

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:

Michael C. Farrar, Chairman
Dr. Peter S. Lam
Dr. Paul B. Abramson

In the Matter of

PRIVATE FUEL STORAGE, LLC

(Independent Spent Fuel Storage Installation)

Docket No. 72-22-ISFSI

ASLBP No. 97-732-02-ISFSI

February 24, 2005

MEMORANDUM

(Providing a Publicly-Available Version
of Today's Board Decision on F-16 Aircraft Accident Consequences)

The Licensing Board has today issued a decision resolving the last issue remaining before it, which involves the potential effect of F-16 aircraft crashes into concrete and steel casks that would be located at the proposed Private Fuel Storage facility. Given the nature of that issue, some of the evidence before the Board, and the Board's discussion of that evidence, must for obvious reasons be designated, in the NRC's vernacular, as "safeguards" and thereby by law and regulation withheld from public disclosure. Accordingly, two different versions of our decision are being issued today – one available to the public, and the other (the "official" one) available only to the litigating parties and to any reviewing tribunals.

Attached hereto is the publicly-available version of today's decision. It differs from the nonpublic version only in that its Part II contains a non-safeguards summary of the Board majority's reasoning on the crucial issues, rather than the full analysis in the non-public version.

In all other respects, the two versions are identical. Each is numbered by section, rather than consecutively from beginning to end -- thus, only the "B"-numbered Part II has different pagination (13 pages in the Public Version, 43 pages in the Safeguards Version). This public version also includes in toto the "D"-numbered dissenting opinion, which was framed to avoid including safeguards information.

With the issuance of this Memorandum and its Attachment, the Public Version of our decision – which is clearly designated as such on each page -- is being made available electronically to the parties; it will then be made accessible electronically through a direct link on the agency's public web site (and will later appear on the agency's ADAMS electronic document system) so that it will be readily available to any who are interested. The Safeguards Version, with sensitive information interwoven throughout its much longer Part II, may not be transmitted electronically, so hard copies are being provided to, and only to: (1) the parties who litigated this particular matter (the State of Utah, the Applicant PFS, and the NRC Staff); and (2) the NRC Commissioners (and subsequently any reviewing courts) who will consider and resolve any appeals from our decision.

Although there will be no public access to the Safeguards Version of today's decision, the Board intends to explore the extent to which there are non-sensitive portions of Part II of the decision that could be usefully extracted. If feasible, the Board eventually will prepare a redacted version that would be both published in the bound volumes of the periodic Nuclear Regulatory Commission Issuances and provided electronically in the agency's ADAMS system for public viewing and reference. If experience is any guide, any eventual redacted version, which would make more information available to the public, will take us some time to prepare because the parties' counsel and the agency's security experts will need to be heavily involved in the review process.

FOR THE ATOMIC SAFETY
AND LICENSING BOARD
/RA/

Michael C. Farrar, Chairman
ADMINISTRATIVE JUDGE

Rockville, Maryland
February 24, 2005

Copies of this Memorandum, and of the attached Public Version of the Board's February 24, 2005 Final Partial Initial Decision regarding F-16 Aircraft Accident Consequences, were sent this date by Internet e-mail transmission to counsel for (1) Applicant PFS; (2) Intervenors Southern Utah Wilderness Alliance, Skull Valley Band of Goshute Indians, OGD, Confederated Tribes of the Goshute Reservation, and the State of Utah; and (3) the NRC Staff.

ATTACHMENT:
PUBLICLY-AVAILABLE VERSION
OF
LICENSING BOARD'S FEBRUARY 24, 2005
"FINAL PARTIAL INITIAL DECISION"
ON F-16 AIRCRAFT ACCIDENT CONSEQUENCES

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

ATOMIC SAFETY AND LICENSING BOARD
Before Administrative Judges:

Michael C. Farrar, Chairman
Dr. Peter S. Lam
Dr. Paul B. Abramson

In the Matter of	Docket No. 72-22-ISFSI
PRIVATE FUEL STORAGE, LLC	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel Storage Installation)	February 24, 2005

FINAL PARTIAL INITIAL DECISION -- Public (Non-Safeguards) Version¹
(Regarding F-16 Aircraft Accident Consequences)

Overview and Summary. Over the last several years, this Board has resolved a large number of wide-ranging issues regarding the application of a nuclear utility consortium known as Private Fuel Storage to construct and to operate -- on a Goshute Indian Reservation in Skull Valley, Utah, 50 miles southwest of Salt Lake City -- an aboveground facility for the temporary storage of spent fuel from the nation's nuclear reactors. If created as planned, that facility would consist of an array of 500 concrete pads, each 67 feet by 30 feet, on which would sit 4,000 cylindrical storage casks, each nearly 20 feet in height and 11 feet in diameter. Each carbon-steel-encased concrete cask would hold a stainless steel canister housing spent fuel rods.

