LIMITING CONDITIONS FOR OPERATION AND SURVEILLANCE REQUIREMENTS

BASES

SECTION PAGE

TABLE 3 3-9

REMOTE SHUTDOWN MONITORING INSTRUMENTATION

	INSTRUMENT	READOUT LOCATION	MEASUREMENT RANGE	MINIMUM CHANNELS OPERABLE
1.	Source Range Nuclear Flux	NOTE 1	0.1 to 1 x 10^5 cps	1
2.	Reactor Trip Breaker Indication	at trip switchgear	OPEN-CLOSE	1/trip breaker
3.	Reactor Coolant Temperature - Hot Leg	NOTE 1	0-650°F	1/loop
4.	Pressurizer Pressure	NOTE 1	0-3000 psig	1
5.	Pressurizer Leve1	NOTE 1	0-100%	1
6.	Steam Generator Pressure	NOTE 1	0-1200 psig	1/steam generator
7.	Steam Generator Leve1	NOTE 2 or near Auxilary F. W. Pump	0-100%	1/steam generator
8.	Deleted			
9.	RHR Flow Rate	NOTE 1	0-4500 gpm	1
10	RHR Temperature	NOTE 1	50-400°F	1
11.	Auxiliary Feedwater Flow Rate	NOTE 1	0-440 gpm	1/steam generator

3/4 5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3/4 5.1 ACCUMULATORS

COLD LEG INJECTION ACCUMULATORS

LIMITING CONDITION FOR OPERATION

3.5.1.1 Each cold leg injection accumulator shall be OPERABLE with

a The isolation valve open,

b A contained borated water volume of between 7615 and 7960 gallons of borated water,

c. Between 3500 and 3800 ppm of boron,

d A nitrogen cover-pressure of between 624 and 668 psig, and

e Power removed from isolation valve when RCS pressure is above 2000 psig

APPLICABILITY: MODES 1, 2 and 3.*

ACTION

a. With one cold leg injection accumulator inoperable, except as a result of boron concentration not within limits, restore the inoperable accumulator to OPERABLE status within one hour or be in at least HOT STANDBY within the next 6 hours and reduce pressurizer pressure to 1000 psig or less within the following 6 hours.

b. With one cold leg injection accumulator inoperable due to the boron concentration not within limits, restore boron concentration to within limits within 72 hours or be in at least HOT STANDBY within the next 6 hours and reduce pressurizer pressure to 1000 psig or less within the following 6 hours.

*Pressurizer pressure above 1000 psig.

EMERGENCY CORE COOLING SYSTEMS (ECCS)

3/4.5.5 REFUELING WATER STORAGE TANK

LIMITING CONDITION FOR OPERATION

3.5.5 The refueling water storage tank (RWST) shall be OPERABLE with:

a A contained borated water volume of between 370,000 and 375,000 gallons,

b. A boron concentration of between 3600 and 3800 ppm of boron,

c. A minimum solution temperature of 60°F, and

d. A maximum solution temperature of 105°F.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With the RWST inoperable, restore the tank to OPERABLE status within 1 hour or be in at least HOT STANDBY within 6 hours and in COLD SHUTDOWN within the following 30 hours

SURVEILLANCE REQUIREMENTS

4.5.5 The RWST shall be demonstrated OPERABLE:

a At least once per 7 days by:

1. Verifying the contained borated water volume in the tank, and

2. Verifying the boron concentration of the water.

b. At least once per 24 hours by verifying the RWST temperature.

3/4 7 14 CASK PIT POOL MINIMUM BORON CONCENTRATION

LIMITING CONDITION FOR OPERATION

3.7.14 This specification has been deleted.

5 3 REACTOR CORE

FUEL ASSEMBLIES

5.3.1 The reactor shall contain 193 fuel assemblies. Each assembly shall consist of a matrix of zircaloy or M5 clad fuel rods with an initial composition of natural or slightly enriched uranium dioxide as fuel material Limited substitutions of zirconium alloy or stainless steel filler rods for fuel rods, in accordance with NRC-approved applications of fuel rod configurations, may be used. Fuel assemblies shall be limited to those fuel designs that have been analyzed with applicable NRC staff-approved codes and methods, and shown by tests or analyses to comply with all fuel safety design bases. A limited number of lead test assemblies that have not completed representative testing may be placed in nonlimiting core regions. Sequoyah is authorized to place a limited number of lead test assemblies into the reactor as described in the Framatome-Cogema Fuels report BAW-2328, beginning with the Unit 1 Operating Cycle 12.

Sequoyah is authorized to place a maximum of 2256 Tritium Producing Burnable Absorber Rods into the reactor in an operating cycle

CONTROL ROD ASSEMBLIES

5.3.2 The reactor core shall contain 53 full length and no part length control rod assemblies. The full length control rod assemblies shall contain a nominal 142 inches of absorber material The nominal values of absorber material shall be 80 percent silver, 15 percent indium and 5 percent cadmium. All control rods shall be clad with stainless steel tubing.

5 4 REACTOR COOLANT SYSTEM

DESIGN PRESSURE AND TEMPERATURE

5 4.1 The reactor coolant system is designed and shall be maintained.

a. In accordance with the code requirements specified in Section 5 2 of the FSAR, with allowance for normal degradation pursuant to the applicable Surveillance Requirements,

b. For a pressure of 2485 psig, and

c. For a temperature of 650°F, except for the pressurizer which is 680°F.

VOLUME

5.4.2 The total water and steam volume of the reactor coolant system is 12,612 $\pm$ 100 cubic feet at a nominal T_{avg} of 525°F.

5 5 METEOROLOGICAL TOWER LOCATION

5.5.1 The meteorological tower shall be located as shown on Figure 5.1-1.

5 6 FUEL STORAGE

CRITICALITY - SPENT FUEL

For convenience of reference, the following definitions apply:

Type A fuel refers to spent fuel assemblies which have not contained tritium producing burnable absorber rods (TPBAR's) during in-core operations

Type T fuel refers to spent fuel assemblies which have contained tritium producing burnable absorber rods (TPBAR's) during in-core operations.

Fresh fuel refers to unirradiated Type A or Type T fuel or irradiated Type A or Type T fuel that has not attained sufficient burnup to meet spent fuel requirements

Cooling time is defined as the period since reactor shutdown at the end of the last operating cycle for the discharged spent fuel assembly.

5.6 1.1 The spent fuel storage racks are designed for fuel enriched to 5 weight percent U-235 and shall be maintained with:

a. A k_{eff} less than critical when flooded with unborated water and a k_{eff} less than or equal to 0 95 when flooded with water containing 300 ppm soluble boron *

b A nominal 8.972 inch center-to-center distance between fuel assemblies placed in the storage racks.

c Arrangements of one or more of three different arrays (Regions) or sub-arrays as illustrated in Figures 5.6-1 and 5.6-1a These arrangements in the spent fuel storage pool have the following definitions:

1. Region 1 is designed to accommodate new fuel with a maximum enrichment of 4.95 ± 0.05 wt% U-235, (or spent fuel regardless of the fuel burnup), in a 1-in-4 checkerboard arrangement of 1 fresh assembly with 3 Type A spent fuel assemblies with enrichment-burnup and cooling times illustrated in Figure 5.6-2 and defined by the equations in Table 5.6-1. The presence of a removable, non-fissile insert such as a burnable poison rod assembly (BPRA) or either gadolinia or integral fuel burnable absorber (IFBA) in a fresh fuel assembly does not affect the applicability of Figure 5 6-2 or Table 5.6-1.

   Two alternative storage arrays (or sub-arrays) are acceptable in Region 1 if the fresh fuel assemblies contain rods with either gadolinia or integral fuel burnable absorber (IFBA). For these types of assemblies, the minimum burnup of the spent fuel in the 1-of-4 sub-array are defined by the equations in Table 5 6-2.

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*For some accident conditions, the presence of dissolved boron in the pool water may be taken into account by applying the double contingency principle which requires two unlikely, independent, concurrent events to produce a criticality accident.

