

APPENDIX A

CERTIFICATE OF COMPLIANCE NO. 9261, REVISION 2

MODEL NO. HI-STAR 100 SYSTEM

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Table A.1 (Page 1 of 19)
Fuel Assembly Limits

I. MPC MODEL: MPC-24

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

- a. Cladding type: ZR or stainless steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class
- b. Maximum initial enrichment: As specified in Table A.2 for the applicable fuel assembly array/class.
- c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly
 - i. ZR clad: An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
 - ii. SS clad: An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.6, as applicable.
- d. Decay heat per assembly:
 - i. ZR Clad: ≤ 833 Watts
 - ii. SS Clad: ≤ 488 Watts
- e. Fuel assembly length: ≤ 176.8 inches (nominal design)
- f. Fuel assembly width: ≤ 8.54 inches (nominal design)
- g. Fuel assembly weight: $\leq 1,680$ lbs

B. Quantity per MPC: Up to 24 PWR fuel assemblies.

C. Fuel assemblies shall not contain non-fuel hardware or neutron sources.

D. Damaged fuel assemblies and fuel debris are not authorized for transport in the MPC-24.

E. Trojan plant fuel is not permitted to be transported in the MPC-24.

Table A.1 (Page 2 of 19)
Fuel Assembly Limits

II. MPC MODEL: MPC-68

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies listed in Table A.3, with or without Zircaloy channels, and meeting the following specifications:

- | | |
|--|---|
| a. Cladding type: | ZR or stainless steel (SS) as specified in Table A.3 for the applicable fuel assembly array/class. |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | |
| i. ZR clad: | An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.7, except for (1) array/class 6x6A, 6x6C, 7x7A, and 8x8A fuel assemblies, which shall have a cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U , and (2) array/class 8x8F fuel assemblies, which shall have a cooling time ≥ 10 years, an average burnup $\leq 27,500$ MWD/MTU, and a minimum initial enrichment ≥ 2.4 wt% ^{235}U . |
| ii. SS clad: | An assembly cooling time after discharge ≥ 16 years, an average burnup $\leq 22,500$ MWD/MTU, and a minimum initial enrichment ≥ 3.5 wt% ^{235}U . |
| e. Decay heat per assembly: | |
| i. ZR Clad: | ≤ 272 Watts, except for array/class 8X8F fuel assemblies, which shall have a decay heat ≤ 183.5 Watts. |
| ii. SS Clad: | ≤ 83 Watts |
| f. Fuel assembly length: | ≤ 176.2 inches (nominal design) |
| g. Fuel assembly width: | ≤ 5.85 inches (nominal design) |
| h. Fuel assembly weight: | ≤ 700 lbs, including channels |

Table A.1 (Page 3 of 19)
 Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|--|---|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ²³⁵ U. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels and damaged fuel container |

Table A.1 (Page 4 of 19)
 Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

3. Mixed oxide (MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for fuel assembly array/class 6x6B. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for fuel assembly array/class 6x6B. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 400 lbs, including channels |

Table A.1 (Page 5 of 19)
 Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

4. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for array/class 6x6B. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for array/class 6x6B. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels |

Table A.1 (Page 6 of 19)
Fuel Assembly Limits

II. MPC MODEL: MPC-68 (continued)

A. Allowable Contents (continued)

5. Thoria rods (ThO₂ and UO₂) placed in Dresden Unit 1 Thoria Rod Canisters (as shown in Figure 1.2.11A of the HI-STAR 100 System SAR, Revision 10) and meeting the following specifications:

- | | |
|---|---|
| a. Cladding type: | ZR |
| b. Composition: | 98.2 wt.% ThO ₂ , 1.8 wt. % UO ₂ with an enrichment of 93.5 wt. % ²³⁵ U. |
| c. Number of rods per Thoria Rod Canister: | ≤ 18 |
| d. Decay heat per Thoria Rod Canister: | ≤ 115 Watts |
| e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister: | A fuel post-irradiation cooling time ≥ 18 years and an average burnup ≤ 16,000 MWD/MTIHM. |
| f. Initial heavy metal weight: | ≤ 27 kg/canister |
| g. Fuel cladding O.D.: | ≥ 0.412 inches |
| h. Fuel cladding I.D.: | ≤ 0.362 inches |
| i. Fuel pellet O.D.: | ≤ 0.358 inches |
| j. Active fuel length: | ≤ 111 inches |
| k. Canister weight: | ≤ 550 lbs, including fuel |

B. Quantity per MPC: Up to one (1) Dresden Unit 1 Thoria Rod Canister plus any combination of damaged fuel assemblies in damaged fuel containers and intact fuel assemblies, up to a total of 68.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C, or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68. The Antimony-Beryllium source material shall be in a water rod location.