The only question remaining before us was raised by the State of Utah and concerns the risk to those casks and their contents presented by an accidental crash of one of the some 7,000 flights of F-16 military jets that head down Skull Valley each year. By a 2-1 vote (Judge Lam dissenting), we resolve that question in favor of the Applicant (whose position the NRC Staff supported). Issuance of the requested license is now for the Commission to consider (see

¹ Two versions of this decision are being issued: (1) the official one, which contains "Safeguards" information and thus cannot be released to the public; and (2) an unofficial one, containing no Safeguards information and thus available to the public. The differences between their respective contents are explained herein and in the Public Version's cover Memorandum.

p. 8, below, n.14 and accompanying text). In the rest of this introduction, we provide a brief summary of the facts and overview of the reasoning underlying our decision.²

1. Spent Fuel Logistics. Each of the 4,000 casks described above would be comprised of an “overpack” -- consisting in part of over two feet of concrete sandwiched between carbon steel shells (a 3/4-inch-thick outer shell, and an inner shell with attached liner totaling 2 inches) - - housing and protecting a 1/2-inch-thick stainless steel “multi-purpose canister” (MPC) resting inside it. The MPCs would have been loaded with spent nuclear fuel at different reactors around the country, welded shut, and moved to the site by rail (see p. A-5, below) in a government-approved transportation cask, at an average rate of about four a week for 20 years.

The rail cars would be off-loaded at the facility’s proposed Canister Transfer Building (CTB), with each MPC being shifted (unopened) from the transportation cask in which it arrived into one of the storage casks that will have been fabricated on site. After being loaded with an MPC, each cask would be straddled and lifted by a massive, heavy-haul dual-tracked transporter vehicle that would move the cask to a position on one of the concrete pads .

2. Previous Aircraft Crash Decision. Nearly two years ago, we issued a Partial Initial Decision³ on an earlier phase of this major safety issue raised by the State, which had intervened in the proceeding as part of its opposition to the PFS application for an NRC

² Because this is the last decision we will issue in the proceeding, and it may lead to license issuance, we believe it appropriate -- for the benefit of reviewing tribunals as well as of those interested in how the agency conducts its business -- to devote considerable attention herein to the procedural and substantive history of the issue before us, given its significance to the people of Utah and the Nation (see the agency’s Strategic Plan, NUREG-1614, Vol. 3, Part III (“Openness”)(Aug. 2004), stressing the importance of effective outreach and communication as an adjunct to the agency’s technical oversight of nuclear reactor and materials safety). In addition, all three Board members join in appending hereto information about the history of the proceeding which should be useful to various readers (see Appendix-1 to -15).

³ LBP-03-04, 57 NRC 69 (Mar. 10, 2003).

license.⁴ This safety issue, one of many presented to us by the State and now the last one pending, concerned the potential risk that accidental military jet crashes could damage the facility and thereby cause the release of radioactivity from the spent fuel rods held in the MPC.

The concern about such accidental crashes arose because pilots from Hill Air Force Base, northeast of Salt Lake City, annually make some 7,000 relatively routine flights down Skull Valley in F-16 single-engine fighter jets on their way to conducting intensive training maneuvers in the Utah Test and Training Range, located over the State's West Desert. Our earlier decision, following a lengthy evidentiary hearing, was that the probability of an accidental F-16 crash into the Applicant's proposed Skull Valley site was over four times too high to permit facility licensing (see Section 3, below) unless the potential consequences of such an accident were to be addressed in some fashion, such as by demonstrating their lack of significance or by guarding against them.⁵

3. "Credible Accident" Concept. The above-mentioned "probability" and "consequences" concepts come into play because nuclear facilities, such as power plants or spent fuel storage sites, must be designed to withstand all accidental events which are sufficiently likely to occur (while causing radiation releases in excess of specified limits) as to be deemed "credible" threats. Under the regulatory standard applicable here (see p. A-9, below), if the probability of such a radiation release from an accidental crash of one of the F-16s is less than one in a

⁴ The State's broadscale and enduring opposition to the PFS proposal has been manifested here and in other forums. In that regard, the United States Court of Appeals for the Tenth Circuit recently affirmed a federal District Court's invalidation of certain State statutes designed to block the facility. See Skull Valley Band of Goshute Indians v. Nielson, 376 F.3d 1223 (Aug. 4, 2004), affirming Skull Valley Band of Goshute Indians v. Leavitt, 215 F. Supp. 2d 1232 (D. Utah 2002), petition for cert. filed (Oct. 28, 2004) sub nom. Nielson v. Private Fuel Storage, No. 04-575. See also Bullcreek v. NRC, 359 F.3d 536 (D.C. Cir. 2004) (rejecting the State's theory that the NRC lacks authority to license a privately-owned away-from-reactor spent fuel storage facility).