5 6 FUEL STORAGE

Restrictions in Region 1

Any of the three sub-arrays illustrated in Figure 5.6-1a may be used in any combination provided that:

A) Each sub-array of 4 fuel assemblies includes, in addition to the fresh fuel assembly, 3 assemblies with enrichment and minimum burnup requirements defined by the equations in Tables 5.6-1 and 5.6-2, as appropriate

B) The arrangement of Region 1 sub-arrays must not allow a configuration with fresh assemblies adjacent to each other.

C) If Region 1 arrays are used in conjunction with Region 3 or Region 4 arrangements (see below), the arrangements shall not allow fresh fuel assemblies to be adjacent to each other (see also Figure 5.6-1)

D) If miscellaneous non-fissile bearing items or equipment are stored in cells of Region 1, the total volume of the miscellaneous items shall be no more than 75% of the total storage cell volume

2. Region 2 is designed to accommodate Type A or Type T fuel of 4.95±0.05 wt% U-235 initial enrichment burned to at least 30.27 (Type A) or 33.1095 (Type T) MWD/KgU (assembly average), or fuel of other enrichments with a burnup yielding an equivalent reactivity in the fuel racks. The minimum required assembly average burnup in MWD/KgU and cooling time is given by the equations in Table 5.6-3 (Type A) or 5 6-4 (Type T). The minimum required burnups are illustrated in Figure 5.6-3 (Type A) or 5 6-4 (Type T) in terms of the initial enrichment and cooling time.

Restrictions in Region 2

The following restrictions apply to the storage of spent fuel in the Region 2 cells:

A) The spent fuel shall conform to the minimum burnup requirements defined by the equations in Table 5 6-3 or 5 6-4, as appropriate. Linear interpolation between cooling times may be made if desired.

B) For the interface with Region 1 or 4 storage cells, fresh fuel in Region 1 or 4 shall not be stored adjacent to spent fuel assemblies in the Region 2 storage cells.

C) If miscellaneous non-fissile bearing items or equipment are stored in cells of Region 2, the total volume of the miscellaneous items shall be no more than 75% of the total storage cell volume.

3. Region 3 is designed to accommodate fuel of 4.95±0.05 wt% U-235 initial enrichment (or fuel assemblies of any lower reactivity) in a 2-out-of-4 checkerboard arrangement with water-filled cells. The water-filled cells shall not contain any components bearing any fissile material, but may accommodate miscellaneous items or equipment.

5 6 FUEL STORAGE

Restrictions in Region 3

The following restrictions apply to the storage of fuel in the Region 3 cells:

A) For the interface between Region 3 and Region 1 or 4 storage regions, fresh fuel assemblies shall not be stored adjacent to each other.

B) If miscellaneous non-fissile bearing items or equipment are stored in the water cells of Region 3, the total volume of the miscellaneous items shall be no more than 75% of the storage cell volume.

C) No loose fuel rods or items containing fissile material shall be stored in the water cells of Region 3.

4. Region 4 is designed to accommodate fresh fuel with a maximum enrichment of 4.95 $\pm$ 0.05 wt% U-235 (or spent fuel regardless of the fuel burnup), in a 1-in-4 checkerboard arrangement of 1 fresh assembly with three Type T spent fuel assemblies having burnup and cooling times illustrated in Figure 5.6-5 and defined by the equations in Table 5 6-5. The presence of either gadolinia or integral fuel burnable absorber (IFBA) in a fresh fuel assembly does not affect the applicability of Figure 5.6-5 or Table 5.6-5.

One alternative storage array (or sub-array) is acceptable in Region 4 if the fresh fuel contains rods with gadolinia fuel burnable absorber. For these types of assemblies, the minimum burnup of the spent fuel in the 1-of-4 sub-array is defined by the equations in Table 5 6-6 and illustrated in Figure 5.6-6. For fresh assemblies containing more than eight (8) gadolinia bearing fuel rods, the limiting burnup for eight (8) gadolinia rods shall apply.

Restrictions in Region 4

Any of the two sub-arrays illustrated in Figure 5 6-1a applying to Region 4 storage may be used in any combination provided that:

A) Each sub-array of 4 fuel assemblies includes, in addition to the fresh fuel assembly, 3 assemblies with enrichment and minimum burnup requirements defined by the equations in Tables 5.6-5 and 5.6-6, as appropriate.

B) The arrangement of Region 4 sub-arrays must not allow a configuration with fresh assemblies adjacent to each other.

C) If Region 4 arrays are used in conjunction with Region 1 or 3 arrangements, the arrangements shall not allow fresh fuel assemblies to be adjacent to each other (see Figure 5.6-1)

D) If miscellaneous non-fissile bearing items or equipment are stored in cells of Region 4, the total volume of the miscellaneous items shall be no more than 75% of the total storage cell volume.

d. An empty cell (or a cell containing non-fissile bearing miscellaneous items displacing no more than 75% of the storage cell volume) is less reactive than any cell containing fuel and therefore may be used as a Region 1, 2, 3, or 4 cell in any arrangement

e. A nominal concentration of 2000 ppm boron is in the pool water. This concentration of soluble boron provides a margin sufficient to allow timely detection of a boron dilution accident and corrective action before the minimum concentration (700 ppm) required to protect against the most severe postulated fuel handling accident or before the minimum concentration (300 ppm) required to maintain the storage configuration design basis (keff less than 0.95) is reached.

5 6 FUEL STORAGE

CRITICALITY - NEW FUEL

5 6 1.2 The new fuel pit storage racks are designed for fuel enriched to 5.0 weight percent U-235 and shall be maintained with the arrangement of 146 storage locations shown in Figure 5.6-7. The cells shown as empty cells in Figure 5.6-7 shall have physical barriers installed to ensure that inadvertant loading of fuel assemblies into these locations does not occur. This configuration ensures k_{eff} will remain less than or equal to 0.95 when flooded with unborated water and less than or equal to 0.98 under optimum moderation conditions

DRAINAGE

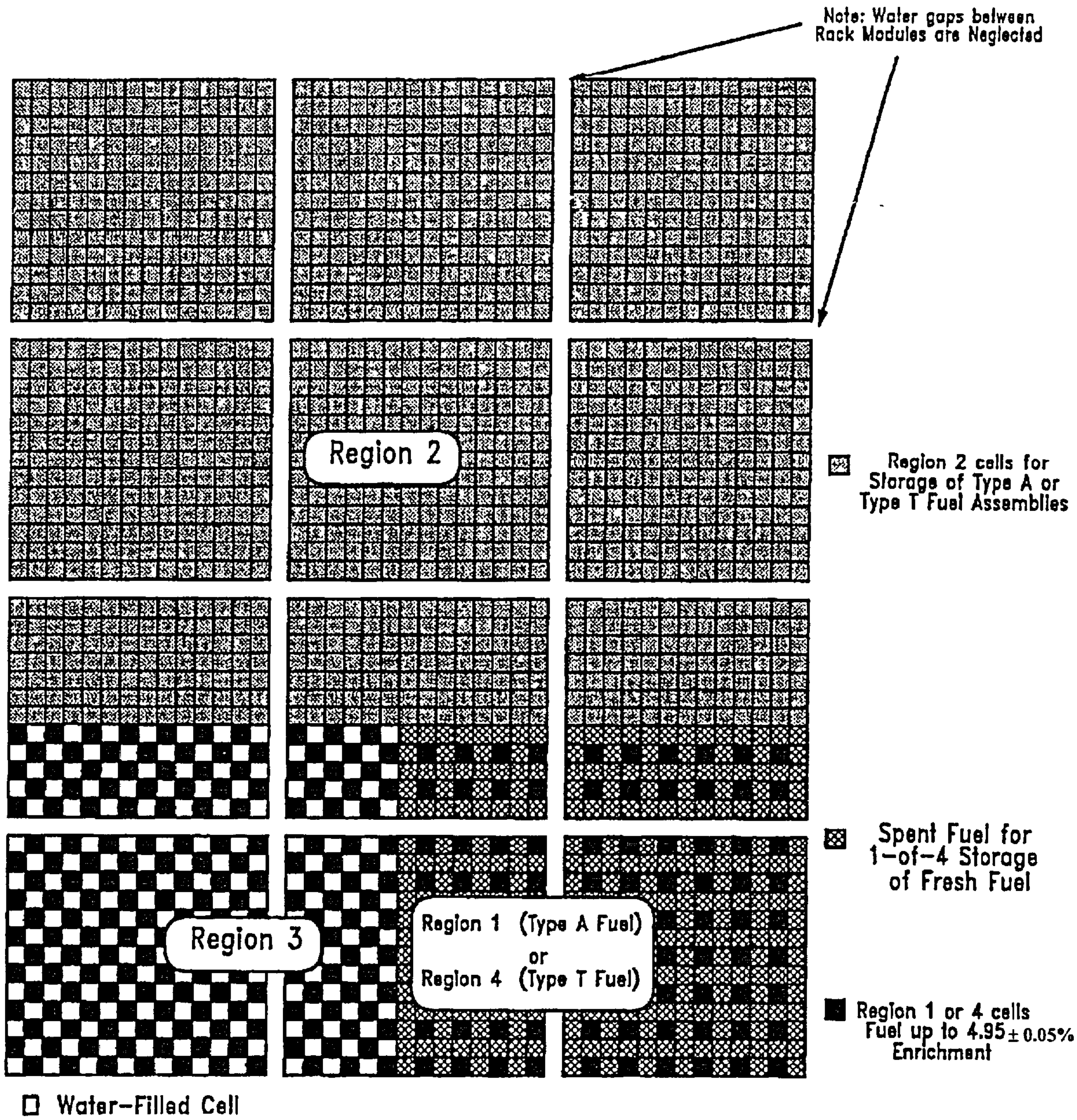
5 6 2 The spent fuel pit is designed and shall be maintained to prevent inadvertent draining of the pool below elevation 722 ft.