Table A.1 (Page 7 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F

A. Allowable Contents

1. Uranium oxide, BWR intact fuel assemblies, with or without Zircaloy channels. Uranium oxide BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A and meet the following specifications:
 - a. Cladding type: ZR
 - b. Maximum planar-average initial enrichment: As specified in Table A.3 for the applicable fuel assembly array/class.
 - c. Initial maximum rod enrichment: As specified in Table A.3 for the applicable fuel assembly array/class.
 - d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U .
 - e. Fuel assembly length: ≤ 176.2 inches (nominal design)
 - f. Fuel assembly width: ≤ 5.85 inches (nominal design)
 - g. Fuel assembly weight: ≤ 400 lbs, including channels

Table A.1 (Page 8 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

2. Uranium oxide, BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. Uranium oxide BWR damaged fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for the applicable fuel assembly array/class. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U . |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels |

Table A.1 (Page 9 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

3. Uranium oxide, BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the uranium oxide BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6A, 6x6C, 7x7A, or 8x8A, and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for the applicable original fuel assembly array/class. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for the applicable original fuel assembly array/class. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTU, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the original fuel assembly. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels |

Table A.1 (Page 10 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

4. Mixed oxide(MOX), BWR intact fuel assemblies, with or without Zircaloy channels. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for fuel assembly array/class 6x6B. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for fuel assembly array/class 6x6B. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 400 lbs, including channels |

Table A.1 (Page 11 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

5. Mixed oxide (MOX), BWR damaged fuel assemblies, with or without Zircaloy channels, placed in damaged fuel containers. MOX BWR intact fuel assemblies shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for array/class 6x6B. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for array/class 6x6B. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels |

Table A.1 (Page 12 of 19)
 Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

6. Mixed oxide (MOX), BWR fuel debris, with or without Zircaloy channels, placed in damaged fuel containers. The original fuel assemblies for the MOX BWR fuel debris shall meet the criteria specified in Table A.3 for fuel assembly array/class 6x6B and meet the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum planar-average initial enrichment: | As specified in Table A.3 for original fuel assembly array/class 6x6B. |
| c. Initial maximum rod enrichment: | As specified in Table A.3 for original fuel assembly array/class 6x6B. |
| d. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time ≥ 18 years, an average burnup $\leq 30,000$ MWD/MTIHM, and a minimum initial enrichment ≥ 1.8 wt% ^{235}U for the UO_2 rods in the original fuel assembly. |
| e. Fuel assembly length: | ≤ 135.0 inches (nominal design) |
| f. Fuel assembly width: | ≤ 4.70 inches (nominal design) |
| g. Fuel assembly weight: | ≤ 550 lbs, including channels |

Table A.1 (Page 13 of 19)
Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

A. Allowable Contents (continued)

7. Thoria rods (ThO_2 and UO_2) placed in Dresden Unit 1 Thoria Rod Canisters (as shown in Figure 1.2.11A of the HI-STAR 100 System SAR, Revision 10) and meeting the following specifications:

- | | |
|---|---|
| a. Cladding Type: | ZR |
| b. Composition: | 98.2 wt. % ThO_2 , 1.8 wt. % UO_2 with an enrichment of 93.5 wt. % ^{235}U . |
| c. Number of rods per Thoria Rod Canister: | ≤ 18 |
| d. Decay heat per Thoria Rod Canister: | ≤ 115 Watts |
| e. Post-irradiation fuel cooling time and average burnup per Thoria Rod Canister: | A fuel post-irradiation cooling time ≥ 18 years and an average burnup $\leq 16,000$ MWD/MTIHM. |
| f. Initial heavy metal weight: | ≤ 27 kg/canister |
| g. Fuel cladding O.D.: | ≥ 0.412 inches |
| h. Fuel cladding I.D.: | ≤ 0.362 inches |
| i. Fuel pellet O.D.: | ≤ 0.358 inches |
| j. Active fuel length: | ≤ 111 inches |
| k. Canister weight: | ≤ 550 lbs, including fuel |