⁵ See LBP-03-04, 57 NRC at 77-78, 135. That first phase of the aircraft crash issue became known colloquially as the "probability" phase, and the current, second phase as the "consequences" phase. As will be seen, those categorizations turned out to be not fully descriptive. See p. 5, below.

million per year, such crashes need not be considered in designing the facility (in NRC parlance, are not “credible accidents”) and therefore do not pose a barrier to licensing the facility.

The first portion of our proceeding addressed the preliminary question of only the probability of an accidental crash of an F-16 into the site,⁶ for if that probability had proven to be less than one in a million, the Applicant would have prevailed without having to present further analysis. With the evidence showing that probability to be over four in a million per year, however, this second portion has focused upon a more refined question: whether there is a probability greater than one in a million per year that an accidental crash of an F-16 would have the consequence of breaching a canister and thereby causing a release of radiation.⁷ For if not, the facility would need not be designed to withstand such an accidental crash and would not on that ground be denied a license.

4. Recent Aircraft Crash Hearing. In the aftermath of our first F-16 crash decision, and of the Commission’s declining to review it at that juncture (CLI-03-05, 57 NRC 279 (May 28, 2003)), the Applicant attempted to show, at a 16-day evidentiary hearing before us in late

⁶ For purposes of determining that probability, a standard formula was employed (see p. A-12, below). See generally LBP-03-04, 57 NRC at 87-88, 114-22._____.

⁷ As will be seen, the Applicant chose not to attempt to demonstrate that a radiation release, if it occurred, would not cause doses in excess of applicable limits (see pp. A-15 to A-16, below). Rather, it chose to hold itself to a more stringent test by attempting to establish that no radiation release whatsoever would result from any accidental crash deemed credible. See p. A-15, below.

summer, 2004,⁸ that its storage casks were already designed robustly enough to alleviate the crash concern.⁹ More specifically, the Applicant -- pointing to (1) the structure of the proposed storage casks and (2) the pattern of the actual F-16 crashes that have occurred worldwide -- urged that, even if an F-16 did crash into the site, such a crash was so unlikely to cause cask and canister damage resulting in radiological release that, under the “less than one-in-a-million” probability standard, the residual risk was an acceptable one to take.

Before the hearing began, the Applicant chose not to present evidence on possible radiological consequences from a breached canister, but to focus instead just on the probability that there would be no such breach. Accordingly, it could be said that this second phase of our hearing dealt not with classic accident “consequences” in a radiological release sense but with a consequences-oriented refinement, focusing on canister damage, of the initial site-related “probability” analysis. See p. A-15, below; LBP-03-04, 57 NRC at 78; and CLI-03-05, 57 NRC at 283-84. But see LBP-03-04, 57 NRC at 136 n.110, anticipating just such a segmentation of the issues.

⁸ As adverted to in note 1, above, and in the cover memorandum to the Public Version of this decision, that hearing had to be closed to the public to protect from disclosure certain information -- referred to as “Safeguards” because it involves safeguarding nuclear materials -- relating to analyses of cask characteristics, and the impact of aircraft crashes thereon, that could be of interest to potential terrorists. For similar reasons, the public will be able to review only the conceptual framework, not the detailed analysis, which supports our decision (see p. 9, below). Our detailed fact-finding and reasoning -- related to the extent, or lack thereof, of structural damage caused by aircraft impacts at particular speeds -- must be withheld from the public.

We would, however, point out to residents of Utah, and to other interested persons, that counsel from the State Attorney General’s office participated fully in opposing the facility during the hearing. Counsel had the opportunity to challenge all the evidence in favor of the project and to present evidence on behalf of those opposed to it. Those same State counsel will now be in position to scrutinize, and if desired to challenge, our full decision. In that regard, that full decision, including the non-public versions being served on the parties today, will be available to any reviewing tribunals (see n.15, below).