CAPACITY

5 6.3 The spent fuel storage pool is designed and shall be maintained with a storage capacity limited to no more than 2091 fuel assemblies.

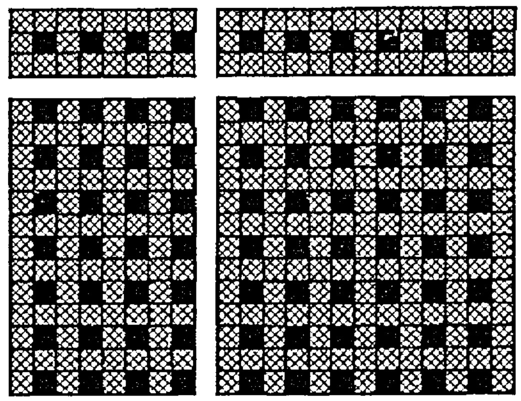
5 7 COMPONENT CYCLIC OR TRANSIENT LIMIT

5 7.1 The components identified in Table 5 7-1 are designed and shall be maintained within the cyclic or transient limits of Table 5 7-1.



Note: The edges of the sketch above are not necessarily the edges of the pool. The Regions may appear anywhere in the pool and in any orientation, subject to the restrictions in Design Features 5.6.1.1.c.

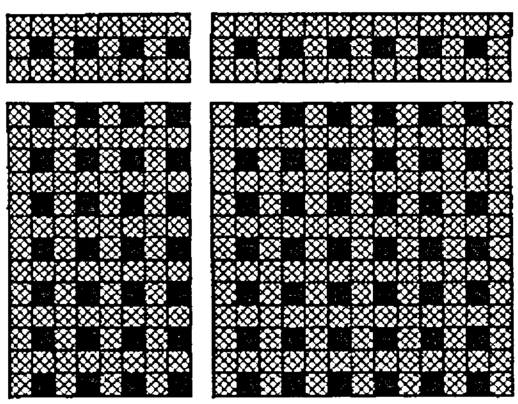
FIG 5.6-1 Arrangements of Fuel Storage Regions in the Sequoyah Spent Fuel Storage Pool



▩ Spent Fuel for Storage in Region 1 (Type A Fuel) or Region 4 (Type T Fuel) in 1-of-4 Pattern

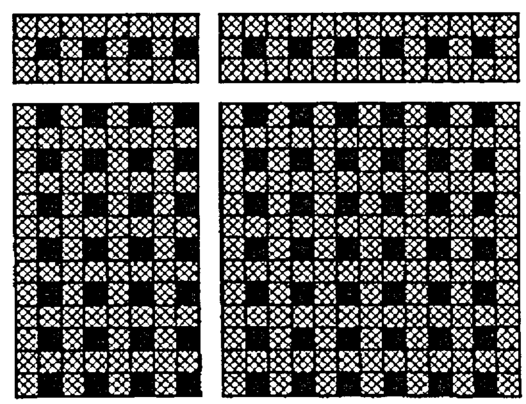
■ Fresh Fuel for Region 1 or Region 4 cells (No Gd or IFBA)

NOTE: WHEN CREDIT IS TAKEN FOR GADOLINIA RODS IN FRESH ASSEMBLIES THE SPENT FUEL ASSEMBLIES NEED NOT HAVE CONTAINED GADOLINIA RODS..



▩ Spent Fuel for Storage of Region 1 (Type A Fuel) or Region 4 (Type T Fuel) in 1-of-4 Pattern

■ Fresh Fuel with Gadolinia for Region 1 or Region 4 cells



▩ Spent Fuel for Storage in Region 1 in 1-of-4 Pattern

■ Fresh Fuel with IFBA Rods for Storage in Region 1 only (1-of-4 Pattern)

Fig. 5.6-1a Acceptable Storage Patterns for Checkerboard Storage of Fresh and Spent Fuel Assemblies in Region 1 or Region 4 – Example