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Fuel Assembly Limits

III. MPC MODEL: MPC-68F (continued)

B. Quantity per MPC:

Up to four (4) damaged fuel containers containing uranium oxide or MOX BWR fuel debris. The remaining MPC-68F fuel storage locations may be filled with array/class 6x6A, 6x6B, 6x6C, 7x7A, and 8x8A fuel assemblies of the following type, as applicable:

1. Uranium oxide BWR intact fuel assemblies;
2. MOX BWR intact fuel assemblies;
3. Uranium oxide BWR damaged fuel assemblies placed in damaged fuel containers;
4. MOX BWR damaged fuel assemblies placed in damaged fuel containers; or
5. Up to one (1) Dresden Unit 1 Thoria Rod Canister.

C. Fuel assemblies with stainless steel channels are not authorized for loading in the MPC-68F.

D. Dresden Unit 1 fuel assemblies (fuel assembly array/class 6x6A, 6x6B, 6x6C or 8x8A) with one Antimony-Beryllium neutron source are authorized for loading in the MPC-68F. The Antimony-Beryllium neutron source material shall be in a water rod location.

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Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:

- | | |
|---|--|
| a. Cladding type: | ZR or stainless steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class |
| b. Maximum initial enrichment: | As specified in Table A.2 for the applicable fuel assembly array/class. |
| c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly | |
| i. ZR clad: | Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable. |
| ii. SS clad: | An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.6, as applicable. |
| iii Trojan plant fuel | An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.8. |
| iv Trojan plant non-fuel hardware and neutron sources | Post-irradiation cooling time, and average burnup as specified in Table A.9 |
| d. Decay heat per assembly | |
| i. ZR Clad: | Except for Trojan plant fuel, decay heat \leq 833 Watts. Trojan plant fuel decay heat: \leq 725 Watts |
| ii. SS Clad: | \leq 488 Watts |
| e. Fuel assembly length: | \leq 176.8 inches (nominal design) |
| f. Fuel assembly width: | \leq 8.54 inches (nominal design) |
| g. Fuel assembly weight: | \leq 1,680 lbs, including non-fuel hardware and neutron sources |

Table A.1 (Page 16 of 19)
Fuel Assembly Limits

IV. MPC MODEL: MPC-24E

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

- | | |
|---|--|
| a. Cladding type: | ZR |
| b. Maximum initial enrichment: | 3.7% ²³⁵ U |
| c. Fuel assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly | An assembly post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8

Decay Heat: ≤ 725 Watts |
| d. Fuel assembly length: | ≤ 169.3 inches (nominal design) |
| e. Fuel assembly width: | ≤ 8.43 inches (nominal design) |
| f. Fuel assembly weight: | ≤ 1,680 lbs, including DFC or Failed Fuel Can |

- B. Quantity per MPC: Up to 24 PWR intact fuel assemblies. For Trojan plant fuel only, up to four (4) damaged fuel assemblies may be stored in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24E fuel storage locations may be filled with Trojan plant intact fuel assemblies.
- C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.
- D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware or neutron sources. Trojan intact fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.
- E. Trojan plant damaged fuel assemblies must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan Plant fuel.
- F. One (1) Trojan plant Sb-Be and /or up to two (2) Cf neutron sources in a Trojan plant intact fuel assembly (one source fuel assembly) may be transported in any one MPC. Each fuel assembly neutron source may be transported in any fuel storage location.
- G. Fuel debris is not authorized for transport in the MPC-24E.
- H. Trojan plant non-fuel hardware and neutron sources may not be transported in the same fuel storage location as a damaged fuel assembly.

