in the vicinity of the transfer lid or pool lid. For example, if the missile shield was a 2 inch thick steel plate, the gamma dose rate would be reduced by approximately 90%.

The dose to any real individual at or beyond the controlled area boundary is required to be below 25 mrem per year. The minimum distance to the controlled area boundary is 100 meters from the ISFSI. As mentioned, only the MPC-24 was used in the calculation of the dose rates at the controlled area boundary. Table 5.1.9 presents the annual dose to an individual from a single HI-STORM 100S Version B cask and various storage cask arrays, assuming an 8760 hour annual occupancy at the dose point location. The minimum distance required for the corresponding dose is also listed. These values were ~~conservatively~~ calculated for a burnup of 60,000 MWD/MTU and a 3-year cooling time. In addition, the annual dose was calculated for a burnup of 45,000 MWD/MTU with a corresponding cooling time of 9 years. BPRAs were included in these dose estimates. Additionally, Section 5.4.11 shows the annual dose results for the limiting contents, which encompass all allowable fuel burnups and cooling times from Section 2.1.9 permitted for these canisters. It is noted that these data are provided for illustrative purposes only. A detailed site-specific evaluation of dose at the controlled area boundary must be performed for each ISFSI in accordance with 10CFR72.212. The site-specific evaluation will consider dose from other portions of the facility and will consider the actual conditions of the fuel being stored (burnup and cooling time). For guidance on fuel parameters for site-specific analyses see Subsection 5.2.5.4.

Figure 5.1.3 is an annual dose versus distance graph for the HI-STORM 100 cask array configurations provided in Table 5.1.9. This curve, which is based on an 8760 hour occupancy, is provided for illustrative purposes only and will be re-evaluated on a site-specific basis.

Section 5.2 lists the gamma and neutron sources for the design basis fuels. Since the source strengths of the GE 6x6 intact and damaged fuel and the GE 6x6 MOX fuel are significantly smaller in all energy groups than the intact design basis fuel source strengths, the dose rates from the GE 6x6 fuels for normal conditions are bounded by the MPC-68 analysis with the design basis intact fuel. Therefore, no explicit analysis of the MPC-68 with either GE 6x6 intact or damaged or GE 6x6 MOX fuel for normal conditions is required to demonstrate that the MPC-68 with GE 6x6 fuels will meet the normal condition regulatory requirements. Section 5.4.2 evaluates the effect of generic damaged fuel in the MPC-24E, MPC-32 and the MPC-68.

Section 5.2.6 lists the gamma and neutron sources from the Dresden Unit 1 Thoria rod canister and demonstrates that the Thoria rod canister is bounded by the design basis Dresden Unit 1 6x6 intact fuel.

Section 5.2.4 presents the Co-60 sources from the BPRAs, TPDs, CRAs and APSRs that are permitted for storage in the HI-STORM 100 System. Section 5.4.6 discusses the increase in dose rate as a result of adding non-fuel hardware in the MPCs.

Section 5.4.7 demonstrates that the Dresden Unit 1 fuel assemblies containing antimony-beryllium neutron sources are bounded by the shielding analysis presented in this section.

5.4.11 Limiting Content Evaluation

5.4.11.1 General

As discussed in Section 5.1, results are presented for the representative burnup and cooling times that result in radial dose rates consistent with the dose limits selected for ALARA purposes. The additional shielding calculations in this section are performed to illustrate the maximum dose rates for the HI-STORM 100 System under normal conditions, when loaded with the limiting contents specified in Section 2.1.9. Specifically, all allowable fuel burnups and cooling times from Section 2.1.9 permitted for the MPC-24, MPC-32 and MPC-68 canisters are evaluated, and the maximum possible dose rate over the entire range of qualified content is determined separately for each relevant dose location. Note that the maximum dose rate at different locations may be from different burnup and cooling time combinations. Hence the reported maximum dose rates for all principal locations may not be from a single burnup and cooling time combination out of the set. The initial enrichments used in the analysis are discussed in Section 5.4.11.2.

In order to perform a bounding shielding analysis, all burnups and cooling time combinations are analyzed in the HI-STORM 100S Version B overpack and 100-ton HI-TRAC transfer cask, which produce higher dose rates. The calculations are performed using the MCNP5-1.51 code and the source terms determined by the TRITON/ORIGAMI sequence from SCALE 6.2.1.

Results of the calculations, showing only total dose rates for all relevant surface and 1 m dose locations, are summarized and compared in Tables 5.4.21 and 5.4.22. Table 5.4.23 presents the annual dose to an individual from a single HI-STORM 100S Version B cask and various storage cask arrays at or beyond the controlled area boundary as well as the minimum distance required for the corresponding dose, assuming 100% annual occupancy (8760 hours) and the conservative top surface contribution of 10%. The dose rates presented for the MPC-24 and MPC-32 canisters include the contribution from BPRAs. The results and comparisons show that for bounding content, the external dose rates would be unacceptably high, justifying the introduction of the dose limit. However, these are just examples provided to the users of the system, the only formal restriction is the dose rate limits on the outside of the casks. It should be noted that bounding content is used in the analysis of the accident conditions in Section 5.1, to avoid any complication in showing compliance with the corresponding regulatory requirements. Hence additional site specific evaluations for accident conditions are not required.

5.4.11.2 Fuel Enrichment

As discussed in Subsection 5.2.2, enrichments have a significant impact on neutron dose rates, with lower enrichments resulting in higher neutron dose rates for the same burnup and cooling time. For assemblies with higher burnups (where the neutron contribution to the total dose rate is higher) and/or locations that are more neutron dominated, the enrichment would therefore be important in order to present dose rates in a conservative way. However, it would be impractical

Table 5.4.23

ANNUAL DOSE FOR ARRAYS OF HI-STORM 100S VERSION B
FOR DIFFERENT MPCs WITH THE BOUNDING CONTENT

Array Configuration	**1 cask**	**2x2**	**2x3**	**2x4**	**2x5**
MPC-24					
Annual Dose[1] (mrem/year)	14.60	15.13	22.70	12.32	15.40
Distance to Controlled Area Boundary[2] (meters)	400	500	500	600	600
MPC-32					
Annual Dose (mrem/year)	16.51	15.76	23.64	13.25	16.56
Distance to Controlled Area Boundary (meters)	400	500	500	600	600
MPC-68					
Annual Dose (mrem/year)	16.33	16.25	24.38	14.47	18.09
Distance to Controlled Area Boundary (meters)	400	500	500	600	600

[1] 8760 hr. annual occupancy is assumed.

[2] Dose location is at the center of the long side of the array.