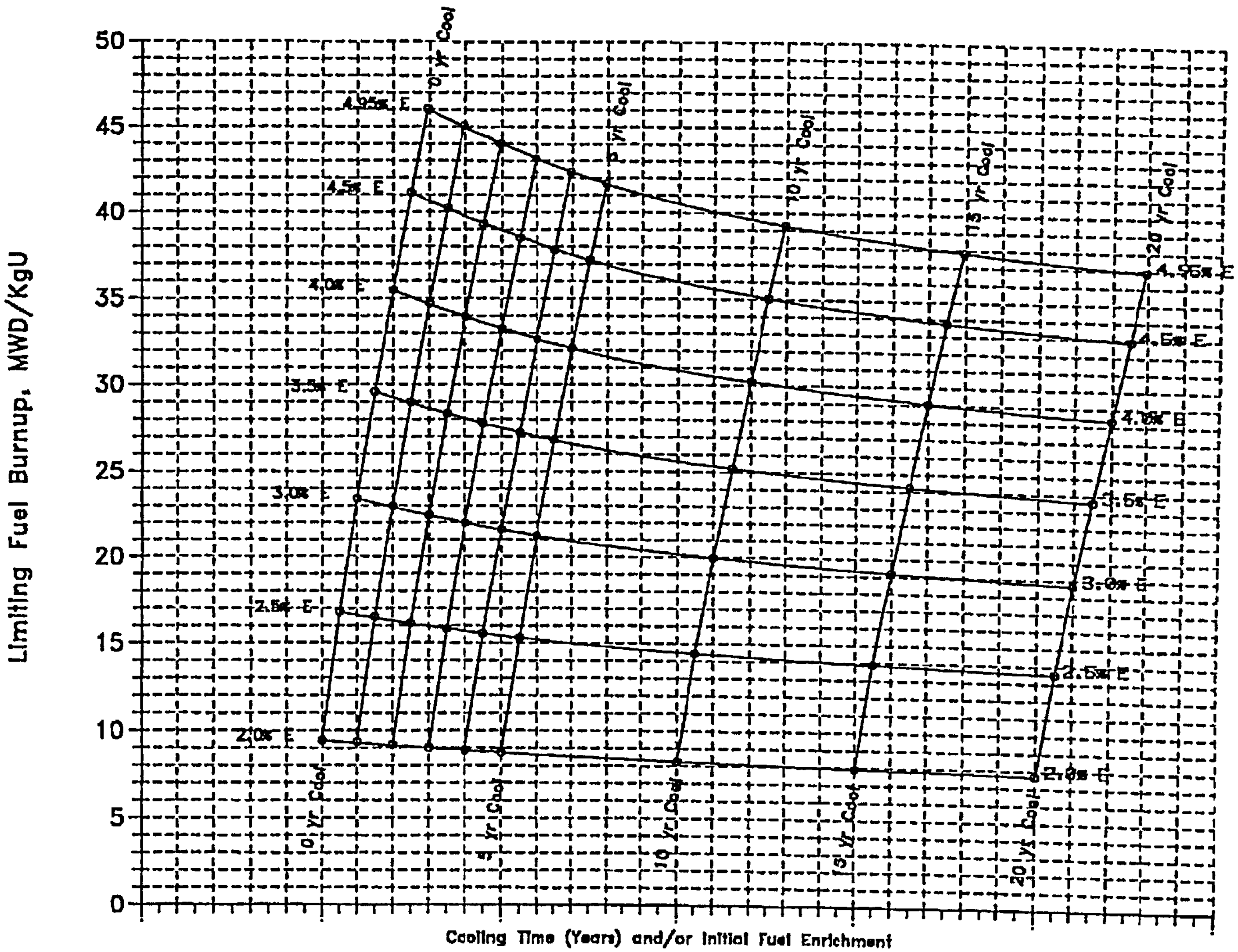


Fig. 5.6-2 3-Dimensional Plot of Minimum Fuel Burnups for Type A Fuel in Region 1 for Enrichments and/or Cooling Times

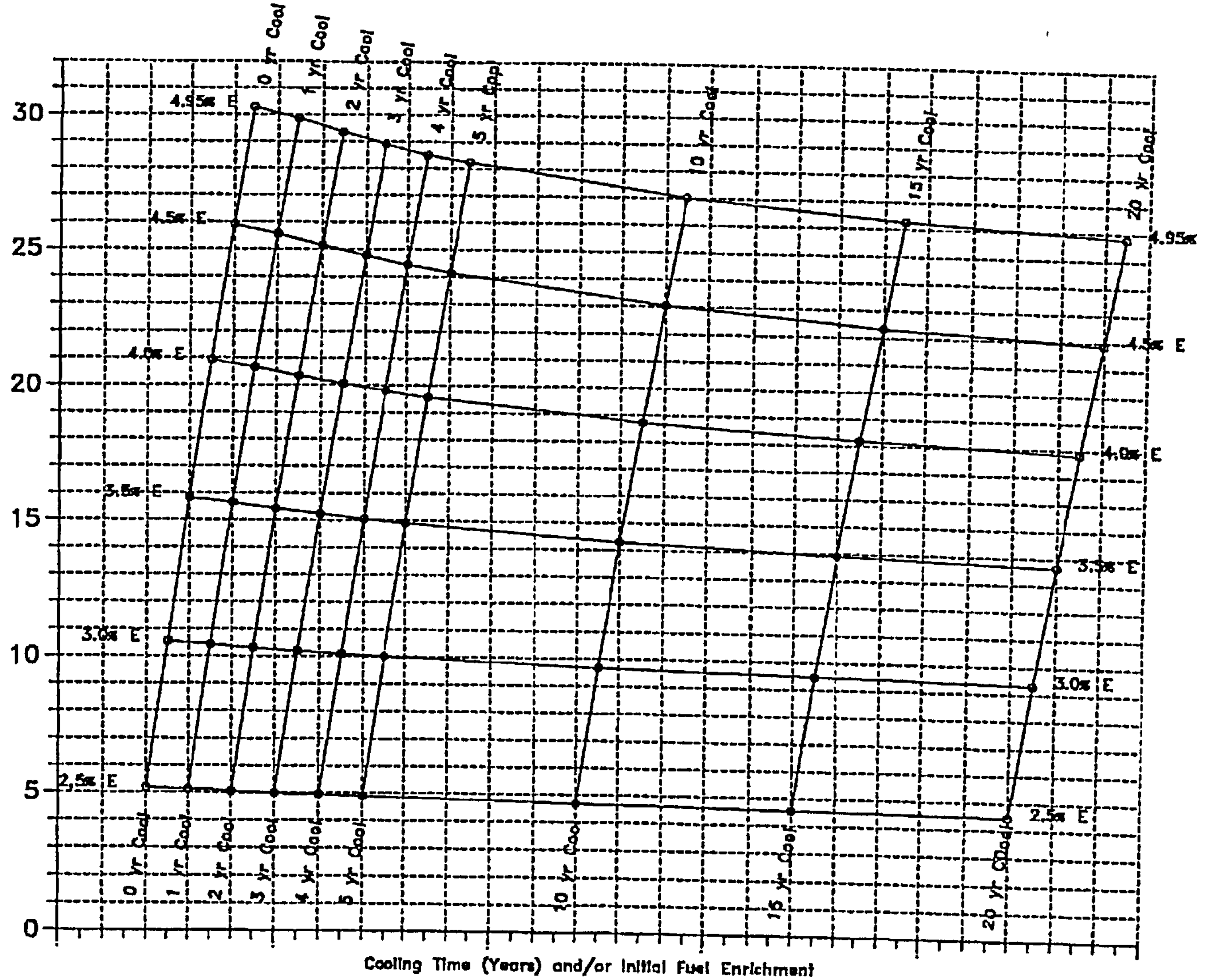


Fig. 5.6-3 3-dimensional Plot of Minimum Fuel Burnups For Type A Fuel in Region 2 for Enrichments and Cooling Times