⁹ At one point, the Applicant sought approval to begin building an interim, smaller facility. That plan involved storing a reduced number of casks (336 instead of 4,000), thus taking up less space and presenting a smaller “target” area (see p. A-7, below), and arguably reducing the probability of a military jet crash to acceptable levels. The Applicant did not pursue that interim step after we initially rejected it on procedural grounds. See May 29, 2003 Tr. at 13729-855 (oral argument), 13857-59 (Board ruling); see also Tr. at 13859-75 (anticipating possible further proceedings).

Just as vigorously as the Applicant presented its position that the probability of a consequential breach-causing crash was low enough to be ignored, the State urged the opposite, through witness testimony and documentary evidence of its own indicating that the probability was too high.¹⁰ The NRC Staff, having, as part of its regulatory function, put a lengthy, time-consuming series of questions to the Applicant before the hearing, came to the hearing essentially supporting the Applicant's position.

5. Today's Split Board Decision.¹¹ Upon review of all the evidence, Judges Farrar and Abramson find themselves essentially in agreement with the Applicant and NRC Staff on the key issues before us. As that majority of the Board sees it, the evidence -- including analytical and experimental data, and computer simulations based thereon -- establishes, based on the properties and shape of the concrete and steel "overpack" cask and of the stainless steel internal canister, that an F-16 crashing at or below a particular rate of speed and angle of impact (the "bounding impact," which is non-public Safeguards Information) would not damage a canister. Further, the nature of F-16 flights down Skull Valley, and the data that can be gleaned from the reports of prior F-16 crashes worldwide in circumstances akin to Skull Valley

¹⁰ With "risk" being made up of both probability and consequences factors, for simplicity it is often sufficient to focus on only one of those elements. Thus, if the consequences of an accident are shown to be not significant, no attention need be paid to the actual probability of that accident, for it does not matter if it occurs. Conversely, if the probability of an accident is sufficiently low, the consequences need not be examined, for even if they be assumed to be excessive, they need not be guarded against. (See the NRC Staff explanation preceding the opening of the Salt Lake City hearings (April 8, 2002 Tr. at 2997-99); our LBP-03-04 discussion (57 NRC at 138); and the Commission's explanation in an opinion herein, 57 NRC at 283-84.)

¹¹ In May 2003, the Commission expressed its belief that we should be able to issue today's decision by the end of that calendar year, i.e., nearly 14 months ago. See 57 NRC at 284-85. Much of the extra time, whose causes we reported to the Commission at each stage, was taken by the Staff's pursuit of additional questions in performing its pre-hearing regulatory review, and the Applicant's need for additional time to respond to those questions. In any event, all three Board members summarize in the Appendix our thoughts about the time consumed by this phase of the proceeding, both to complete the report the Commission expected, and to pass along our view that: (1) the extra time the parties took contributed much to the thoroughness and completeness of our evidentiary record; and (2) the course of this proceeding may be instructive in shaping expectations for future, similarly complex proceedings, especially in illustrating how large portions of time are outside Board control.

operations, reveal that there is over an 80% likelihood that the accidental crash of an F-16 into the site would be at a less severe speed and angle than the bounding impact and thus not damage a canister.

As a result, by virtue of the refined analysis presented by the Applicant and NRC Staff during the most recent hearings, the previously-determined over four in a million per year likelihood of a crash into the site (a relatively unsophisticated inquiry) has now been superseded by a more detailed inquiry. The latest analysis establishes that the likelihood of a crash causing a canister breach is somewhat less than one in a million per year.

Although the calculated probability seems to pass the applicable standard only marginally, the Board majority goes on to point out that there are at least four factors, not considered quantitatively in determining the probability, that can be seen qualitatively as serving to reduce that probability to an appreciable degree. These conservatisms involve: (1) the likelihood that, rather than being a “direct hit” causing the greatest damage, a crash could be off-center, a factor not considered in the evidentiary calculations; (2) the likely damage to an aircraft, and the reduction of its destructive force, that would occur if the plane hit short of the casks and skidded into them, a possibility that was analyzed at trial as though the crashing plane would continue unimpeded by its skid; (3) the possibility that before ejecting a pilot would attempt to direct the aircraft away from the site, a factor that -- although we declined to give the Applicant the “almost certain” credit for it being sought at the prior hearing -- has some support in the prior opinion testimony and anecdotal evidence and could thus justify some (albeit much smaller) credit; and (4) the possibility that the “bounding impact,” below which canister breach was demonstrated not to occur, might upon further analysis be found to be slightly higher and thus move more crash scenarios into the “no-breach” category.

