State of Utah

DEPARTMENT OF ENVIRONMENTAL QUALITY
OFFICE OF THE EXECUTIVE DIRECTOR

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Attached comments may contain proprietary information.

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December 6, 1999

Hand Delivered

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PROPOSED RULE PR 72
(64FR51271)

Emile L. Julian, Assistant for
Rulemakings and Adjudications
Rulemakings and Adjudications Staff
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Washington, D.C. 20555

re: State of Utah's Comments on NRC's Proposed Approval of the Holtec Hi-Storm 100 Cask System, Docket No. 72-1014

Dear Secretary:

Attached are the State of Utah's comments on the Staff's preliminary Safety Evaluation Report of the Holtec SAR and proposed Certificate of Compliance for the Holtec Hi-Storm 100 cask system. The comments may contain information claimed as proprietary by Holtec International. *See* cover page of State's Comments for further explanation.

If you have any questions or need further clarification on any comment please contact me at 801-366-0523.

Sincerely,

Connie S. Nakahara

Connie S. Nakahara

enclosures: as stated

cc: Brian Gutherman, Holtec International
Sherwin Turk, NRC Staff Counsel
Jay E. Silberg, Shaw Pittman Potts & Trowbridge

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Acknowledged by card JAN 1 2 2000

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Comments by the State of Utah on the NRC's Proposal to Add the Holtec HI-STORM 100 Cask System to the List of Approved Spent Fuel Storage Casks

The State has obtained certain information from Holtec International under a confidentiality agreement. The agreement provides that the State may disclose the information to the NRC and the Private Fuel Storage, LLC, (PFS) provided the State files the document containing the confidential information as a proprietary submittal. In these comments, the State references information obtained under the State-Holtec Confidentiality Agreement. Accordingly, the State files these comments as a proprietary submittal; however, the State makes no representation whether or not any of this information should be treated as proprietary. A copy of these comments is being provided to Holtec International who may take whatever steps are necessary to ensure that NRC treats the information contained in the comments as a proprietary submittal.

Comments by the State of Utah on the NRC's Proposal to Add the Holtec HI-STORM 100 Cask System to the List of Approved Spent Fuel Storage Casks

December 6, 1999

The State of Utah submits the following comments on the Proposed Rule, "List of Approved Spent Fuel Storage Casks: HI-STORM 100 Addition," 64 Fed. Reg. 51,271 (September 22, 1999). These comments were prepared with the assistance of Dr. Marvin Resnikoff and Matthew Lamb of Radioactive Waste Management Associates, who are experts in the field of radioactive waste management and storage. Copies of their resumes are attached hereto as Exhibits 1 and 2, respectively.

The State of Utah is an intervenor in the Private Fuel Storage, L.L.C. ("PFS") PFS licensing proceeding for the PFS proposed Independent Spent Fuel Storage Installation ("ISFSI") in Skull Valley, Utah. PFS proposes to use the HI-STORM 100 cask system at the ISFSI, and relies on portions of the HI-STORM 100 Topical Safety Analysis Report ("TSAR ") to support various aspects of the PFS facility design. A key example of this is the thermal design of the PFS facility. PFS relies extensively on Holtec's analysis of the HI-STORM 100 design for its own evaluation of the adequacy of the PFS design with respect to thermal conditions. The State raised significant site-specific concerns about the thermal design of the PFS facility in its contentions regarding the PFS license application. *See* Contention H, admitted by the Licensing Board in Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-98-7, 47 NRC 142, 189 (1998); *see also* Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-98-10, 47 NRC 288, 295 (1998). A copy of Contention H is attached. These issues are now in litigation before the Atomic Safety and Licensing Board.

The issues raised by the State in Contention H are affected by this rulemaking because the HI-STORM 100 design and the PFS facility design are integrally related. For instance, PFS adopts Holtec's thermal analysis and applies it *in toto* to the PFS facility. The Holtec analysis, in turn, is based on various general assumptions about the thermal characteristics at a range of sites. Thus, to the extent that PFS is relying on Holtec's generic analysis to address unique site specific conditions that occur in the desert environment of Skull Valley, the specificity and reliability of the generic analysis are of great importance to the State of Utah. Accordingly, the State is filing these rulemaking comments to ensure that its concerns about the deficiencies in the analysis of the HI-STORM 100 cask system are thoroughly considered in any forum where they are relevant. It should not be inferred from the filing of these comments, however, that the State views its concerns about the use of the HI-STORM 100 cask system at PFS's proposed Skull Valley facility as "generic" issues that are capable of resolution solely in this rulemaking. To the contrary, the State continues to believe that PFS is required to demonstrate, in the pending licensing proceeding, that the design of the PFS facility, including the HI-STORM 100 cask design, is capable of assuring safe operation in the unique desert conditions of Skull Valley.

