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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	ASLBP No. 97-732-02-ISFSI

APPLICANT'S RESPONSE TO STATE OF UTAH CROSS MOTION IN LIMINE REGARDING USE OF EFFECTIVE AREAS IN CONSEQUENCES CALCULATIONS

Pursuant to the order of the Atomic Safety and Licensing Board ("Board") in the pre-hearing conference of July 1, 2004, Applicant Private Fuel Storage, L.L.C. ("PFS") hereby files this reply to the State of Utah's Response to Applicant's Motion in Limine to Preclude New State of Utah Testimony Regarding Jettisoned Ordnance Impact Probability, dated June 21, 2004 ("State Resp.").[1] Because the State in its Response to PFS's Motion sought to have potential PFS evidence precluded from the upcoming evidentiary hearing, the Board characterized the Response as a cross motion and provided an opportunity for PFS and NRC Staff responses to it.

In its Response the State asserts that elements of the expert report prepared by Dr. Allin Cornell concerning the calculation of the unanalyzed event probability ("UEP") for the Private Fuel Storage Facility ("PFSF"), i.e., an upper bound on the probability that an aircraft crash or jettisoned ordnance impact would have significant structural consequences for the Canister Transfer Building ("CTB") or a spent fuel storage cask,[2] should

[1] See Applicant's Motion in Limine to Preclude New State of Utah Testimony Regarding Jettisoned Ordnance Impact Probability (June 9, 2004) ("PFS Motion").

[2] Probability Assessment of the Aircraft Crash Impact Hazard for the Private Fuel Storage Facility Based on Engineering Evaluations of Storage Cask and Canister Transfer Building Structural Integrity, Rev. 1 (January 2004) ("Cornell Report").

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be precluded from PFS's use on res judicata grounds because it "directly challenges the Board's impact probability formula for the cask storage area." State Resp. at 9. Thus, the State claimed that if the Board precluded the State's use of any evidence from the Thorne or McDonald Reports[3] on jettisoned ordnance in response to PFS's Motion, it should also preclude PFS's use of evidence from Dr. Cornell's report. Id. The State's cross motion should be denied. It mischaracterizes Dr. Cornell's work and wrongly equates it with the material concerning jettisoned ordnance impact probability in the Thorne and McDonald Reports to which PFS objected in its Motion.

I. BACKGROUND

A. The Board's Determination of Facility Effective Area

The Board calculated the probability of F-16 impact into the PFSF by using the "four-factor" formula traditionally used by the NRC to assess aircraft impact probabilities. Private Fuel Storage, L.L.C. (Independent Spent Fuel Storage Installation), LBP-03-4, 57 NRC 69, 112, 203 (2003). One of the factors is the facility effective area. Id. The effective area accounts for the possibility that a crashing aircraft could skid along the ground and hit the facility and the possibility that an aircraft that would otherwise impact the ground just behind the facility would hit an elevated portion of it. Id. at 215. The Board determined the effective area for the PFSF, which includes both the spent fuel cask storage area ("CSA") and the CTB, based on PFS's uncontested testimony. Id. at 214-15.

B. Dr. Cornell's UEP Calculations

In his report, Dr. Cornell calculates the UEP for the PFSF as the cumulative probability of aircraft crash or jettisoned ordnance impact events that are "unanalyzed" in

[3] M.C. Thorne, "Ordnance Impacts and Aircraft Crashes at a Proposed Private Fuel Storage Facility for Spent Nuclear Fuel in Utah: Summary of Probability Estimates," MTA/P0014/2004-1: Issue 2 (May 2004) ("Thorne Report"); Lt. Col. Louis N. McDonald, III (USAF), "Evaluation of Military Ordnance Impacts at the Proposed Private Fuel Storage Site in Skull Valley, Utah" (Sept. 2003) ("McDonald Report").

