the Required Action and associated Completion Time of Condition A or B is not met, or if the DOSE EQUIVALENT I-131 is > [60.0] μCi/gm, the reactor must be brought to MODE 3 within 6 hours and MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE REQUIREMENTS

SR 3.4.16.1

SR 3.4.16.1 requires performing a gamma isotopic analysis as a measure of the noble gas specific activity of the reactor coolant at least once every 7 days. This measurement is the sum of the degassed gamma activities and the gaseous gamma activities in the sample taken. This Surveillance provides an indication of any increase in the noble gas specific activity.

Trending the results of this Surveillance allows proper remedial action to be taken before reaching the LCO limit under normal operating conditions. The 7 day Frequency considers the low probability of a gross fuel failure during this time.

Due to the inherent difficulty in detecting Kr-85 in a reactor coolant sample due to masking from radioisotopes with similar decay energies, such as F-18 and I-134, it is acceptable to include the minimum detectable activity for Kr-85 in the SR 3.4.16.1 calculation. If a specific noble gas nuclide listed in the definition of DOSE EQUIVALENT XE-133 is not detected, it should be assumed to be present at the minimum detectable activity.

A Note modifies the SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.16.2

This Surveillance is performed to ensure iodine specific activity remains within the LCO limit during normal operation and following fast power changes when iodine spiking is more apt to occur. The 14 day Frequency is adequate to trend changes in the iodine activity level, considering noble gas activity is monitored every 7 days. The Frequency, between 2 and 6 hours after a power change ≥ 15% RTP within a 1 hour period, is established because the iodine levels peak during this time following iodine spike initiation; samples at other times would provide inaccurate results.

The Note modifies this SR to allow entry into and operation in MODE 4, MODE 3, and MODE 2 prior to performing the SR. This allows the Surveillance to be performed in those MODES, prior to entering MODE 1.

REFERENCES

---------- Reviewer's Note ----------
The first listed References 1 and 2 are for plants that are licensed to 10 CFR 100.11. The second set of References are for plants that are licensed to 10 CFR 50.67.

[1. 10 CFR 100.11.

2. Standard Review Plan (SRP) Section 15.1.5 Appendix A (SLB) and Section 15.6.3 (SGTR).

1. 10 CFR 50.67.

2. Standard Review Plan (SRP) Section 15.0.1 "Radiological Consequence Analyses Using Alternative Source Terms."]

3. FSAR, Section [15.1.5].

4. FSAR, Section [15.6.3].