As demonstrated below the HI-STORM 100 cask design has significant deficiencies which have not been addressed by Holtec, or the NRC Staff. The Holtec thermal analysis and design do not realistically account for site conditions in several significant respects. Holtec has ignored or oversimplified real-world thermal conditions in its thermal analysis, with the result that the cask's thermal design is insufficient to protect against overheating of the casks. Moreover, the casks are insufficiently protected against sabotage; and Holtec has not performed an adequate evaluation of dose consequences. The NRC Staff's evaluation of these issues is appallingly superficial and incomplete. As a result, the Staff has no basis for its finding, in the SER, that the HI-STORM 100 design is adequate to protect health and safety; nor does it have a basis for concluding that licensing of the cask poses no significant environmental risk.

THERMAL EVALUATION

The HI-STORM 100 cask is cooled by passive, convective air flow through four ducts that draw air at the bottom, flow inside the concrete overpack, but outside the multi-purpose canister (MPC), and release heated air through the top four vents. Heated air rises in a manner known as the chimney effect. Section 4 of the HI-STORM TSAR evaluates thermal conditions within the MPC and in the surrounding concrete overpack, among other locations (*i.e.*, within the canister and inside the concrete liner) in the HI-STORM 100 cask system. The Holtec TSAR was revised a number of times, concluding with Revision 9. Holtec concludes, based on its calculations, that the concrete temperature limits of 200 °F and 350 °F for normal and off-normal conditions will not be exceeded at any site where temperatures meet Holtec's Certificate of Compliance ("CoC") design limits. These design limits are that normal ambient temperatures are 80 °F, averaged over day and night; and off-normal temperatures are 125 °F for three consecutive days.

In support of its conclusion, Holtec calculates that if air is drawn in at 80 °F, the outlet temperature will be 179 °F. Under normal conditions, the resulting average concrete temperature for the outer shell, as calculated by Holtec, will be 149 °F, far under the 200 °F limit. Under extreme conditions, if air is drawn in at 125 °F, Holtec calculates that the outlet temperature will be 231 °F.

In Section 4 of the SER, the Staff addresses its evaluation of Holtec's thermal analysis. The Staff summarizes its evaluation as follows:

> The Staff reviewed all inputs, assumptions, methodology, and results of the applicant's temperature and pressure analyses which were submitted in support of the [Holtec] SAR. All the assumptions were found to be in compliance with

> NUREG-1536 Section 4.V.5(c). Input parameters are consistent with design values for the HI-STORM overpack. The applicant selected suitably bounding and appropriate boundary conditions for normal, off-normal and accident conditions. Previous Staff evaluations of the applicant's HI-STAR 100 SAR's FLUENT computer code results, using the ANSYS finite element computer code, confirmed the temperature calculation results of this method. The Staff performed independent calculations for the form loss and friction loss coefficients used by the applicant to simulate the hydraulic characteristics of the internal air passage. The applicant's former loss coefficients were found to be suitably bounding and applicable to the specific geometry of the HI-STORM 100 air passages. The Staff evaluated and accepted the applicant's selected heat transfer coefficients. The temperature and pressure results were found to be correctly calculated using the identified inputs, assumptions, and methodology.

SER at 4-8. Accordingly, as a general matter, the Staff accepted the Holtec thermal analysis. The only thermal-related limitation imposed by the Staff is to require that, because the outlet temperature would be above the 200 °F design limit under accident conditions, users of the HI-STORM 100 system must monitor the temperature at required intervals.

The Staff's evaluation of the Holtec TSAR is completely inadequate to support any positive safety finding regarding the thermal design for the PFS facility or any other facility using the HI-STORM cask. The Staff has failed to address fundamental and significant deficiencies in critical assumptions made by Holtec, such as Holtec's unsupported extrapolation of its infinite cask array model to a two-by-four cask array, and Holtec's oversimplification of the "ambient" temperature around the casks. Moreover, although the Staff claims to have thoroughly evaluated the TSAR, in fact, it has performed only the most superficial review. Although Holtec relies on an extremely complex computer code and a number of interactive assumptions to generate its conclusions, to the State's knowledge, the Staff did not perform any independent calculations to confirm the validity of the Holtec assumptions and methodology for performing the calculations.

Holtec Model Incorrect

The Holtec computational model does not appear to take into account the thermal interaction between casks on an ISFSI pad, and the thermal interaction between a cask and the pad.

a) Holtec claims that the spacing of casks in an infinite array is equivalent to the spacing of casks in a two-by-four block array. TSAR, figure 4.4.24. As far as the State can determine, Holtec assumed that the center-to-center distance between casks is 18.6 feet. The PFS facility design, for example, is a two-by-four block array and calls for spacing the casks much closer together than Holtec assumes in its analysis, with a 15 foot center-to-center distance, and a surface-to-surface distance of three feet. This closer spacing could have a significant effect on the thermal design of the individual storage facility.[1] Accordingly, Holtec's equivalency determination between an infinite array and a two-by-four array is invalid where the differences in cask spacing do not meet the 18.6 feet center-to-center assumption underlying Holtec's analysis. Any CoC issued for this cask system must address this shortcoming.

