**Table 8.II.0.1**
**Estimated Handling Weights of HI-STORM 100S VERSION E Components HI-TRAC MS****

| Component | MPC-32M (Lbs.) | MPC-32 Version 1 (Lbs.) | MPC-68 Version 1 (Lbs.) | Case Applicability † 1 | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|---|---|---|---|
| Empty HI-STORM 100S Version E overpack (without lid)†† | 221,700 | 221,700 | 221,700 | | | | | 1 | |
| HI-STORM 100S Version E lid (without rigging) | 28,300 | 28,300 | 28,300 | | | | | 1 | |
| Empty MPC Version ( with basket, without lid or closure ring including drain line) | 28,700 | 37,800 | 34,600 | 1 | 1 | 1 | 1 | 1 | 1 |
| MPC lid (without fuel spacers or drain line) | 10,000 | 10,000 | 10,000 | 1 | 1 | 1 | 1 | 1 | 1 |
| MPC Closure Ring | 145 | 145 | 145 | | | 1 | 1 | 1 | 1 |
| Fuel (design basis) | 56,000 | 56,000 | 49,640 | 1 | 1 | 1 | 1 | 1 | 1 |
| MPC water (with fuel in MPC) | 13,000 | 13,000 | 13,000 | 1 | 1 | | | | |
| Annulus Water | 256 | 256 | 256 | 1 | 1 | | | | |
| HI-TRAC Lift Yoke (with slings) | 6,000 | 6,000 | 6,000 | 1 | 1 | 1 | | | |
| Annulus Seal | 50 | 50 | 50 | 1 | 1 | | | | |
| Lid Retention System | 2,300 | 2,300 | 2,300 | | | | | | |
| Transfer frame | 6,700 | 6,700 | 6,700 | | | | | | 1 |
| Mating Device | 15,000 | 15,000 | 15,000 | | | | | | |
| Empty HI-TRAC MS (,no neutron shield jacket water, or bottom lids) | 110,000 | 110,000 | 110,000 | 1 | 1 | 1 | | | 1 |
| HI-TRAC MS Pool Lid(with bolts) | 10,500 | 10,500 | 10,500 | 1 | 1 | 1 | | | |
| HI-TRAC MS Neutron Shield Jacket Water | 8,000 | 8,000 | 8,000 | | 1 | 1 | | | 1 |
| MPC Stays (total of 2) | 200 | 200 | 200 | | | | | | |
| MPC Lift Cleat | 480 | 480 | 480 | | | 1 | 1 | | 1 |

** Actual component weights are dependent upon as-built dimensions. The values provided herein are estimated. FSAR analyses use bounding values provided elsewhere. Users are responsible for ensuring lifted loads meet site capabilities and requirements.

† See Table 8.II.~~1~~0.2 for a description of each load handling case

~~Shielding~~

~~The effect on the shielding performance of the system as a result of this event is two-fold. First, there may be a localized decrease in the shielding thickness of the concrete in the body of the overpack. Second, the bottom of the overpack, which is normally facing the ground and not accessible, will now be facing the horizon. This orientation will increase the off-site dose rate. However, the dose rate limits of 10CFR72.106 are not exceeded.~~

~~Criticality~~

~~There is no effect on the criticality control features of the system as a result of this event.~~

~~Confinement~~

~~There is no effect on the confinement function of the MPC as a result of this event. As discussed in the structural evaluation above, all stresses remain within allowable values, assuring confinement boundary integrity.~~

~~Radiation Protection~~

~~There is no effect on occupational or public exposures from radionuclide release as a result of this accident event since the confinement boundary integrity of the MPC remains intact.~~

~~Immediately after the tip-over accident a radiological inspection of the HI-STORM will be performed and temporary shielding shall be installed to limit exposure from direct radiation. Based on a minimum distance to the controlled area boundary of 100 meters, the 10CFR72.106 dose rate requirements at the controlled area boundary (5 Rem limit) are not exceeded~~However, there is no significant adverse effect on the structural, confinement, thermal, or criticality performance.

Based on this evaluation, it is concluded that the accident does not affect the safe operation of the HI-STORM 100 System.

11.2.3.3 Tip-Over Dose Calculations

The analysis of the tip-over accident has shown that the MPC confinement barrier will not be compromised and, therefore, there will be no release of radioactivity or increase in site-boundary dose rates from release of radioactivity.