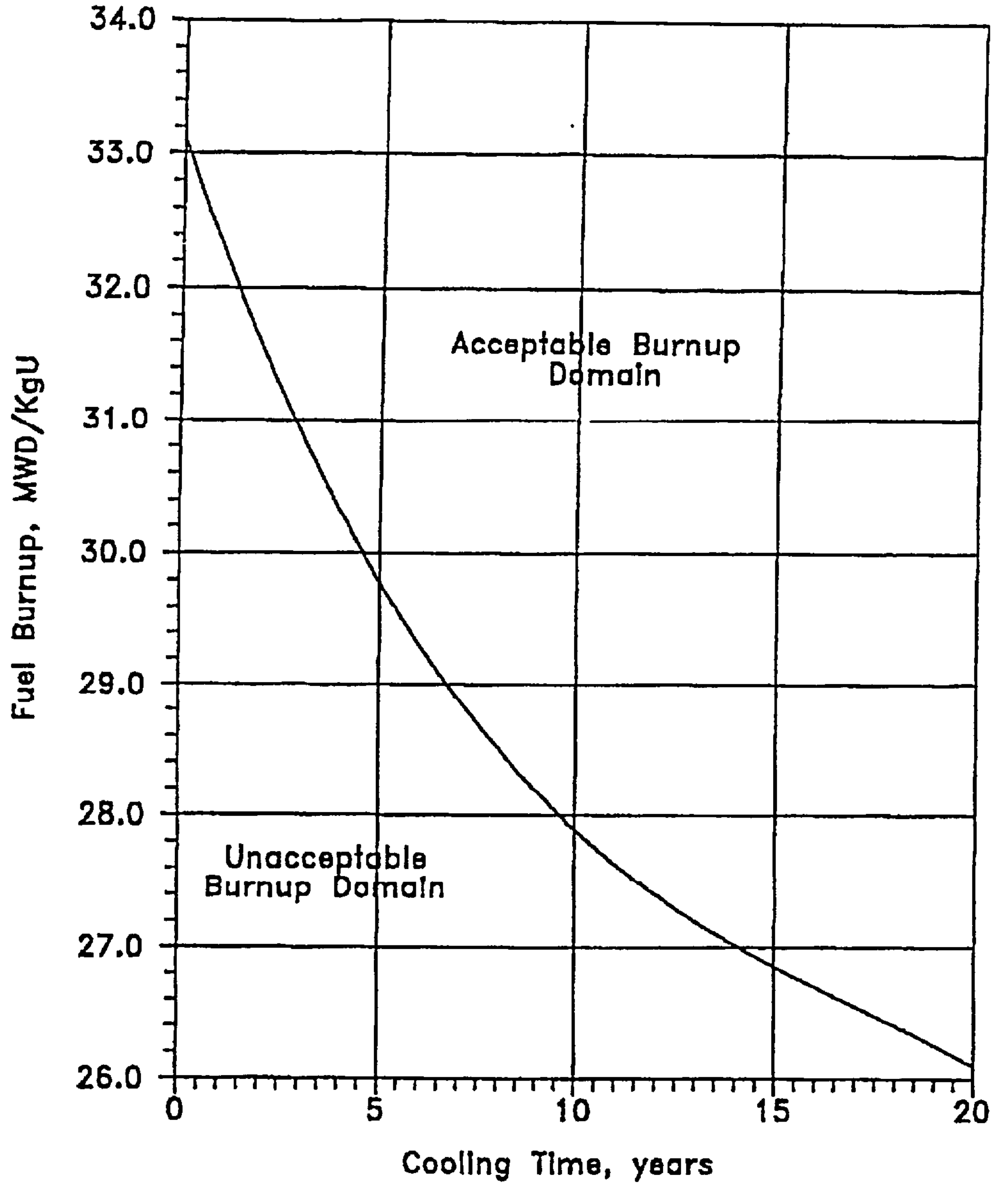


Fig. 5.6–4 Limiting Burnup Requirements in Region 2 for Face Adjacent Storage of Type T Spent Fuel Assemblies

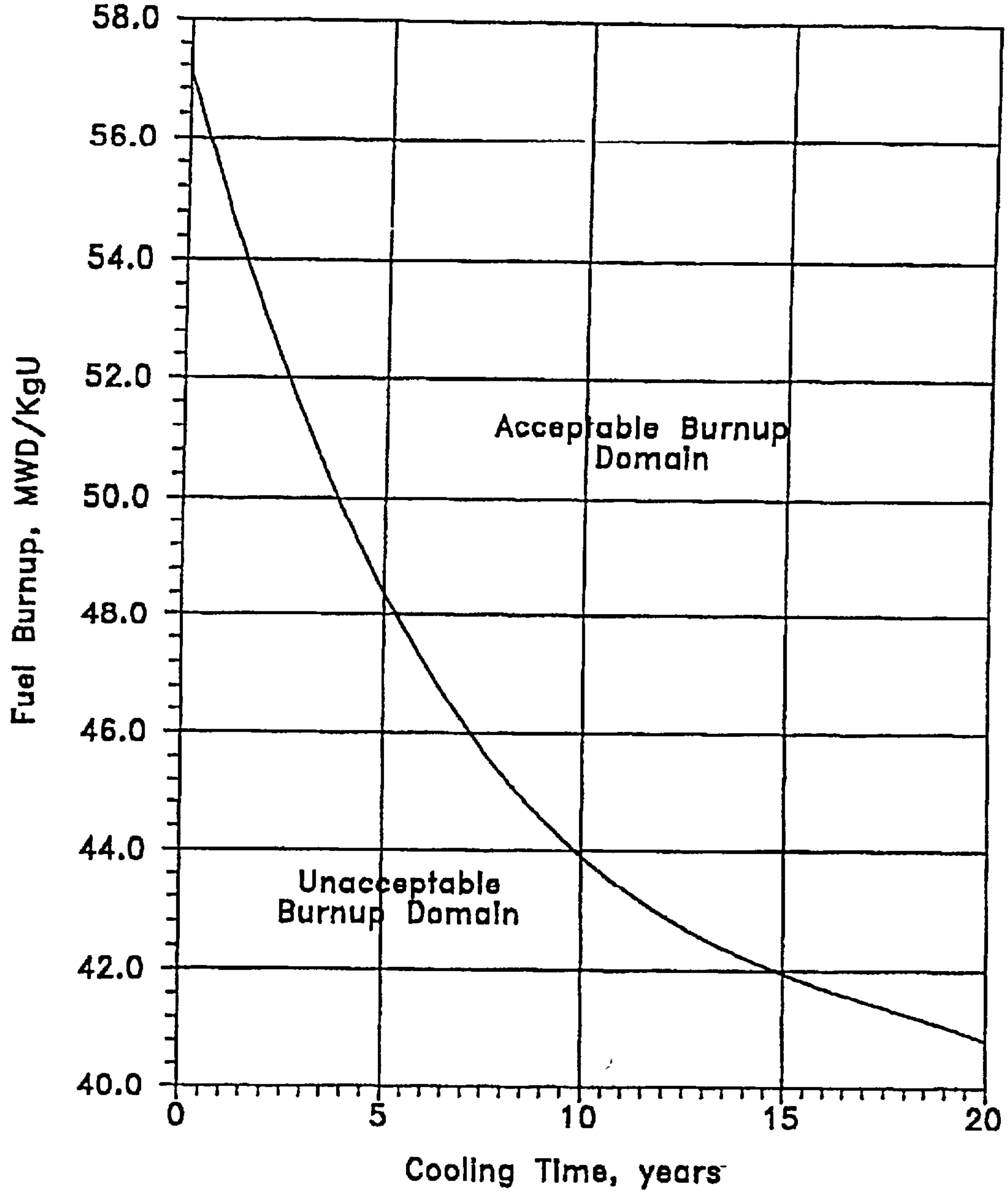


Fig. 5.6-5 Limiting Burnup Requirements in Region 4, Checkerboard Array of 1 Fresh and 3 Type T Spent Fuel Assemblies