Table A.1 (Page 17 of 19)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents

1. Uranium oxide, PWR intact fuel assemblies listed in Table A.2 and meeting the following specifications:
 - a. Cladding type: ZR or stainless steel (SS) as specified in Table A.2 for the applicable fuel assembly array/class.
 - b. Maximum initial enrichment: As specified in Table A.2 for the applicable fuel assembly array/class.
 - c. Post-irradiation cooling time, average burnup, and minimum initial enrichment per assembly
 - i. ZR clad: Except for Trojan plant fuel, an assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.4 or A.5, as applicable.
 - ii. SS clad: An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.6, as applicable.
 - iii Trojan plant fuel: An assembly post-irradiation cooling time, average burnup, and minimum initial enrichment as specified in Table A.8.
 - iv Trojan plant non-fuel hardware and neutron sources: Post-irradiation cooling time, and average burnup as specified in Table A.9.
 - d. Decay heat per assembly:
 - a. ZR Clad: Except for Trojan plant fuel, decay heat ≤ 833 Watts. Trojan plant fuel decay heat: ≤ 725 Watts.
 - b. SS Clad: ≤ 488 Watts
 - e. Fuel assembly length: ≤ 176.8 inches (nominal design)
 - f. Fuel assembly width: ≤ 8.54 inches (nominal design)
 - g. Fuel assembly weight: $\leq 1,680$ lbs, including non-fuel hardware and neutron sources.

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Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

2. Trojan plant damaged fuel assemblies meeting the applicable criteria listed in Table A.2 and meeting the following specifications:

- | | |
|--|--|
| a. Cladding type: | ZR |
| b. Maximum initial enrichment: | 3.7% ²³⁵ U |
| c. Fuel assembly post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly: | An assembly post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8.

Decay Heat: \leq 725 Watts |
| d. Fuel assembly length: | \leq 169.3 inches (nominal design) |
| e. Fuel assembly width: | \leq 8.43 inches (nominal design) |
| f. Fuel assembly weight: | \leq 1,680 lbs, including DFC or Failed Fuel Can. |

- B. Quantity per MPC: Up to 24 PWR intact fuel assemblies. For Trojan plant fuel only, up to four (4) damaged fuel assemblies may be stored in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24EF fuel storage locations may be filled with Trojan plant intact fuel assemblies.
- C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.
- D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware or neutron sources. Trojan intact fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.
- E. Trojan plant damaged fuel assemblies must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan Plant fuel.
- F. One (1) Trojan plant Sb-Be and /or up to two (2) Cf neutron sources in a Trojan plant intact fuel assembly (one source fuel assembly) may be transported in any one MPC. Each fuel assembly neutron source may be transported in any fuel storage location.
- G. Trojan plant non-fuel hardware and neutron sources may not be transported in the same fuel storage location as a damaged fuel assembly.

Table A.1 (Page 19 of 19)
Fuel Assembly Limits

V. MPC MODEL: MPC-24EF

A. Allowable Contents (continued)

3. Trojan Fuel Debris Process Can Capsules and/or Trojan plant fuel assemblies classified as fuel debris, for which the original fuel assemblies meet the applicable criteria listed in Table A.2 and meet the following specifications:

- | | |
|--|---|
| a. Cladding type: | ZR |
| b. Maximum initial enrichment: | 3.7% ²³⁵ U |
| c. Fuel debris post-irradiation cooling time, average burnup, decay heat, and minimum initial enrichment per assembly: | Post-irradiation cooling time, average burnup, and initial enrichment as specified in Table A.8.
Decay Heat: ≤ 725 Watts |
| d. Fuel assembly length: | ≤ 169.3 inches (nominal design) |
| e. Fuel assembly width: | ≤ 8.43 inches (nominal design) |
| f. Fuel assembly weight: | ≤ 1,680 lbs, including DFC or Failed Fuel Can. |

- B. Quantity per MPC: Up to 24 PWR intact fuel assemblies. For Trojan plant fuel only, up to four (4) damaged fuel assemblies, fuel assemblies classified as fuel debris, and/or Trojan Fuel Debris Process Can Capsules may be stored in fuel storage locations 3, 6, 19, and/or 22. The remaining MPC-24EF fuel storage locations may be filled with Trojan plant intact fuel assemblies.
- C. Trojan plant fuel must be transported in the custom-designed Trojan MPCs with the MPC spacer installed. Fuel from other plants is not permitted to be transported in the Trojan MPCs.
- D. Except for Trojan plant fuel, the fuel assemblies shall not contain non-fuel hardware or neutron sources. Trojan intact fuel assemblies containing non-fuel hardware may be transported in any fuel storage location.
- E. Trojan plant damaged fuel assemblies, fuel assemblies classified as fuel debris, and Fuel Debris Process Can Capsules must be transported in a Trojan Failed Fuel Can or a Holtec damaged fuel container designed for Trojan Plant fuel.
- F. One (1) Trojan plant Sb-Be and /or up to two (2) Cf neutron sources in a Trojan plant intact fuel assembly (one source fuel assembly) may be transported in any one MPC. Each fuel assembly neutron source may be transported in any fuel storage location.
- G. Trojan plant non-fuel hardware and neutron sources may not be transported in the same fuel storage location as a damaged fuel assembly.