PFS's structural engineering evaluations. Those engineering evaluations analyzed certain crash or jettisoned ordnance impact events and showed that they would not cause a loss of structural integrity in the CTB or the spent fuel storage casks to be used at the PFSF. The other possible crash or jettisoned ordnance impact events at the PFSF remained "un-analyzed" and, without determining whether they would or would not cause a loss of structural integrity, Dr. Cornell added their probabilities to calculate the UEP, which he ultimately compared to the NRC's 10^{-6} per year aircraft crash (and jettisoned ordnance impact) hazard standard for spent fuel storage installations. See Cornell Report at 6-7.

In calculating the UEP, Dr. Cornell broke the problem down into three broad segments. First, he calculated the UEP contribution from potential jettisoned ordnance impacts at the PFSF. Second, he calculated the UEP contribution from potential F-16 crashes into the CTB. Third, he calculated the UEP contribution from potential F-16 crashes into the CSA, where the 4,000 spent fuel storage casks will be stored. He ultimately summed those contributions to yield the UEP for the PFSF. Cornell Report at 10.

To calculate the UEP for the CSA, which is what the State challenges in its cross motion, Dr. Cornell recognized, relying on PFS's engineering evaluations, that the consequences of an F-16 impact into the CSA (or more precisely which impacts could be taken to have no consequences) would depend on exactly what the aircraft hit and the speed and angle at which the aircraft was traveling at the time of impact. Id. at 20. That is, PFS's engineering evaluations had shown that impacts at certain speeds and angles would have no consequences while other potential speeds and angles were not analyzed. Similarly, with respect to impact locations, PFS's engineering evaluations provided different analyses for the side of the cask and the top of the cask. Thus, to properly apply the engineering evaluations to determine the UEP, Dr. Cornell had to focus separately on cask tops and cask sides. . See generally id. at 22-27.

Therefore, Dr. Cornell began his calculation of the UEP for the CSA by taking a close look at the relevant structures in the CSA—the casks as they would actually be arranged at the facility. He saw that the arrangement of the casks allowed the CSA to be modeled as "columns" of pairs of casks separated by empty space between each column. Each column was represented as a long rectangular building, with a roof corresponding to the cask tops and walls corresponding to the cask sides. See Cornell Report at 27-28, 35-44. This modeling allowed him to determine by geometry, using the dimensions of the columns and the flight path of the F-16, the probability that an impacting F-16 would strike a cask top and the probability that it would strike a cask side.. Id. at 35. He did so by expressing the relative collective sizes of the cask tops (i.e., the roofs of all of the columns) and the cask sides (i.e., the walls of all of the columns) as effective areas, or areas of the cask tops and cask sides as would be seen from the perspective of the crashing aircraft. See id. at 45-46 (Tables V-1 and V-2). His calculations of cask top and cask side effective areas are discussed in detail in Appendix B to his report.

The flight path of the F-16 is defined by its impact angle and the impact azimuth (compass heading) and a crashing F-16 in Skull Valley could exhibit many potential impact angles and azimuths. Therefore, Dr. Cornell performed multiple cask top and cask side effective area calculations, corresponding to different pairs of postulated F-16 crash impact angles and crash impact azimuths. See Tables V-1 and V-2. Dr. Cornell then averaged the effective areas across all azimuth intervals to yield an average or "azimuth weighted effective area" for the cask tops and sides for each impact angle interval.

To convert the "azimuth weighted effective areas" into impact probabilities, Dr. Cornell used the F-16 crash impact probability for the PFSF determined by the Board in the previous phase of this proceeding. He divided that probability by the effective area for the PFSF (as also determined by the Board) to arrive at an F-16 impact rate per square mile for Skull Valley. See id. at 12, 49. He then multiplied that impact rate by the effec-

tive areas for the cask tops and the cask sides as functions of impact angle, which are dictated by the geometry of the columns in the CSA, to yield probabilities as a function of impact angle that an F-16 would impact a cask top or cask side. See id. at 46-47 (Tables V-3 and V-4).[4]

Finally, Dr. Cornell used the cask top and side impact probabilities with information about the distribution of F-16 crash impact speeds and the results of PFS's engineering evaluations for the casks to calculate the UEP for the CSA, i.e., the probability of an impact event that had not been demonstrated to have no consequences. See id. at 48-49.