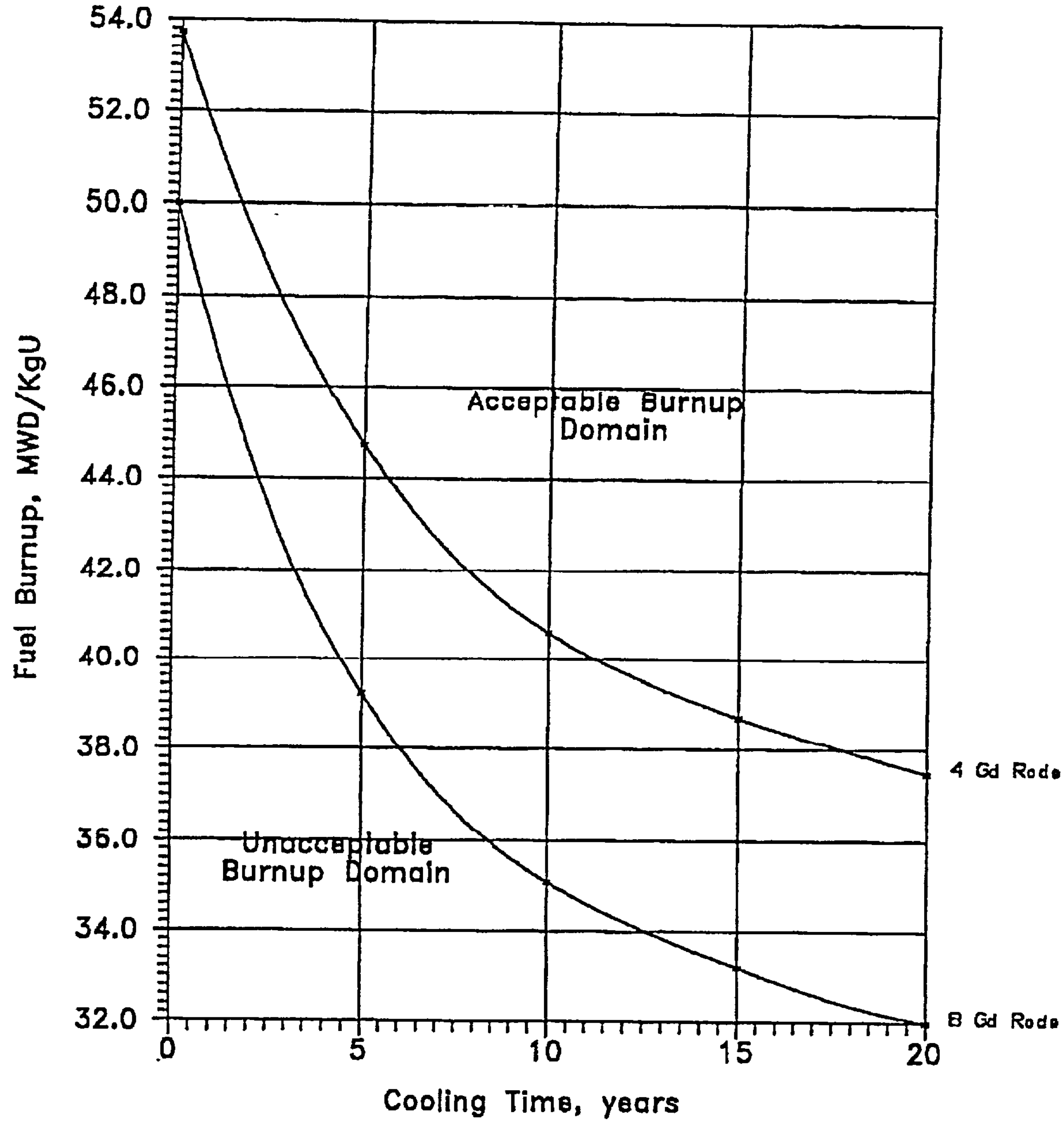


Fig. 5.6-6 Limiting Burnup Requirements in Region 4, Checkerboard Array of 1 Fresh (with Gadolinia) and 3 Type T Spent Fuel Assemblies

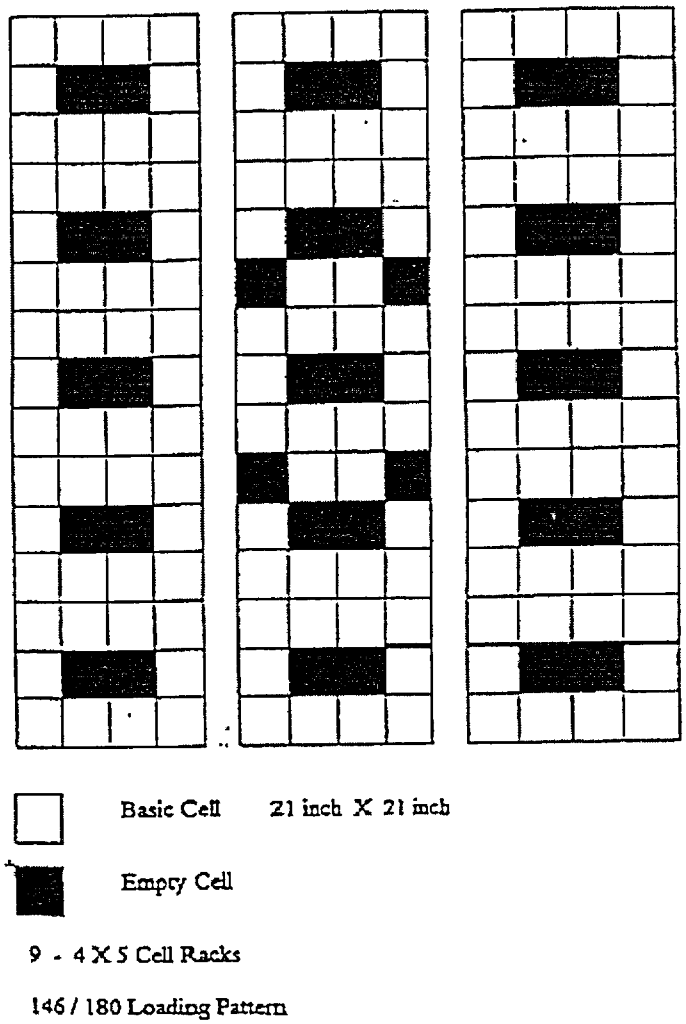


Figure 5.6-7
New Fuel Pit Storage Rack Loading Pattern

Table 5.6-1

Region 1 Storage Burnup Restrictions. Checkerboard of 1
Fresh Fuel Assembly (Without Gadolinium or IFBA Rods) and 3 Type A Spent Fuel Assemblies

For Zero Year Cooling Time
Bu (limit) = $-28.1868 + 23.0765 \times E - 2\ 46264 \times E^2 + 0.167868 \times E^3$
For One Year Cooling Time
Bu (limit) = $-27.3317 + 22.5087 \times E - 2\ 40586 \times E^2 + 0.164207 \times E^3$
For Two Years Cooling Time
Bu (limit) = $-26\ 4693 + 21.8404 \times E - 2.31873 \times E^2 + 0.158218 \times E^3$
For Three Years Cooling Time
Bu (limit) = $-25\ 7404 + 21.2659 \times E - 2.24287 \times E^2 + 0.153018 \times E^3$
For Four Years Cooling Time
Bu (limit) = $-25.1367 + 20\ 7910 \times E - 2.18484 \times E^2 + 0.1499363 \times E^3$
For Five Years Cooling Time
Bu (limit) = $-24.5981 + 20.3568 \times E - 2.12719 \times E^2 + 0.145431 \times E^3$
For Ten Years Cooling Time
Bu (limit) = $-23\ 2050 + 19\ 2969 \times E - 2.06993 \times E^2 + 0\ 145875 \times E^3$
For Fifteen Years Cooling Time
Bu (limit) = $-22.6098 + 18\ 8544 \times E - 2.08617 \times E^2 + 0.150473 \times E^3$
For Twenty Years Cooling Time
Bu (limit) = $-22.3017 + 18.622 \times E - 2\ 11206 \times E^2 + 0.15467 \times E^3$

Note: E = initial enrichment in the axial zone of highest enrichment (wt% U-235)

Table 5.6-2
Region 1 Storage Burnup Restrictions with Gadolinium or IFBA in Fresh Fuel

With Gadolinium Credit: Checkerboard of 1 Fresh Fuel Assembly with 3 Type A Spent Fuel Assemblies

Zero Year Cooling Time, 0 Gadolinia Rods Bu (limit) = - 28.1868 + 23 0765 x E – 2.46264 x E^2 + 0.167868 x E^3
Zero Year Cooling Time, 4 Gadolinia Rods Bu (limit) = - 28 4012 + 22.0062 x E – 2.19268 x E^2 + 0.143601 x E^3
Zero Year Cooling Time, 8 Gadolinia Rods Bu (limit) = - 31.4262 + 22.0768 x E – 2.38845 x E^2 + 0.164888 x E^3

Note: If more that 8 Gadolinium rods per assembly, use the 8 rod correlation

With IFBA Credit Checkerboard of 1 Fresh Fuel Assembly with 3 Type A Spent Fuel Assemblies

Zero Year Cooling Time, 0 IFBA Rods Bu (limit) = - 28.1868 + 23.0765 x E – 2.46264 x E^2 + 0.167868 x E^3
Zero Year Cooling Time, 16 IFBA Rods Bu (limit) = - 28.5048 + 21.6411 x E – 2.15262 x E^2 + 0.140904 x E^3
Zero Year Cooling Time, 32 IFBA Rods Bu (limit) = - 31.0949 + 22.0435 x E – 2.36088 x E^2 + 0 162229 x E^3
Zero Year Cooling Time, 48 IFBA Rods Bu (limit) = - 33.1342 + 22.3999 x E – 2 55367 x E^2 + 0 18082 x E^3
Zero Year Cooling Time, 64 IFBA Rods Bu (limit) = - 36.0468 + 24.1492 x E – 3.11807 x E^2 + 0.233987 x E^3