b) The Holtec thermal calculations are based on a correspondence between an infinite equally spaced array and a finite two-by-four block array. This correspondence is not necessarily valid. It is based on an assumption that individual casks will not interfere with cooling air supply of each other, either in the block array or infinite array. This may or may not be true, but is not the key concern. The State's key concern is, in large part, the thermal interaction of casks via radiative heat transfer, whereas Holtec limits its concern only with the independence of air intakes. This is a shortcoming in Holtec's analysis.

c) Holtec's model assumes a radius R for a hypothetical cylindrical tank. TSAR, at 4.4-18. This is a hypothetical reflecting boundary that is intended to simulate heating from surrounding casks. But the temperature of the reflecting boundary, as calculated by Holtec, is the temperature of an **isolated** cask. The temperature of the reflecting boundary should be taken as the temperature of the cask in interaction with the other casks.

d) The Holtec model does not appear to take into account the fact that the heating of the concrete pad is likely to diminish the "chimney effect" of the intake and outake vents. Holtec claims to have taken into account the heating of the pad in recent calculations reported in Rev. 9. If this were the case, one would expect to see higher MPC outer shell temperatures, because air velocity will be slower than previously expected, and therefore the cooling of the casks will be less effective than previously calculated. If we compare the calculations in the earlier revisions of the TSAR with the calculations in Rev. 9, however, there is little difference: the calculated off-normal outer shell temperatures are 322 °F for the earlier calculations and 324 °F for the later calculations. This indicates that in fact, Holtec did not take the diminution of the chimney effect into account.

Oversimplified Concept of "Ambient Temperature"

The "ambient temperature" is an important assumption in the Holtec thermal calculations, and an important design element in the CoC. The Holtec analysis assumes an ambient temperature of 80 degrees. The SER states that the ambient temperature under normal conditions must be less than 80 °F. Despite the importance of this term, it

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[1] Although the State has raised this issue in the licensing case for the PFS facility, neither Holtec nor the NRC Staff has addressed this problem. *See* State's Opposition to Applicant's Partial Motion for Summary Disposition of Utah Contention H - Inadequate Thermal Design (*Proprietary Version)* (June 25, 1999).

is not defined by Holtec or the NRC Staff.

Holtec, with the approval of the Staff, has grossly oversimplified the concept of ambient temperature, to the extent of rendering the Holtec thermal analysis completely useless.

Holtec assumes that the ambient temperature at the intake and outlet vents is the same. However, the temperature in any environment in which the surface of the ground absorbs solar energy will be significantly higher near the ground than it will be some distance above. This is significant with respect to the Holtec thermal analysis, because the HI-STORM 100 cask system is designed to take advantage of air convection through the cask. The intake vent is placed near the ground, where cooler air is assumed to enter the overpack and rise to an outlet valve approximately 5 meters higher than the air inlet valve. The cooling of the casks depends on this upward flow of air. If the air temperature at the ground or intake level is higher than the air temperature five meters above, this will greatly interfere with both the velocity and the temperature of the convective cooling air flow.

The temperature of the air at the intake vent may be much higher than the 80 °F "ambient" temperature assumed by Holtec, and much higher than the temperature five feet off the ground. According to Dr. Hashem Akbari, the leader of the Heat Island Group, a research group at Lawrence Berkeley National Laboratory, a desert may have a surface temperature of 180°F. According to Dr. Akbari, approximately 50% of the temperature gradient will occur within the first 1 to 2 cm above the ground. He estimates the air temperature 2-3 cm above the ground to be 140°F, the temperature 0.5m above ground to be 130°F, and the temperature 2m above ground to be 115-120°F. At 2m above ground, the maximum temperature difference between the air above a hot surface and that above a cooler (*e.g.* grass) surface would be at most 1-2 degrees. Personal correspondence: telephone conversation between Matthew Lamb and Dr. Hashem Akbari, November,19 1999, attached hereto as Exhibit 3. The temperature gradient that may occur at the various sites that store fuel in the HI-STORM 100 is completely lacking in Holtec's assumed ambient temperature and therefore is a significant flaw in Holtec's analysis.

According to diagram 1495, no. 2, (HI-STORM TSAR), the air inlets are at the surface of the concrete pad. Therefore, the inlet temperature is more likely to be closer to 180 °F, rather than 80 °F normal conditions, or 125 °F off-normal conditions. If the inlet "ambient" temperature is 180 °F, and the outlet "ambient" temperature is 80 °F, the effective buoyancy and air velocity through the cooling ducts will be reduced, compared to Holtec's calculations. Similar to a partial vent blockage accident, this implies that the concrete surface temperature will be higher, and the fuel cladding temperature will be higher. Accordingly, the Holtec TSAR does not satisfy 10 CFR § 72.24, because the "analysis and evaluation of the design and performance of structures, systems and components important to safety" are **not** "in sufficient detail to support a finding that the HI-STORM 100 cask will satisfy the design bases with an adequate margin for safety."