Thus, Dr. Cornell analysis focused on the probability that an aircraft would impact casks sides and cask tops so he could calculate the UEP with respect to such impacts. In doing so, he effectively – and properly – excluded aircraft impacts in the empty space between the columns of the casks.[5] The effective area of this empty space is obviously of no interest in calculating the UEP because an impact into empty space results in no consequences.

II. DISCUSSION

A. Res Judicata

PFS discussed the applicability of res judicata and collateral estoppel in its Motion. In sum, "the doctrine [of res judicata or collateral estoppel] precludes the relitigation of issues of law or fact which have been finally adjudicated by a tribunal of compe-

[4] The probability of impacting a cask side or a cask top is equal to the crash rate per square mile, ν, times the azimuth weighted effective area, times the impact angle probability, f_i, summed over all impact angle intervals. See Tables V-3 and V-4, p. 48. Dr. Cornell's calculations of "probability weighted areas" as functions of impact angle interval also include the "probability of speed > analyzed speed," i.e., the probability of the impact speed being above the bounding or analyzed speed defined for the cask top or the cask side for that angle interval. That factor converts the probability of impacting the cask top or side into the probability that an impact would contribute to the UEP (the engineering evaluations determined that impacts below the bounding speed would not cause a loss of cask structural integrity).

[5] Appendix B to Dr. Cornell's describes his effective area calculations for the cask sides and the cask tops and reflects the exclusion of empty space between the columns from the effective areas for sides and tops based on the methodology set forth in the Appendix.

tent jurisdiction in a proceeding involving the same parties or their privies." Toledo Edison Co. (Davis-Besse Nuclear Power Station, Units 1, 2, and 3), ALAB-378, 5 NRC 557, 561 (1977) (citations omitted). Collateral estoppel does not require the identity of the parties to or the claims asserted in the two proceedings. See Alabama Power Co. (Joseph M. Farley Nuclear Plant, Units 1 and 2), ALAB-182, 7 AEC 210, 212-13, remanded on other grounds, CLI-74-12, 7 AEC 203 (1974). It follows that when one NRC proceeding is divided into two phases, a party cannot relitigate in the second phase an issue adequately explored in the first phase. See Public Service Co. of New Hampshire (Seabrook Station, Units 1 and 2), ALAB-942, 32 NRC 395, 403 (1990) (prohibiting relitigation of emergency planning issues not materially different from those decided in earlier phase of reactor operating license proceeding). In any event, neither res judicata nor collateral estoppel apply here, because Dr. Cornell's calculations do not challenge the Board's prior determination of the facility effective area.

B. Dr. Cornell's Calculations Do Not Challenge the Board's Determination of Facility Effective Area

The State claims that Dr. Cornell does not use the value for effective area determined by the Board in the previous hearing; rather, he uses (as described above) the effective areas of the cask sides and the cask tops in the CSA. State Resp. at 8. Thus, the State asserts, Dr. Cornell "substantially diminishes the area of the cask storage area from that used by the Board when it ruled on the facility impact probability." Id. at 9.

The State misses several points in describing what Dr. Cornell did. First, it fails to recognize that the Board adopted an effective area for the entire PFS facility for aircraft impacts and an effective area for ordnance impacts, while Dr. Cornell broke the UEP problem for the facility down into three independent parts: ordnance impacts, aircraft impacts into the CTB, and aircraft impacts into the CSA. Cornell Report at 10. Thus, Dr. Cornell had to use different—and smaller—areas to evaluate the CTB and the

CSA than what the Board did in determining an aircraft impact probability for the entire site. Second, Dr. Cornell breaks the CSA down into its component parts of cask sides and cask tops (each collectively) and, effectively, empty space when he models the casks the CSA as columns to determine the probability of an aircraft impact a cask top, a cask side, or simply the ground. See id. at 27-28, 35-44; id. Appendix B. Thus, the effective areas of those components also had to be smaller than the effective area the Board used for the entire site.