The tip-over accident could cause localized damage to the radial concrete shield and outer steel shell where the overpack impacts the surface. The overpack surface dose rate in the affected area could increase due to the damage. However, there should be no noticeable increase in the ISFSI site or boundary dose rate as a result of the localized damage on the side of the overpack.

The tip-over accident will also cause a re-orientation of the bottom of the overpack. As a result, radiation leaving the bottom of the overpack, which would normally be directed into the ISFSI pad,

will be directed towards the horizon and the controlled area boundary. The dose rate at 100 meters from the bottom of the overpack, the minimum distance to the controlled area boundary, was calculated for the HI-STORM 100S Version B with an MPC-24 for an assumed accident duration of 30 days. The burnup and cooling time of the fuel was 60,000 MWD/MTU and 3 years, which is more conservative than the off-site dose analysis reported in Chapter 10~~1~~, Table 10~~1~~.4.1. This combination of overpack, MPC, burnup and cooling time is the same as that used in Chapters 5 and 10 for off-site dose calculations. The results presented below demonstrate that the regulatory requirements of 10CFR72.106 are easily met.

| Distance | Dose Rate (mrem/hr) | Accident Duration | Total Dose (mrem) | 10CFR72.106 Limit (mrem) |
|---|---|---|---|---|
| 100 meters | 2.36 | 720 hours or 30 days | 1699.2 | 5000 |

11.2.3.4 Tip-Over Accident Corrective Action

~~Following a tip-over accident, the ISFSI operator shall first perform a radiological and visual inspection to determine the extent of the damage to the overpack. Special handling procedures, including the use of temporary shielding, will be developed and approved by the ISFSI operator.~~

~~If upon inspection of the MPC, structural damage of the MPC is observed, the structural damage shall be assessed and a determination shall be made if repairs will enable the MPC to return to service. If determined necessary, the MPC shall be returned to the facility for fuel unloading or transferred to either a HI-STAR or HI-STORM overpack in accordance with Chapter 8 for a duration that is determined to be appropriate. Likewise, the HI-STORM overpack shall be thoroughly inspected and a determination shall be made if repairs are required and will enable the HI-STORM overpack to return to service. Subsequent to the repairs, the equipment shall be inspected and appropriate tests shall be performed to certify the HI-STORM 100 System for service. If the equipment cannot be repaired and returned to service, the equipment shall be disposed of in accordance with the appropriate regulations.~~Corrective action after a tip-over would include a radiological and visual inspection to determine the extent of the damage to the overpack and the contained MPC. Special handling procedures, including the use of temporary shielding, will be developed and approved by the ISFSI operator.

11.2.4 Fire Accident

11.2.4.1 Cause of Fire

Although the probability of a fire accident affecting a HI-STORM 100 System during storage operations is low, a conservative fire has been assumed and analyzed. The analysis shows that the HI-STORM 100 System continues to perform its structural, confinement, thermal, and subcriticality functions.

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An example evaluation is performed for the long-term storage of HI-STORM 100 Version E system under sheltered configuration following the methodology described above. The assumed geometry and detailed description of the sheltered configuration is documented in the companion calculation package [4.II.7]. The computed temperatures and pressures for the assumed sheltered configuration, following the above methodology, are presented in Table 4.II.4.8. It is demonstrated that the peak cladding temperature, HI-STORM and MPC component temperatures, and MPC cavity pressure are below the acceptance criteria set forth in Section 4.II.3.7 for normal storage.

### 4.II.4.8 Low Speed Wind

Per NUREG-2174, low speed wind can affect the thermal performance of ventilated storage systems. A sensitivity study is performed herein to demonstrate safety of the HI-STORM 100 Version E system under such environmental conditions. The thermal model in Section 4.II.4.1 is modified appropriately (details documented in [4.II.7]) and evaluated for wind speeds ranging from 0 to 15 mph. It is concluded that low speed winds have a marginal impact on the peak cladding temperature, HI-STORM/MPC component temperatures and MPC cavity pressure under long term storage. The computed temperatures and pressures are in compliance with the acceptance criteria outlined in Section 4.II.3.7. The computed PCT and the MPC cavity pressures under low speed wind are presented in Table 4.II.4.9.