Further, NRC Staff have not conducted an independent review to verify these matters.

No Independent Staff Review

In order to confirm Holtec's calculations, NRC Staff should have reviewed the inputs and outputs of the FLUENT calculation by Holtec, and also run an independent model, such as the ANSYS code. Without an independent confirmation, the Staff is in the position of accepting Holtec's analysis without independent confirmation. Nevertheless, it does not appear that the Staff conducted any independent analysis. As the NRC Staff acknowledges in the SER, it looked at FLUENT results, but apparently did not actually employ the FLUENT code. In addition, the discussion in section 4.5.4 of the SER suggests that the Staff did not conduct any independent confirmation of the results of the FLUENT code on a HI-STORM 100 cask system. The NRC Staff states that an alternate code, ANSYS, was employed to test the temperature results given by FLUENT on a completely different project involving the HI-STAR 100 system. This suggests that the NRC Staff did not perform a validation of the thermal model employed by Holtec for the HI-STORM 100 system, nor did it conduct an independent thermal evaluation using the ANSYS code. The HI-STAR analysis cannot be extrapolated to the HI-STORM cask. These casks are constructed of different materials, with different methods of heat dispersion. With respect to HI-STORM, the NRC Staff simply accepted Holtec's results without an independent assessment. Moreover, as discussed above, the Staff accepted without question fundamentally defective assumptions used by Holtec – even though the problems had previously been pointed out by the State. By ignoring obvious deficiencies in Holtec's assumptions, and by failing to conduct any independent analysis of the Holtec calculations, the Staff has abdicated its role as independent regulator. Under these circumstances, there is no lawful basis for the issuance of a CoC for the HI-STORM 100 cask system.

OFF-SITE RADIOLOGICAL CONSEQUENCES

The design basis accident (Section 11 of the TSAR and SER) and the method of calculating radiological consequences (Section 7 of the TSAR and SER) are not sufficiently protective of the health and safety of the public.

Design Basis Accident

The methodology Holtec employs for accident calculations in the TSAR has changed. In earlier revisions of the TSAR, Holtec's accident analyses assumed, in the design basis accident case, a loss of confinement. That is, the canister lid was removed and 100% of the cladding was broken. Holtec assumed all the radioactive material within the gap between the cladding and fuel could be released. Holtec then considered the quantity of particulates, gases and volatiles that was respirable. Holtec also assumed the dose was due only to radioactive effluents inhaled from the passing cloud, and ignored direct gamma and ingestion.

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In the latest design basis accident calculations (Rev. 9), based on Staff interim guidance ISG-5, the canister lid is not assumed to be removed. Instead, Holtec now assumes 100% of the cladding is broken, and all the particulates that are released to the environment are respirable. However, Holtec also assumes an extremely small leakage rate. Although Holtec does not state the basis for the new assumption of a small leakage rate, the new assumed leakage rate is consistent with Table 4-1, NUREG-1617, "Standard Review Plan for Transportation Packages for Spent Nuclear Fuel," that is based on another NRC document, NUREG/CR-6487, "Containment Analysis for Type B Packages Used to Transport Various Contents."[2]

The State takes issue with the use of the leakage rate employed by Holtec, because it is based on an analysis of a **transportation** cask rather than a storage cask, for which the NRC and industry have different design and testing requirements. The small assumed leakage rate and calculation methodology in NUREG/CR-6487 are based on ANSI standard N14.5 for transportation casks.[3] ANSI standard N14.5 assumes[4] that casks will be leak-tested periodically, before shipment and after maintenance and repair.[5] But some ISFSIs, such as the PFS facility, have no design provisions for testing helium leakage during storage and no provisions for repairing and maintaining casks and testing for leakage after repair and maintenance. Thus, these ISFSIs cannot satisfy the leak testing requirements of N14.5. Under the circumstances, it is completely inappropriate to assume that these storage casks will have the same small leakage rate as transportation casks, for which leakage potential is designed and planned to be monitored. Accordingly, neither Holtec nor the NRC Staff has any basis for relying on NUREG-1617 to assume a small leakage rate in the event of a storage cask breach. Although the State has raised this issue in the PFS licensing case, the Staff has made no attempt to address it in the SER. *See* State of Utah's Request for Admission of Late-Filed Amended Utah Contention C (June 23, 1999) (rejected on grounds of lateness only, LBP-99-43, __ NRC ___ (November 4, 1999).

Further, the methodology employed in NUREG/CR-6487 may not apply for certain accidents that exceed the design basis accident. NUREG/CR-6487 calculates the leak hole diameter that corresponds to a regulatory-allowable release rate under accident conditions. This leak hole size can easily be exceeded in accidents involving sabotage. Impact with a MILAN or TOW-2 hand held anti-tank device can produce a leak hole larger than calculated in NUREG/CR-6487. Impact with a jet engine or military ordnance can also produce leak holes larger than estimated in NUREG/CR-6487.