Third, the Board's prior finding as to the effective area of the site (and an F-16 impact probability) is absolutely no bar to Dr. Cornell analyzing the consequences of aircraft impacts into different parts of that effective area. As discussed, Dr. Cornell shows that impacts into the cask tops area and the cask sides area have different potential consequences. What Dr. Cornell's analysis also shows is that certain impacts into what had been defined as the effective area for the PFS site (at least that portion representing the CSA) have zero consequences because they impact empty space.[6]

The constitution of the CSA can be more clearly seen in Figure 1.2-1 of the PFS Safety Evaluation Report, which shows the columns of casks (which are made up of tops and sides) and the empty spaces around and between them. All Dr. Cornell did is evaluate the area within the gross dimensions of the CSA to determine the critical areas that could give rise to consequences were they impacted by an F-16.

Thus, Dr. Cornell is not challenging the Board's determination of the effective area of the PFSF. Rather his analysis simply reflects that impacts into certain parts of that area would have no consequences. Therefore, the Board's prior determination of the

[6] He also showed that impacts into casks by the aircraft's wings alone, which had contributed to part of the overall effective area for the PFSF would have no consequences and hence the wings could be eliminated as contributors to the effective areas for the columns of casks. Cornell Report at 30-31 n.20.

effective area for the entire PFS site does not bar Dr. Cornell's use of the effective areas of the components of the CSA to evaluate the consequences of potential F-16 crashes.

C. Res Judicata Has a Different Effect on the Cornell Report Than It Does on the Thorne and McDonald Reports

In the July 1 teleconference, the Board asked the parties to discuss whether the principle by which the Board would decide the res judicata effect of its prior decision would apply to the material in the Cornell Report the same way it would apply to the material in the Thorne and McDonald Reports. Tr. 15012 (Farrar) ("[I]n other words, if the Applicant is correct about the State's Testimony, then is the State necessarily correct about Dr. Cornell's testimony? Or is that an independent question.") The State asserts that any res judicata effect of Board's prior decision would apply equally to the Cornell material as it would to the Thorne and McDonald material. The State claims that the same way Dr. Cornell considers that F-16 impacts may have different potential effects on cask sides and cask tops in the CSA, the Thorne and McDonald Reports "address the implications of impacts to individual casks from more than one ordnance being dropped from the 587 annual sorties flying over the PFS site that will be carrying heavy ordnance." State Resp. at 9. The State, however, is wrong.

The material in the Thorne and McDonald Reports to which PFS objected does not address the implications of ordnance impacts onto individual casks.[7] The Thorne Report, as quoted in the PFS Motion, asserts that:

> when either 500 pound bombs or 2000 pound bombs are jettisoned, there are two objects falling that could penetrate the casks. If these two objects are treated as independent in terms of their probability of impacting the facility area, the total value of [probability] P (and P_{eff}) is increased to 2.11 10^{-7} x 2 = 4.22 10^{-7} per year.

[7] The Thorne report does address the probability of ordnance penetrating a spent fuel cask given an impact, but PFS did not challenge that claim in its Motion.