Note: If more that 64 IFBA rods per assembly, use the correlation for 64 IFBA rods

Note: E = initial enrichment in the axial zone of highest enrichment (wt% U-235)

Table 5 6-3
Region 2 Storage Burnup Restrictions
For Type A Fuel

Zero Cooling Time
Bu (limit) = $-23.8702 + 12.3026 \times E - 0.275672 \times E^2$
1 Year Cooling Time
Bu (limit) = $-23\ 6854 + 12.2384 \times E - 0.287498 \times E^2$
2 Years Cooling Time
Bu (limit) = $-23\ 499 + 12.1873 \times E - 0.305988 \times E^2$
3 Years Cooling Time
Bu (limit) = $-23.3124 + 12.1249 \times E - 0\ 319566 \times E^2$
4 Years Cooling Time
Bu (limit) = $-23.1589 + 12.0748 \times E - 0.332212 \times E^2$
5 Years Cooling Time
Bu (limit) = $-22.6375 + 11.7906 \times E - 0.307623 \times E^2$
10 Years Cooling Time
Bu (limit) = $-21.7256 + 11.3660 \times E - 0.31029 \times E^2$
15 Years Cooling Time
Bu (limit) = $-21.1160 + 11.0663 \times E - 0.306231 \times E^2$
20 Years Cooling Time
Bu (limit) = $-20.6055 + 10.7906 \times E - 0.29291 \times E^2$

Note: E = initial enrichment in the axial zone of highest enrichment (wt% U-235)

Table 5.6-4
Face Adjacent Storage of Type T Spent Fuel (Region 2)

$$Bu\ (limit) = 33.1095 - 0.845146 \times CT + 0.0399888 \times CT^2 - 0.000762846 \times CT^3$$

Table 5.6-5
Limiting Burnup For Checkerboard Storage of Fresh and Type T Spent Fuel
(Region 4: 1 Fresh Assembly and 3 Spent Fuel Assemblies in a 2X2 Arrangement)

$$Bu\ (limit) = 57.118 - 2.13277 \times CT + 0.0772537 \times CT^2 + 0.00127446 \times CT^3 - 9.15855\ E\text{-}5 \times CT^4$$

Table 5.6-6
Gadolinia Credit: Limiting Burnup For Checkerboard Storage of Fresh and Type T Spent Fuel
(Region 4: 1 Fresh Assembly With Gadolinia and 3 Spent Fuel Assemblies in a 2X2 Arrangement)

4 Gadolinia Rods

$$Bu\ (limit) = 53.73 - 2.5265 \times CT + 0.172283 \times CT^2 - 0.00585995 \times CT^3 + 0.0000766655 \times CT^4$$

8 Gadolinia Rods

$$Bu\ (limit) = 50.00 - 3.26817 \times CT + 0.276117 \times CT^2 - 0.0117934 \times CT^3 + 0.000195334 \times CT^4$$

Note: 1. If more than 8 gadolinia rods per assembly, use the 8 rod correlation
2. BU = Fuel Burnup, MWD/Kg-U; CT = Cooling Time of Spent Fuel Assemblies, Years

3/4 6 4 COMBUSTIBLE GAS CONTROL

The OPERABILITY of the equipment and systems required for the detection and control of hydrogen gas ensures that this equipment will be available to maintain the hydrogen concentration within containment below its flammable limit during post-LOCA conditions. Either recombiner unit or the hydrogen mitigation system, consisting of 68 hydrogen ignitions per unit, is capable of controlling the expected hydrogen generation associated with 1) zirconium-water reactions, 2) radiolytic decomposition of water, 3) corrosion of metals within containment, and 4) tritium and hydrogen that exist in the Tritium Producing Burnable Absorber Rods prior to the accident These hydrogen control systems are designed to mitigate the effects of an accident as described in Regulatory Guide 1.7, "Control of Combustible Gas Concentrations in Containment Following a LOCA", Revision 2 dated November 1978. The hydrogen monitors of Specification 3 6 4.1 are part of the accident monitoring instrumentation in Specification 3.3 3.7 and are designated as Type A, Category 1 in accordance with Regulatory Guide 1.97, Revision 2, "Instrumentation for Light-Water-Cooled Nuclear Power Plants to Assess Plant Conditions During and Following an Accident," December 1980

The Hydrogen Recombiner's thermocouples are provided for convenience in testing and periodic checkout of the recombiners. The temperature loop is not necessary for the associated Hydrogen Recombiner to be considered operable. The temperature loop's thermocouples and ambient temperature sensor located in containment were not designed to withstand a harsh environment and cannot be counted on to function following a LOCA. The thermocouples and thermocouple indicators are not part of the instrumentation addressed in SR 4.6 4 2.b.1.

The hydrogen mixing systems are provided to ensure adequate mixing of the containment atmosphere following a LOCA This mixing action will prevent localized accumulations of hydrogen from exceeding the flammable limit

The operability of at least 66 of 68 ignitors in the hydrogen mitigation system will maintain an effective coverage throughout the containment. This system of ignitors will initiate combustion of any significant amount of hydrogen released after a degraded core accident. This system is to ensure burning in a controlled manner as the hydrogen is released instead of allowing it to be ignited at high concentrations by a random ignition source.

3/4 6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 12 psig during LOCA conditions.

3/4 6 5 1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will 1) be distributed evenly through the containment bays, 2) contain sufficient boron to preclude dilution of the containment sump following the LOCA and 3) contain sufficient heat removal capability to condense the reactor system volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum weight figure of 1071 pounds of ice per basket contains a 15% conservative allowance for ice loss through sublimation which is a factor of 15 higher than assumed for the ice condenser design. The minimum weight figure of 2,082,024 pounds of ice also contains an additional 1% conservative allowance to account for systematic error in weighing instruments. In the

B 3/4.7 PLANT SYSTEMS

B 3/4.7.13 Spent Fuel Pool Minimum Boron Concentration

BASES

BACKGROUND

The spent fuel racks have been analyzed in accordance with the Holtec International methodology contained in Holtec Reports HI - 992349 (Ref. 1) and HI-2012629 (Ref 9). This methodology ensures that the spent fuel rack multiplication factor, k_{eff} is less than or equal to 0.95, as recommended by the NRC guidance contained in NRC Letter to All Power Reactor Licensees from B K Grimes, "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications," April 14, 1978 and USNRC Internal Memorandum from L. Kopp, "Guidance On The Regulatory Requirements For Criticality Analysis Of Fuel Storage At Light-Water Reactor Power Plants", August 19, 1998 (Refs 2 & 3). The codes, methods, and techniques contained in the methodology are used to satisfy the k_{eff} criterion. The spent fuel storage racks were analyzed using Westinghouse 17x17 V5H fuel assemblies, with enrichments up to 4.95 ±0.05 w/o U-235 and configurations which take credit for checkerboarding, burnup, soluble boron, integral fuel burnable absorbers (such as IFBA or gadolinia), and cooling time to ensure that k_{eff} is maintained ≤ 0.95, including uncertainties, tolerances, and accident conditions. The analysis also accounts for the reactivity effects of operating the fuel with discrete burnable poisons (such as burnable poison rod absorbers or tritium producing burnable absorber rods). In addition, the SFP k_{eff} is maintained < 1.0, including uncertainties, tolerances on a 95/95 basis without any soluble boron. Calculations were performed to evaluate the reactivity of fuel types used at SQN. The results show that the Westinghouse 17x17 V5H fuel assembly exhibits the highest reactivity, thereby bounding all fuel types utilized and stored at SQN

In the high density Spent Fuel Rack design (Ref. 9), the spent fuel storage pool is divided into four separate and distinct regions which, for the purpose of criticality considerations, are considered as separate pools. For convenience of reference, the following definitions apply:

Type A fuel refers to spent fuel assemblies which have not contained tritium producing burnable absorber rods (TPBAR's) during in-core operation.

Type T fuel refers to spent fuel assemblies which have contained tritium producing burnable absorber rods (TPBAR's) during in-core operation.