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[2] Anderson, BL et al, "Containment Analysis for Type B Packages Used to Transport Various Contents," Lawrence Livermore National Laboratory, NUREG/CR-6487, November 1996.

[3] NUREG/CR-6487, p. 1.

[4] American National Standards Institute, ANSI N14.5, "Leakage Tests on Packages for Shipment," Table 1.

[5] Id.

Fires

The HI-STORM TSAR has only considered a fire analysis involving a 50-gallon spill. HI-STORM TSAR § 11.2.4.2.2. The short-term accident design temperatures for the HI-TRAC cask, the cask that transfers the MPC from the HI-STAR 100 transportation cask to the HI-STORM 100 storage cask, varies from 300 °F for the neutron absorber material (Holtite-A) at the top of the HI-TRAC cask to 600-700 °F for other materials such as the lead liner and outer water jacket. HI-STORM TSAR, Table 2.2.3. The maximum temperature of the fuel cladding under steady-state conditions is 902 °F while the fuel cladding for a 50 gallon fire is 942 °F. Id. at 4.5-11 (Rev. 8); *see also* id. at Table 4.5.2. However, Holtec has not calculated the maximum fuel cladding temperature for a 300 gallon fire or a 6,000 gallon fire. Such a fire would cause gross cladding defects.

A fire involving a 300 or 6,000 gallon spill is a credible accident at an ISFSI. A heavy haul tractor carries 300 gallons of fuel. These tractors will be used, for instance, at the PFS facility, and it is likely that they will be used at other facilities. Locomotives that carry casks to ISFSIs may carry even more fuel. For example, the GE AC6000CW locomotive has a fuel capacity of 6,000 gallons of diesel fuel.

The Holtec analysis is also deficient because all of Holtec's fire calculations assume the fire takes place outside the concrete storage cask. Holtec does not consider the possibility of a fuel fire being drawn into the intake vent of the HI-STORM 100 cask and does not analyze the consequences of such a fire.

The NRC Staff's SER is silent on the fire-related issues raised above. These are obvious and significant problems that should have been addressed by the Staff in its review.

Explosions

The Holtec TSAR considers explosions that produce a slight over pressure at the cask. Holtec concludes that this slight overpressure has no effect on the containment and would not cause a radioactive release. We agree.

However, Holtec has not analyzed the consequences of a hit by an anti-tank missile, such as the MILAN or TOW-2 missile; nor has the NRC Staff addressed this issue. The NRC has it within its power to place additional conditions in the CoC to lower the probability of a sabotage event. For example, the NRC could impose additional conditions, such as, requiring a berm to remove the line-of-sight. However, the NRC has ignored the issue of sabotage, and has refused to impose these relatively simple measures that could substantially increase protection against sabotage.

The NRC's treatment of sabotage issues has been inconsistent. When the State attempted to raise sabotage issues in the licensing proceeding for the PFS facility, the

Licensing Board rejected them, on the grounds that the State was attempting to challenge generic determinations. *See* LBP-98-7, 47 NRC at 199. The State then raised the inadequacy of protection against sabotage in the rulemaking for the HI-STAR transportation cask. In response, the NRC Staff stated that it considered these issues when subparts K and L were added to 10 CFR Part 72 (July 18, 1990). Final Rule, HI-STAR 100, response to comment #16. This is incorrect. These regulations only require that a licensee install systems that protect against unauthorized entry. Since anti-tank missiles can be fired from a 1 km distance with great accuracy, entry to a site is not required to successfully carry out sabotage. In its response to the State's comments on the HI-STAR 100 SER, the NRC Staff also directed the State back to the license proceeding: "It is the ISFSI licensee who is responsible for protecting spent fuel in the casks from sabotage rather than the certificate holder. Comments on the specific transportation aspects of the cask system and existing regulations specifying what type of sabotage events must be considered are beyond the scope of this rulemaking." Id. This argument is circular. The NRC cannot declare through the Licensing Board that an issue is generic, and then turn around and declare through a rulemaking that it is case-specific. The NRC has acted inconsistently and arbitrarily in determining whether to treat sabotage issues as site-specific or generic.

NO ADEQUATE EVALUATION OF DOSE CONSEQUENCES.

Holtec's calculations grossly underestimate the dose consequences of a design basis accident in several significant respects. The State has raised these issues in the PFS licensing proceeding. *See* Contention C, submitted with the State of Utah's Contentions on November 27, 1997; *see also*, Amended Contention C (June 23, 1999). Presumably, the NRC Staff is aware of the State's concerns, and it is also aware that PFS is relying on the Holtec TSAR for many of its erroneous assumptions. Yet, the Staff has ignored these issues in the SER for the Holtec TSAR. The following deficiencies in Holtec's dose analysis remain deficient and unresolved:

a) **Thirty Day Release.** Holtec assumes a 30-day duration of a radiological release during an accident. This assumption is also stated in ISG-5, interim Staff guidance-5. Although the Staff has put the assumption into ISG-5, it has not issued any accompanying report justifying the assumption. Nor is there any justification. NRC regulations for ISFSIs do not require offsite emergency planning, or planning for the ingestion pathway zone. Therefore, there is no basis for assuming that something happens within 30 days to stop the release.

b) **Exposure Duration.** To calculate exposures during an accident, Holtec assumes a person stands at the 500m location for 2,000 hours/yr. There are 8,760 hours in a year; 2,000 hours corresponds to the number of working hours in a year. That is, Holtec assumes that a person at the fence post can only be a worker, not a resident.