Thorne Report at 4 (emphasis added), quoted in PFS Motion at 4. Thus, Dr. Thorne plainly states that he is addressing the "probability of impacting the facility area," not the individual casks as claimed in the State's Response. If Dr. Thorne were addressing the potential for impacts onto individual casks, he would have had to perform some kind of calculation similar to Dr. Cornell's that considered the areas of the casks as opposed to the area of the entire facility. However, Dr. Thorne did not do that. On the contrary, as he states in his report, Dr. Thorne is asserting that the Board's previously determined impact probability for the facility area ought to be doubled because of the possibility of an F-16 jettisoning two bombs or racks of bombs. Unlike Dr. Cornell's UEP calculations, Dr. Thorne's assertion is a direct challenge to the Board's prior determination of the effective area of the PFSF.[8]

Therefore, in response to the Board's question, res judicata does not apply to the material in the Cornell Report the same way it applies to the material in the Thorne and McDonald Reports. Dr. Cornell is effectively considering which fraction of the potential impacts onto the PFS site, whose probability was previously found by the Board, can be excluded because they demonstrably have no consequences. In contrast, Dr. Thorne is saying that the probability of ordnance impacting the site should be twice that previously found by the Board.

[8] As stated in its Motion, PFS objected to the State's use of the material in the McDonald Report to the extent that it was used to support a claim challenging the Board's prior determination of the probability of jettisoned ordnance impacting the PFS facility. See PFS Motion at 6-7.

III. CONCLUSION

In accordance with the foregoing, the Board should deny the State's cross motion regarding PFS's use of effective areas in its consequences calculations.

Respectfully submitted,

Jay E. Silberg
Paul A. Gaukler
D. Sean Barnett
SHAW PITTMAN, LLP
2300 N Street, N.W.
Washington, DC 20037
(202) 663-8000
Counsel for Private Fuel Storage L.L.C

Dated: July 13, 2004

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NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

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CERTIFICATE OF SERVICE

I hereby certify that copies of the "Applicant's Response to State of Utah Cross Motion in Limine Regarding Use of Effective Areas in Consequences Calculations" were served on the persons listed below (unless otherwise noted) by e-mail with conforming copies by U.S. mail, first class, postage prepaid, this 13th day of July, 2004.

Michael C. Farrar, Esq., Chairman
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: MCF@nrc.gov

Dr. Paul B. Abramson
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: pba@nrc.gov

Dr. Peter S. Lam
Administrative Judge
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
e-mail: PSL@nrc.gov

*Office of Commission Appellate Adjudication
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Office of the Secretary
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001
Attention: Rulemakings and Adjudications Staff
e-mail: hearingdocket@nrc.gov
(Original and two copies)

* Adjudicatory File
Atomic Safety and Licensing Board Panel
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Catherine L. Marco, Esq.
Sherwin E. Turk, Esq.
Office of the General Counsel
Mail Stop O-15 B18
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555
e-mail: pfscase@nrc.gov

John Paul Kennedy, Sr., Esq.
David W. Tufts, Esq.
Confederated Tribes of the Goshute Reservation and David Pete
Durham Jones & Pinegar
111 East Broadway, Suite 900
Salt Lake City, Utah 84105
e-mail: dtufts@djplaw.com

Diane Curran, Esq.
Harmon, Curran, Spielberg & Eisenberg, L.L.P.
1726 M Street, N.W., Suite 600
Washington, D.C. 20036
e-mail: dcurran@harmoncurran.com

Paul EchoHawk, Esq.
Larry EchoHawk, Esq.
Mark EchoHawk, Esq.
EchoHawk PLLC
P.O. Box 6119
Pocatello, ID 83205-6119
e-mail: paul@echohawk.com

* By U.S. mail only

Denise Chancellor, Esq.
Assistant Attorney General
Utah Attorney General's Office
160 East 300 South, 5th Floor
P.O. Box 140873
Salt Lake City, Utah 84114-0873
e-mail: dchancel@att.state.UT.US

Joro Walker, Esq.
Land and Water Fund of the Rockies
1473 South 1100 East
Suite F
Salt Lake City, UT 84105
e-mail: utah@lawfund.org

Tim Vollmann, Esq.
Skull Valley Band of Goshute Indians
3301-R Coors Road, N.W.
Suite 302
Albuquerque, NM 87120
e-mail: tvollmann@hotmail.com

D. Sean Barnett