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Table A.2 (Page 1 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	14x14A	14x14B	14x14C	14x14D	14x14E
Clad Material (Note 2)	ZR	ZR	ZR	SS	Zr
Design Initial U (kg/assy.) (Note 3)	≤ 407	≤ 407	≤ 425	≤ 400	≤ 206
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ²³⁵ U)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.0 (24) ≤ 5.0 (24E/EF)	≤ 5.0
No. of Fuel Rod Locations	179	179	176	180	173
Fuel Clad O.D. (in.)	≥ 0.400	≥ 0.417	≥ 0.440	≥ 0.422	≥ 0.3415
Fuel Clad I.D. (in.)	≤ 0.3514	≤ 0.3734	≤ 0.3880	≤ 0.3890	≤ 0.3175
Fuel Pellet Dia. (in.)	≤ 0.3444	≤ 0.3659	≤ 0.3805	≤ 0.3835	≤ 0.3130
Fuel Rod Pitch (in.)	≤ 0.556	≤ 0.556	≤ 0.580	≤ 0.556	Note 6
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 144	≤ 102
No. of Guide Tubes	17	17	5 (Note 4)	16	0
Guide Tube Thickness (in.)	≥ 0.017	≥ 0.017	≥ 0.038	≥ 0.0145	N/A

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Table A.2 (Page 2 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	15x15A	15x15B	15x15C	15x15D	15x15E	15x15F
Clad Material (Note 2)	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 464	≤ 464	≤ 464	≤ 475	≤ 475	≤ 475
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ²³⁵ U)	≤ 4.1 (24) ≤ 4.5 (24E/EF)					
No. of Fuel Rod Locations	204	204	204	208	208	208
Fuel Clad O.D. (in.)	≥ 0.418	≥ 0.420	≥ 0.417	≥ 0.430	≥ 0.428	≥ 0.428
Fuel Clad I.D. (in.)	≤ 0.3660	≤ 0.3736	≤ 0.3640	≤ 0.3800	≤ 0.3790	≤ 0.3820
Fuel Pellet Dia. (in.)	≤ 0.3580	≤ 0.3671	≤ 0.3570	≤ 0.3735	≤ 0.3707	≤ 0.3742
Fuel Rod Pitch (in.)	≤ 0.550	≤ 0.563	≤ 0.563	≤ 0.568	≤ 0.568	≤ 0.568
Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	21	21	17	17	17
Guide/Instrument Tube Thickness (in.)	≥ 0.015	≥ 0.015	≥ 0.0165	≥ 0.0150	≥ 0.0140	≥ 0.0140

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Table A.2 (Page 3 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/ Class	15x15G	15x15H	16x16A	17x17A	17x17B	17x17C
Clad Material (Note 2)	SS	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 420	≤ 475	≤ 443	≤ 467	≤ 467	≤ 474
Initial Enrichment (MPC-24, 24E, and 24EF) (wt % ²³⁵ U)	≤ 4.0 (24) ≤ 4.5 (24E/EF)	≤ 3.8 (24) ≤ 4.2 (24E/EF)	≤ 4.6 (24) ≤ 5.0 (24E/EF)	≤ 4.0 (24) ≤ 4.4 (24E/EF)	≤ 4.0 (24) ≤ 4.4 (24E/EF) (Note 7)	≤ 4.0 (24) ≤ 4.4 (24E/EF)
No. of Fuel Rod Locations	204	208	236	264	264	264
Fuel Clad O.D. (in.)	≥ 0.422	≥ 0.414	≥ 0.382	≥ 0.360	≥ 0.372	≥ 0.377
Fuel Clad I.D. (in.)	≤ 0.3890	≤ 0.3700	≤ 0.3320	≤ 0.3150	≤ 0.3310	≤ 0.3330
Fuel Pellet Dia. (in.)	≤ 0.3825	≤ 0.3622	≤ 0.3255	≤ 0.3088	≤ 0.3232	≤ 0.3252
Fuel Rod Pitch (in.)	≤ 0.563	≤ 0.568	≤ 0.506	≤ 0.496	≤ 0.496	≤ 0.502
Active Fuel Length (in.)	≤ 144	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Guide and/or Instrument Tubes	21	17	5 (Note 4)	25	25	25
Guide/Instrument Tube Thickness (in.)	≥ 0.0145	≥ 0.0140	≥ 0.0400	≥ 0.016	≥ 0.014	≥ 0.020