This assumption is unsupported and unreasonable. The area beyond the fence line is outside the licensee's control. The licensee cannot dictate that only workers will be in the area, or that people must leave the area for a certain period each day. To be reasonably conservative, Holtec should have assumed that people, such as mothers with pre-school aged children, the elderly, ranchers and farmers are present at the fence post day-long and year-round.

c) **Pathway Analysis.** Holtec calculates a dose due to inhaling radionuclides from a passing cloud. In making this calculation, Holtec ignores direct gamma and ingestion of radionuclides, and thereby underestimates the dose.

The State previously raised this argument in regard to the HI-STAR 100 cask. At that time, NRC Staff disagreed that the above pathways are important because of actions that will be taken by the licensee, such as interdiction of the food supply and other remedial activities. These supposedly are to be taken up in license review. According to NRC Staff, "when a general licensee uses the cask design, it will review its emergency plan for effectiveness in accordance with 10 CFR 72.212. This review will consider interdiction and remedial actions to monitor releases and pathways based on the chosen site conditions and the location. Therefore, the pathways identified by the commenter will be addressed in the general licensee's site specific review." This response does not take into account two important facts: first, there is no regulatory requirement for the actions assumed by the NRC Staff. Therefore, there is no basis for anyone, including Holtec, to include such assumptions in analyses that are used to support cask designs for purposes of regulatory compliance. It is grossly misleading for Holtec to do a calculation that provides a reassuring result, based on assumptions that have nothing to do with the real requirements of the regulations. It is the responsibility of the NRC Staff to prevent the perpetuation of such chimera. Second, it is clear from the PFS proceeding that individual ISFSI license applicants tend to rely heavily on the generic analyses that have been performed by cask manufacturers. If these analyses are faulty, and not caught by the NRC Staff in the individual license reviews, then they will be institutionalized in the individual licensing decisions. There is no reason to allow Holtec's inaccurate assumptions to remain a part of its cask design justification.

d) **Chlorine-36.** Finally, for thyroid and whole body doses, Holtec considers iodine-129, but ignores chlorine-36, which will also be present in irradiated fuel and significantly contributes to the dose.[6] In Appendix A, Yucca Mountain DEIS, the Department of Energy acknowledges that chlorine-36 is one of the significant radionuclides.

CONCLUSION

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[6] Oak Ridge National Laboratory, "Characteristics of Potential Repository Wastes," prepared for the Department of Energy, DOE/RW-0184-R1, Table 1B.1; Gasteiger, R, "Pi-Rezykjlierung in Leichtwasserreaktoren…," Gessellschaft fur Kernforschung M.B.H., KFK 2417, February 1977, Table 5.0-1.

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The NRC Staff has failed to demonstrate, in the SER, that the design of the HI-STORM 100 cask system is adequate to protect public health and safety from radiological accidents and releases. By the same token, there is no basis for concluding that the HI-STORM 100 cask design poses no significant accident risks to the public. Accordingly, the HI-STORM 100 cask approval application should be denied.

Dr. Marvin Resnikoff

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EXPERIENCE:

April 1989 - present **Senior Associate**, Radioactive Waste Management Associates, management of consulting firm focused on radioactive waste issues, evaluation of nuclear transportation and military and commercial radioactive waste disposal facilities.

1978 - 1981; 1983 - April 1989 **Research Director**, Radioactive Waste Campaign, directed research program for Campaign, including research for all fact sheets and the two books, *Living Without Landfills*, and *Deadly Defense*. The fact sheets dealt with low-level radioactive waste landfills, incineration of radioactive waste, transportation of high-level waste and decommissioning of nuclear reactors. Responsible for fund-raising, budget preparation and project management.

1981 - 1983 **Project Director**, Council on Economic Priorities, directed project which produced the report *The Next Nuclear Gamble*, on transportation and storage of high-level waste.

1974 - 1981 **Instructor**, Rachel Carson College, State University of New York at Buffalo, taught classes on energy and the environment, and conducted research into the economics of recycling of plutonium from irradiated fuel under a grant from the Environmental Protection Agency.

1975 - 1976 **Project Coordinator**, SUNY at Buffalo, New York Public Interest Research Group, assisted students on research projects, including project on waste from decommissioning nuclear reactor.

1973 **Fulbright Fellowship** at the Universidad de Chile, conducting research in elementary particle physics.

1967 - 1972 **Assistant Professor of Physics**, SUNY at Buffalo, conducted research in elementary particle physics and taught range of graduate and undergraduate physics courses.