**Table 4.II.4.8 Temperatures and MPC-32M Pressure under Sheltered Configuration**

[

PROPRIETARY INFORMATION WITHHELD IN ACCORDANCE WITH 10CFR2.390

]

**Table 4.II.4.9 Peak Cladding Temperatures and MPC-32M Pressures under Low Speed Wind**

[

PROPRIETARY INFORMATION WITHHELD IN ACCORDANCE WITH 10CFR2.390

]

accident limits. To identify and clear blockages mandatory 30-Day surveillance for casks meeting the threshold heat load criteria incorporated in the Technical Specifications.

4.II.7.2 Loss of Ventilation Under Sheltered Configuration

[
PROPRIETARY INFORMATION WITHHELD IN ACCORDANCE WITH 10CFR2.390
] The methodology delineated therein is adopted and steady state evaluations are performed to compute the ambient air temperatures inside the building. The resulting ambient sink temperatures are adopted in the evaluation of HI-STORM system stored inside the building. The computed component temperatures and MPC cavity pressure are presented in Table 4.II.7.8. The temperatures comply with Table 2.II.2.9 accident limits. The co-incident MPC pressure are compared with the accident design pressure (Table 1.II.2.3) and shows a positive safety margin.

**Table 4.II.7.8 Loss of Building Ventilation under Sheltered Configuration**

[

PROPRIETARY INFORMATION WITHHELD IN ACCORDANCE WITH 10CFR2.390

]

However, it is recognized that the mechanical loadings at a specific ISFSI may be sufficiently strong to cause a tip-over event, even though such a scenario is determined to be counterfactual under the Design Basis Loads (DBLs) treated in this FSAR. To enable the safety evaluation of a postulated tip-over scenario, it is necessary to set down an analysis methodology and the associated acceptance criteria. In Section 3.II.4, the methodology and acceptance criteria are presented and a reference tip-over problem is solved for the reference pad properties listed in Table 2.II.0.1. The reference tip-over problem corresponds to a free rotation of the HI-STORM 100 overpack from the condition of rest at the incipient tipping point (i.e., C.G.-over-corner). The evaluations presented below refer to the above non-mechanistic tip-over scenario.

b. Analysis of the Tip-Over Event

The tip-over accident analysis evaluates the effects of the loaded overpack tipping-over onto a reinforced concrete pad. The tip-over analysis is provided in Section 3.II.4. The structural analysis demonstrates that the acceptance criteria for the basket panels in the active fuel region is met per Tables 2.II.2.3 and 2.II.2.4 and the MPC confinement boundary is not breached.

The tip-over accident could cause localized damage to the radial concrete shield and outer steel shell where the overpack impacts the surface. The overpack surface dose rate in the affected area could increase due to the damage. However, there should be no noticeable increase in the ISFSI site boundary dose rate as a result of the localized damage on the side of the overpack.

The tip-over accident will also cause a re-orientation of the bottom of the overpack. As a result, radiation leaving the bottom of the overpack, which would normally be directed into the ISFSI pad, will be directed towards the horizon and the controlled area boundary. The dose rate at 100 meters from the bottom of the overpack, the minimum distance to the controlled area boundary, was calculated for the HI-STORM 100S Version E with an MPC-32M canister, loaded with the bounding content, for an assumed accident duration of 11 days. This combination of overpack, MPC, and source term is the same as that used in Section 5.II.1. The results presented below demonstrate that the regulatory requirements of 10CFR72.106 can be met.

| Distance | Dose Rate (mrem/hr) | Accident Duration | Total Dose (mrem) | 10CFR72.106 Limit (mrem) |
|---|---|---|---|---|
| 100 meters | 18.77 | 264 hours or 11 days | 4955.3 | 5000 |

c. Corrective Actions: Corrective action after a tip-over would include a radiological and visual inspection to determine the extent of the damage to the overpack and the contained MPC. The dose rate measurements will be performed and the actual dose rate levels will be established. Damage to the pad shall be repaired using approved procedures. Replacement of the storage cask should be considered if in situ repair is not feasible. Based on the dose rates, ~~S~~special handling procedures, including the use of temporary shielding, will be developed and implemented to ensure ALARA during recovery operations.

d. Conclusion: Depending on the strength of the concrete in the cask and the ISFSI pad, the impact from tip-over may cause some localized damage to the concrete and outer shell of the overpack in the local area of collision. However, there is no significant adverse effect on the structural,