Table A.2 (Page 4 of 4)
PWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.
2. ZR Designates cladding material made of Zirconium or Zirconium alloys.
3. Design initial uranium weight is the nominal uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each PWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 2.0 percent for comparison with users' fuel records to account for manufacturer tolerances.
4. Each guide tube replaces four fuel rods.
5. Later
6. This fuel assembly array/class includes only the Indian Point Unit 1 fuel assembly. This fuel assembly has two pitches in different sectors of the assembly. These pitches are 0.441 inches and 0.453 inches
7. Trojan plant-specific fuel is governed by the limits specified for array/class 17x17B and will be transported in the custom-designed Trojan MPC-24E/EF canisters. The Trojan MPC-24E/EF design is authorized to transport only Trojan plant fuel with a maximum initial enrichment of 3.7 wt.% ²³⁵U.

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Table A.3 (Page 1 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	6x6A	6x6B	6x6C	7x7A	7x7B	8x8A
Clad Material (Note 2)	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 110	≤ 110	≤ 110	≤ 100	≤ 195	≤ 120
Maximum planar-average initial enrichment (wt. % ²³⁵ U)	≤ 2.7	≤ 2.7 for the UO ₂ rods. See Note 4 for MOX rods	≤ 2.7	≤ 2.7	≤ 4.2	≤ 2.7
Initial Maximum Rod Enrichment (wt. % ²³⁵ U)	≤ 4.0	≤ 4.0	≤ 4.0	≤ 5.5	≤ 5.0	≤ 4.0
No. of Fuel Rod Locations	35 or 36	35 or 36 (up to 9 MOX rods)	36	49	49	63 or 64
Fuel Clad O.D. (in.)	≥ 0.5550	≥ 0.5625	≥ 0.5630	≥ 0.4860	≥ 0.5630	≥ 0.4120
Fuel Clad I.D. (in.)	≤ 0.5105	≤ 0.4945	≤ 0.4990	≤ 0.4204	≤ 0.4990	≤ 0.3620
Fuel Pellet Dia. (in.)	≤ 0.4980	≤ 0.4820	≤ 0.4880	≤ 0.4110	≤ 0.4910	≤ 0.3580
Fuel Rod Pitch (in.)	≤ 0.710	≤ 0.710	≤ 0.740	≤ 0.631	≤ 0.738	≤ 0.523
Active Fuel Length (in.)	≤ 120	≤ 120	≤ 77.5	≤ 80	≤ 150	≤ 120
No. of Water Rods (Note 11)	1 or 0	1 or 0	0	0	0	1 or 0
Water Rod Thickness (in.)	≥ 0	≥ 0	N/A	N/A	N/A	≥ 0
Channel Thickness (in.)	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.060	≤ 0.120	≤ 0.100

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Table A.3 (Page 2 of 5)
 BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	8x8B	8x8C	8x8D	8x8E	8x8F	9x9A
Clad Material (Note 2)	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 185	≤ 185	≤ 185	≤ 185	≤ 185	≤ 177
Maximum planar-average initial enrichment (wt. % ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.2	< 4.0	≤ 4.2
Initial Maximum Rod Enrichment (wt. % ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	63 or 64	62	60 or 61	59	64	74/66 (Note 5)
Fuel Clad O.D. (in.)	≥ 0.4840	≥ 0.4830	≥ 0.4830	≥ 0.4930	≥ 0.4576	≥ 0.4400
Fuel Clad I.D. (in.)	≤ 0.4295	≤ 0.4250	0.4230	≤ 0.4250	≤ 0.3996	≤ 0.3840
Fuel Pellet Dia. (in.)	≤ 0.4195	≤ 0.4160	≤ 0.4140	≤ 0.4160	≤ 0.3913	≤ 0.3760
Fuel Rod Pitch (in.)	≤ 0.642	≤ 0.641	≤ 0.640	≤ 0.640	≤ 0.609	≤ 0.566
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 or 0	2	1 - 4 (Note 7)	5	N/A (Note 12)	2
Water Rod Thickness (in.)	≥ 0.034	> 0.00	> 0.00	≥ 0.034	≥ 0.0315	> 0.00
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.120	≤ 0.100	≤ 0.055	≤ 0.120