1965 - 1967 **Research Associate**, Department of Physics, University of Maryland, conducted research into elementary particle physics.

EDUCATION

University of Michigan	PhD in Physics, June 1965
Ann Arbor, Michigan	M.S. in Physics, Jan 1962
	B.A. in Physics/Math, June 1959

Resume of Marvin Resnikoff, Ph.D.

Dr. Marvin Resnikoff is Senior Associate at Radioactive Waste Management Associates and is an international consultant on radioactive waste management issues. He is Principal Manager at Associates and is Project Director for risk assessment studies on radioactive waste facilities and transportation of radioactive materials. Dr. Resnikoff has concentrated exclusively on radioactive waste issues since 1974. He has conducted studies on the remediation and closure of the leaking Maxey Flats, Kentucky radioactive landfill for Maxey Flats Concerned Citizens, Inc. under a grant from the Environmental Protection Agency, the Wayne and Maywood, New Jersey thorium Superfund sites and on proposed low-level radioactive waste facilities at Martinsville (Illinois), Boyd County (Nebraska), Wake County (North Carolina), Ward Valley (California) and Hudspeth County (Texas). He has conducted studies on transportation accident risks and probabilities for the State of Nevada and dose reconstruction studies of oil pipe cleaners in Mississippi and Louisiana, residents of Canon City, Colorado near a former uranium mill, residents of West Chicago, Illinois near a former thorium processing plant, and residents and former workers at a thorium processing facility in Maywood, New Jersey. In West Chicago he calculated exposures and risks due to thorium contamination and served as an expert witness for plaintiffs A Muzzey, S Bryan, D Schroeder and assisted counsel for plaintiffs KL West and KA West. He is presently serving as an expert witness for a separate group of plaintiffs in West Chicago, including R Dassion. He also evaluated radiation exposures and risks in worker compensation cases involving G Boeni and M Talitsch, former workers at Maywood Chemical Works thorium processing plant.

Under a contract with the State of Utah, Dr. Resnikoff is a technical consultant to DEQ on the proposed dry cask storage facility for high-level waste at Skull Valley, Utah and proposed storage/transportation casks. He is assisting the State on licensing proceedings before the Nuclear Regulatory Commission. In addition, at hearings before state commissions and in federal court, he has investigated proposed dry storage facilities at the Point Beach (WI), Prairie Island (MN) and Palisades (MI) reactors.

In Canada, he has conducted studies on behalf of the Coalition of Environmental Groups and Northwatch for hearings before the Ontario Environmental Assessment Board on issues involving radioactive waste in the nuclear fuel cycle and Elliot Lake tailings and the Interchurch Uranium Coalition in Environmental Impact Statement hearings before a Federal panel regarding the environmental impact of uranium mining in Northern Saskatchewan. He has also worked on behalf of the Morningside Heights Consortium regarding radium-contaminated soil in Malvern and on behalf of Northwatch regarding decommissioning the Elliot Lake tailings area before a FEARO panel. More recently he completed a study for Concerned Citizens of Manitoba regarding transportation of irradiated fuel to a Canadian high-level waste repository.

He was formerly Research Director of the Radioactive Waste Campaign, a public interest organization conducting research and public education on the radioactive waste issue. His duties with the Campaign included directing the research program on low-level commercial and military waste and irradiated nuclear fuel transportation, writing articles, fact sheets and reports, formulating policy and networking with numerous environmental and public interest organizations and the media. He is author of the Campaign's book on "low-level" waste, *Living Without Landfills*, and co-author of the Campaign's book, *Deadly Defense, A Citizen Guide to Military Landfills*.

Between 1981 and 1983, Dr. Resnikoff was a Project Director at the Council on Economic Priorities, a New York-based non-profit research organization, where he authored the 390-page study, *The Next Nuclear Gamble, Transportation and Storage of Nuclear Waste*. The CEP study details the hazard of transporting irradiated nuclear fuel and outlines safer options.

In February 1976, assisted by four engineering students at State University of New York at Buffalo, Dr. Resnikoff authored a paper that changed the direction of power reactor decommissioning in the United States. His paper showed that power reactors could not be entombed for long enough periods to allow the radioactivity to decay to safe enough levels for unrestricted release. The presence of long-lived radionuclides meant that large volumes of dismantled reactors would still have to go to low-level waste disposal facilities. He has assisted public interest groups NECNP and CAN on the decommissioning of the Yankee-Rowe reactor.

Dr. Resnikoff is an international expert in nuclear waste management, and has testified often before State Legislatures and the U.S. Congress. He has extensively investigated the safety of the West Valley, New York and Barnwell, South Carolina nuclear fuel reprocessing facilities. His paper on reprocessing economics (Environment, July/August, 1975) was the first to show the marginal economics of recycling plutonium. He completed a more detailed study on the same subject for the Environmental Protection Agency, "Cost/Benefits of U/Pu Recycle," in 1983. His paper on decommissioning nuclear reactors (Environment, December, 1976) was the first to show that reactors would remain radioactive for hundreds of thousands of years.