Fresh fuel refers to unirradiated Type A or Type T fuel or irradiated Type A or Type T fuel which has not attained sufficient burnup to meet spent fuel requirements

Cooling time is defined as the period since reactor shutdown at the end of the last operating cycle for the discharged spent fuel assembly.

Region 1 is designed to accommodate fresh fuel with a maximum enrichment of 4.95 +/- 0.05 wt% U-235, or spent fuel regardless of the discharge burnup in a 1-of-4 checkerboard arrangement of 1 fresh assembly with 3 spent Type A fuel

BASES

BACKGROUND (continued)

assemblies with enrichment, burnup, and cooling times in accordance with Design Feature 5.6.1.1.c.1. Region 2 is designed to accommodate Type A or Type T fuel of up to 4.95 +/- 0.05 wt% U-235 initial enrichment burned to an assembly average burnup of at least 30.27 MWD/kgU for Type A fuel or 33.1095 MWD/kgU for Type T fuel, or other enrichment with a burnup yielding an equivalent reactivity in the fuel racks in accordance with Design Feature 5.6 1.1.c 2. Region 3 is designed to accommodate fresh fuel of up to 4 95 +/- 0 05 wt% U-235 initial enrichment, or fuel assemblies of any lower reactivity in a 2-of-4 checkerboard arrangement with water-filled cells in accordance with Design Feature 5.6 1.1.c.3. Region 4 is designed to accommodate fresh fuel up to 4.95 +/- 0 05 wt% U-235 initial enrichment, or spent fuel regardless of the discharge burnup in a 1-of-4 checkerboard arrangement of 1 fresh assembly with 3 spent Type T fuel assemblies with burnup and cooling times in accordance with Design Feature 5.6 1.1.c.4.

The water in the spent fuel storage pool normally contains soluble boron, which results in large subcriticality margins under actual operating conditions. However, the NRC guidelines, based upon the accident condition in which all soluble poison is assumed to have been lost, specify that the limiting k_{eff} of < 1.0 be evaluated in the absence of soluble boron Hence, the design of all regions is based on the use of unborated water, which maintains each region in a subcritical condition during normal operation with the regions fully loaded. The double contingency principle discussed in ANSI N-16.1-1975 and the April 1978 NRC letter (Ref. 5) allows credit for soluble boron under other abnormal or accident conditions, since only a single accident need be considered at one time. For example, the most severe accident scenario is associated with the accidental mishandling of a fresh fuel assembly face adjacent to a fresh fuel assembly of Region 3. This could potentially increase the criticality of Region 3. To mitigate these postulated criticality related accidents, boron is dissolved in the pool water. The soluble boron concentration required to maintain $k_{eff} \leq 0.95$ under normal conditions is 300 ppm and 700 ppm under the most severe postulated fuel mis-location accident. Safe operation of the spent fuel storage racks may therefore be achieved by controlling the location of each assembly in accordance with Design Features 5.6 FUEL STORAGE. During fuel movement, it is necessary to perform Surveillance Requirement 4.7.13.2.

APPLICABLE SAFETY ANALYSES

Most accident conditions do not result in an increase in the reactivity of any one of the three regions. Examples of these accident conditions are the loss of cooling and the dropping of a fuel assembly on the top of the rack. However, accidents can be postulated that could increase the reactivity. This increase in reactivity is unacceptable with unborated water in the storage pool. Thus, for these accident occurrences, the presence of soluble boron in the storage pool prevents criticality in all regions. The most limiting postulated accident with respect to the storage configurations assumed in the spent fuel rack

BASES

APPLICABLE SAFETY ANALYSES (continued)

criticality analysis is the misplacement of a nominal 4.95 ± 0 05 w/o U-235 fresh fuel assembly into an empty storage cell location in the Region 3 checkerboard storage arrangement. The amount of soluble boron required to maintain k_{eff} less than or equal to 0.95 due to this fuel misload accident is 700 ppm (Ref. 1 and Ref. 9)

A spent fuel boron dilution analysis was performed to ensure that sufficient time is available to detect and mitigate dilution of the spent fuel pool prior to exceeding the k_{eff} design basis limit of 0 95 (Ref. 6). The spent fuel pool boron dilution analysis concluded that an inadvertent or unplanned event that would result in a dilution of the spent fuel pool boron concentration from 2000 ppm to 700 ppm is not a credible event

The concentration of dissolved boron in the spent fuel storage pool satisfies Criterion 2 of the NRC Policy Statement.

LCO

The spent fuel storage pool boron concentration is required to be ≥ 2000 ppm. The specified concentration of dissolved boron in the spent fuel storage pool preserves the assumptions used in the analyses of the potential critical accident scenarios as described in Reference 7. This concentration of dissolved boron is the minimum required concentration for fuel assembly storage and movement within the spent fuel storage pool.

APPLICABILITY

This LCO applies whenever fuel assemblies are stored in the spent fuel storage pool.

ACTIONS

Action a

When the concentration of boron in the spent fuel storage pool is less than required, immediate action must be taken to preclude the occurrence of an accident or to mitigate the consequences of an accident in progress. This is most efficiently achieved by immediately suspending the movement of fuel assemblies. The concentration of boron is restored along with suspending movement of fuel assemblies.

Action a is modified by a provision indicating that LCO 3.0.3 does not apply. If the LCO is not met while moving irradiated fuel assemblies in MODE 5 or 6, LCO 3.0 3 would not be applicable. Moving irradiated fuel assemblies while in MODE 1, 2, 3, or 4 is independent of reactor operation. Therefore, inability to suspend movement of fuel assemblies is not sufficient reason to require a reactor shutdown.

BASES

SURVEILLANCE REQUIREMENTS

4 7 13 1

This Surveillance Requirement verifies that the concentration of boron in the spent fuel storage pool is within the required limit. As long as this Surveillance Requirement is met, the analyzed accidents are fully addressed. The 7 day Frequency is appropriate because no significant replenishment of pool water is expected to take place over such a short period of time. (Ref. 6)

4 7 13 2

This Surveillance Requirement verifies that the concentration of boron in the spent fuel storage pool is within the required limit during fuel movement until the final configuration of the assemblies in the storage racks is verified to be correct. As long as this Surveillance Requirement is met, the analyzed accidents are fully addressed The 72 hour Frequency provides additional assurance that the maximum k_{eff} remains below the 0.95 limit under the postulated accident condition (Ref. 1, 8, and 9)

REFERENCES

1. Stanley E. Turner (Holtec International), "Criticality Safety Analyses of Sequoyah Spent Fuel Racks with Alternative Arrangements," HI-992349

2. B.K. Grimes (NRC GL78011), "OT Position for Review and Acceptance of Spent Fuel Storage and Handling Applications", April 14, 1978

3. L. Kopp, "Guidance On The Regulatory Requirements For Criticality Analysis Of Fuel Storage At Light-Water Reactor Power Plants", August 19, 1998

4. UFSAR, Section 4.3 2.7, "Critically of Fuel Assemblies"

5. Double contingency principle of ANSI N16.1-1975, as specified in the April 14, 1978 NRC letter (Section 1.2) and implied in the proposed revision to Regulatory Guide 1.13 (Section 1.4, Appendix A).

6. K K Niyogi (Holtec International), "Boron Dilution Analysis," HI-992302

7. FSAR, Section 15 4.5

8. NRC letter to TVA dated August 1, 1990, " Increase Fuel Enrichment to 5.0 Weight Percent (TAC Nos. 76074, 76075, 76774, 76775) (TS 90-12) - Sequoyah Nuclear Plant, Units 1 and 2"

9. Stanley E. Turner (Holtec International, "Evaluation of the Effect of the Use of Tritium Producing Burnable Absorber Rods (TPBARS) on Fuel Storage Requirements," HI-2012629

PLANT SYSTEMS

BASES

3/4 7.14 CASK PIT POOL MINIMUM BORON CONCENTRATION

This specification is deleted.

Pages B3/4 7-14 through B3/4 7-15 are deleted.

(continued)