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Table A.3 (Page 3 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	9x9B	9x9C	9x9D	9x9E (Note 13)	9x9F (Note 13)	9x9G
Clad Material (Note 2)	ZR	ZR	ZR	ZR	ZR	ZR
Design Initial U (kg/assy.) (Note 3)	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177	≤ 177
Maximum planar-average initial enrichment (wt. % ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0	≤ 4.2
Initial Maximum Rod Enrichment (wt. % ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rods	72	80	79	76	76	72
Fuel Clad O.D. (in.)	≥ 0.4330	≥ 0.4230	≥ 0.4240	≥ 0.4170	≥ 0.4430	≥ 0.4240
Fuel Clad I.D. (in.)	≤ 0.3810	≤ 0.3640	≤ 0.3640	≤ 0.3640	≤ 0.3860	≤ 0.3640
Fuel Pellet Dia. (in.)	≤ 0.3740	≤ 0.3565	≤ 0.3565	≤ 0.3530	≤ 0.3745	≤ 0.3565
Fuel Rod Pitch (in.)	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572	≤ 0.572
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150	≤ 150
No. of Water Rods (Note 11)	1 (Note 6)	1	2	5	5	1 (Note 6)
Water Rod Thickness (in.)	> 0.00	≥ 0.020	≥ 0.0300	≥ 0.0120	≥ 0.0120	≥ 0.0320
Channel Thickness (in.)	≤ 0.120	≤ 0.100	≤ 0.100	≤ 0.120	≤ 0.120	≤ 0.120

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Table A.3 (Page 4 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Fuel Assembly Array/Class	10x10A	10x10B	10x10C	10x10D	10x10E
Clad Material (Note 2)	ZR	ZR	ZR	SS	SS
Design Initial U (kg/assy.) (Note 3)	≤ 186	≤ 186	≤ 186	≤ 125	≤ 125
Maximum planar-average initial enrichment (wt. % ²³⁵ U)	≤ 4.2	≤ 4.2	≤ 4.2	≤ 4.0	≤ 4.0
Initial Maximum Rod Enrichment (wt. % ²³⁵ U)	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0	≤ 5.0
No. of Fuel Rod Locations	92/78 (Note 8)	91/83 (Note 9)	96	100	96
Fuel Clad O.D. (in.)	≥ 0.4040	≥ 0.3957	≥ 0.3780	≥ 0.3960	≥ 0.3940
Fuel Clad I.D. (in.)	≤ 0.3520	≤ 0.3480	≤ 0.3294	≤ 0.3560	≤ 0.3500
Fuel Pellet Dia. (in.)	≤ 0.3455	≤ 0.3420	≤ 0.3224	≤ 0.3500	≤ 0.3430
Fuel Rod Pitch (in.)	≤ 0.510	≤ 0.510	≤ 0.488	≤ 0.565	≤ 0.557
Design Active Fuel Length (in.)	≤ 150	≤ 150	≤ 150	≤ 83	≤ 83
No. of Water Rods (Note 11)	2	1 (Note 6)	5 (Note 10)	0	4
Water Rod Thickness (in.)	≥ 0.0300	> 0.00	≥ 0.031	N/A	≥ 0.022
Channel Thickness (in.)	≤ 0.120	≤ 0.120	≤ 0.055	≤ 0.080	≤ 0.080

Table A.3 (Page 5 of 5)
BWR FUEL ASSEMBLY CHARACTERISTICS (Note 1)

Notes:

1. All dimensions are design nominal values. Maximum and minimum dimensions are specified to bound variations in design nominal values among fuel assemblies within a given array/class.
2. ZR designates cladding material made from Zirconium or Zirconium alloys.
3. Design initial uranium weight is the uranium weight specified for each assembly by the fuel manufacturer or reactor user. For each BWR fuel assembly, the total uranium weight limit specified in this table may be increased up to 1.5% for comparison with users' fuel records to account for manufacturer's tolerances.
4. ≤ 0.635 wt. % ^{235}U and ≤ 1.578 wt. % total fissile plutonium (^{239}Pu and ^{241}Pu), (wt. % of total fuel weight, i.e., UO_2 plus PuO_2).
5. This assembly class contains 74 total fuel rods; 66 full length rods and 8 partial length rods.
6. Square, replacing nine fuel rods.
7. Variable
8. This assembly class contains 92 total fuel rods; 78 full length rods and 14 partial length rods.
9. This assembly class contains 91 total fuel rods, 83 full length rods and 8 partial length rods.
10. One diamond-shaped water rod replacing the four center fuel rods and four rectangular water rods dividing the assembly into four quadrants.
11. These rods may be sealed at both ends and contain Zr material in lieu of water.
12. This assembly is known as "QUAD+" and has four rectangular water cross segments dividing the assembly into four quadrants.
13. For the SPC 9x9-5 fuel assembly, each fuel rod must meet either the 9x9E or 9x9F set of limits for clad O.D., clad I.D., and pellet diameter.

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Table A.4

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24/EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH NON-ZIRCALOY IN-CORE GRID SPACERS

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 9	≤ 24,500	≥ 2.3
≥ 11	≤ 29,500	≥ 2.6
≥ 13	≤ 34,500	≥ 2.9
≥ 15	≤ 39,500	≥ 3.2
> 18	< 44,500	> 3.4

Table A.5

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH ZIRCALOY CLAD AND
WITH ZIRCALOY IN-CORE GRID SPACERS

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 6	≤ 24,500	≥ 2.3
≥ 7	≤ 29,500	≥ 2.6
≥ 9	≤ 34,500	≥ 2.9
≥ 11	≤ 39,500	≥ 3.2
≥ 14	≤ 44,500	≥ 3.4

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Table A.6

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-24/24E/24EF PWR FUEL WITH STAINLESS STEEL CLAD

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 19	$\leq 30,000$	≥ 3.1
> 24	$< 40,000$	> 3.1

Table A.7

FUEL ASSEMBLY COOLING, AVERAGE BURNUP, AND MINIMUM ENRICHMENT
MPC-68

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt. % U-235)
≥ 8	$\leq 24,500$	≥ 2.1
≥ 9	$\leq 29,500$	≥ 2.4
≥ 11	$\leq 34,500$	≥ 2.6
≥ 14	$\leq 39,500$	≥ 2.9
> 19	$\leq 39,100$	> 2.9

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Table A.8

TROJAN PLANT FUEL ASSEMBLY COOLING, AVERAGE BURNUP,
AND MINIMUM ENRICHMENT LIMITS (Note 1)

Post-irradiation Cooling Time (years)	Assembly Burnup (MWD/MTU)	Assembly Minimum Enrichment (wt.% ²³⁵U)
≥ 16	≤ 42,000	≥ 3.09
≥ 16	≤ 37,500	≥ 2.6
≥ 16	≤ 30,000	≥ 2.1

NOTES:

1. Each fuel assembly must only meet one set of limits (i.e., one row)

Table A.9

TROJAN PLANT NON-FUEL HARDWARE AND NEUTRON SOURCES
COOLING AND BURNUP LIMITS

Type of Hardware or Neutron Source	Burnup (MWD/MTU)	Post-irradiation Cooling Time (Years)
BPRAs	≤ 15,998	≥ 24
TPDs	≤ 118,674	≥ 11
RCCAs	≤ 125,515	≥ 9
Cf neutron source	≤ 15,998	≥ 24
Sb-Be neutron source with 4 source rods, 16 burnable poison rods, and 4 thimble plug rods	≤ 45,361	≥ 19
Sb-Be neutron source with 4 source rods, 20 thimble plug rods	≤ 88,547	≥ 9

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REFERENCES:

Holtec International Report No. HI-951251, *Safety Analysis Report for the Holtec International Storage, Transport, And Repository Cask System (HI-STAR 100 Cask System)*, Revision 10, dated August 21, 2003.