Dr. Resnikoff has prepared reports on incineration of radioactive materials, transportation of irradiated fuel and plutonium, reprocessing, and management of low-level radioactive waste. He has served as an expert witness in state and federal court cases and agency proceedings. He has served as a consultant to the State of Kansas on low-level waste management, to the Town of Wayne, New Jersey, in reviewing the cleanup of a local thorium waste dump, to WARD on disposal of radium wastes in Vernon, New Jersey, to the Southwest Research and Information Center and New Mexico Attorney General on shipments of plutonium-contaminated waste to the WIPP facility in New Mexico and the State of Utah on nuclear fuel transport. He has served as a consultant to the New York Attorney General on air shipments of plutonium through New York's Kennedy Airport, and transport of irradiated fuel through New York City, and to the Illinois Attorney General on the expansion of the spent fuel pools at the Morris Operation and the Zion reactor, to the Idaho Attorney General on the transportation of irradiated submarine fuel to the INEL facility in Idaho and to the Alaska Attorney General on shipments of plutonium through Alaska. He was an invited speaker at the 1976 Canadian meeting of the American Nuclear Society to discuss the risk of transporting plutonium by air. As part of an international team of experts for the State of Lower Saxony, the Gorleben International Review, he reviewed the plans of the nuclear industry to locate a reprocessing and waste disposal operation at Gorleben, West Germany. He presented evidence at the Sizewell B Inquiry on behalf of the Town and Country Planning Association (England) on transporting nuclear fuel through London. In July and August 1989, he was an invited guest of Japanese public interest groups, Fishermen's Cooperatives and the Japanese Congress Against A- and H- Bombs (Gensuikin).

Between 1974 and 1981, he was a lecturer at Rachel Carson College, an undergraduate environmental studies division of the State University of New York at Buffalo, where he taught energy and environmental courses. The years 1975-1977 he also worked for the New York Public Interest Group (NYPIRG).

In 1973, Dr. Resnikoff was a Fulbright lecturer in particle physics at the Universidad de Chile in Santiago, Chile. From 1967 to 1973, he was an Assistant Professor of Physics at the State University of New York at Buffalo. He has written numerous papers in particle physics, under grants from the National Science Foundation. He is a 1965 graduate of the University of Michigan with a Doctor of Philosophy in Theoretical Physics, specializing in group theory and particle physics.

Matthew Lamb

Matthew Lamb has been working in the radiation health field since 1996. He has vast experience in conducting site characterizations and risk assessments, as well as performing laboratory research. During his undergraduate studies at Northwestern, where he received a B.S. in Environmental Engineering, he obtained certification as a Department of Energy Radiological Control Technician while working at the Fermi National Accelerator Laboratory in Batavia, Illinois. He also performed an in-depth study of a "brownfield" site, acting as a consultant for a legal clinic representing community groups in the area. Mr. Lamb recently received his M.S. in Environmental Engineering and Science from Stanford, where he conducted research in microbiology as part of his Master's thesis. He has taken courses in Radiation Health Engineering, Hazardous Waste Management, Environmental Engineering Design, Numerical Modeling and FORTRAN programming.

Matthew Raymond Lamb
mrlamb@hotmail.com

EDUCATION:

Stanford University *June 1999*
Stanford, CA
Master of Science in Environmental Engineering & Science

Northwestern University *June 1998*
Evanston, IL
Bachelor of Science in Environmental Engineering, cum laude and departmental honors

WORK EXPERIENCE:

Web Page Designer, **Argonne National Laboratory, Argonne, IL.** Designed and created a waste minimization and pollution prevention web site using HTML and Microsoft FrontPage '98. *October 1998-present.*

Illinois EPA Graduate Intern in Pollution Prevention, **Argonne National Laboratory, Argonne, IL.** Created a laboratory chemical exchange system; performed cost-benefit analysis of potential savings due to waste minimization; developed the Argonne Chemical Exchange System web site. *June 1998-September 1998.*

Intern, Environment, Safety & Health Department, **Fermi National Accelerator Laboratory, Batavia, IL.** Developed a hazardous material recycling center; performed routine occupational exposure analyses; sampled and mapped radiation cooling exhaust systems; obtained Dept. of Energy Radiological Control Technician Certification; completed feasibility studies for waste minimization projects. *June 1996 –September 1996; March 1997 – September 1997.*

RESEARCH EXPERIENCE:

Stanford University: Currently working in a microbiology laboratory, researching enzymatic degradation of vinyl chloride and atrazine through DNA shuffling.

Northwestern University: Performed an in-depth site characterization and risk assessment (Tier I and Tier II) of an abandoned industrial site in Chicago, IL for undergraduate thesis project.

SPECIAL SKILLS:

Computers: Proficient in all Microsoft Office Programs, Microsoft FrontPage '98 desktop publishing system, Windows, Macintosh, or Unix operating systems. Knowledge of FORTRAN and MATLAB programming languages.