These additional conservatisms make the Board majority more comfortable with the degree to which the proposal meets the Commission’s standards than it would be without them. On the other hand, Judge Lam’s dissenting view is that there are too many areas -- including

the historic crash data, the expansive regression analysis, the curve-fitting methods, and the stainless steel behavior in the plastic range -- in which gaps in scientific and technical knowledge undercut the degree to which reliance can be placed on the evidence and the analyses. In his dissenting opinion, he explains why he is thus unwilling to credit the Applicant's and Staff's case sufficiently to approve the project.

6. PFS License Authorization Process. With our decision herein denying the State's assertions on the military aircraft accident issue, all the contentions raised by project opponents have now been considered by the Licensing Board¹² and resolved in the Applicant's favor in one fashion or another.¹³ Thus, under agency rules governing facilities of this nature, it is now up to the Commission to determine whether to authorize the NRC Staff to issue the requested license.¹⁴ Our decision is subject to review by the Commission and by higher tribunals.¹⁵

We build upon the foregoing Overview in Part I below (pp. A-1 to A-17) (Part I contains no Safeguards-related information and will thus be identical in each version of this decision). There we set out the procedural and substantive background that frames the parties' dispute.

In Part II, we provide our analysis of the evidence and explain how we arrived at the findings and reasoning outlined conceptually in this Overview. That discussion of the merits of

¹² As will be detailed, the changing membership of the Licensing Board over the course of the proceeding has not affected our continuity of function.

¹³ See LBP-03-04, 57 NRC at 84. Only now, with our rulings at an end, would some of our earlier rulings have ordinarily become appealable. But the Commission anticipated the need to conserve time when we eventually reached this juncture and previously called upon the parties to file their petitions for review of earlier Board rulings some time ago, rather than await today's completion of Board involvement. CLI-03-16, 58 NRC 360 (2003). The Commission has since addressed, and rejected, those asserted claims of error in our prior interlocutory rulings. See CLI-04-04, 59 NRC 31 (2004); and CLI-04-22, 60 NRC 125 (2004). See also CLI-03-08, 58 NRC 11 (2003) (affirming our earlier partial initial decision on seismic issues); CLI-04-16, 59 NRC 355 (2004) (addressing an earlier decision on financial issues).

¹⁴ See p. C-2, below, citing 10 C.F.R. § 2.764(c); compare id. § 2.764(a)-(b).

¹⁵ Our "Initial Decisions" are, as that term implies, not this agency's last word -- our rulings are subject to review by the five Commissioners who head the NRC and make the final decisions on behalf of the agency. Commission decisions are in turn reviewable by a federal Court of Appeals and may thereafter be considered by the Supreme Court of the United States.

the issue focuses on the three major sub-issues in the case: evaluating the strength of the cask structures; characterizing the historic F-16 crashes; and determining the uppermost probability that a crash into the site would have radiological consequences. (Because Part II is where “Safeguards” information appears, the *Public Version* of this decision contains only a brief, general, non-Safeguards summary, with pages numbered from B-1 to B-13. The complete reasoning in the *Safeguards Version*, available only to the parties and to reviewing tribunals, has pages numbered from B-1 to B-43.¹⁶)

Based on the Part II analysis, we are able in Part III (pp. C-1 to C-7) to bring matters to a conclusion (Part III, like Part I, contains no Safeguards-related information and is identical in both versions). We there recite briefly our formal Conclusions of Law and our Order and add our closing thoughts.

Judge Lam’s dissent appears after our decision. It was framed to avoid inclusion of Safeguards-related information, and thus its pages are numbered D-1 to D-7 in each version.

After that dissent, we present in an Appendix some ancient and some recent history about the case. The former relates primarily to other issues that were raised, and to certain principles that govern our proceedings, and is offered for the benefit of those who may not be familiar with those matters. The latter, intended to complete the report expected by the Commission (see note 11, above), indicates what occurred, and what was accomplished, in the time consumed since our first aircraft crash decision.

¹⁶ In our previous decisions herein, we included both a “Narrative” section addressing the crucial questions presented by way of an opinion, and another section that presented the more traditional and detailed “Findings of Fact.” While this had the virtue of thoroughness, it did so at some cost in terms of both preparation time and overlapping rationales. Accordingly, we began discussing with the parties some time ago a different approach intended to shorten our decision-writing tasks at this juncture. See Tr. at 13912, referred to in our unpublished September 9, 2003, “Scheduling Order and Report,” p. 7, n.10.

Although no specific resolution was agreed upon then, our decision herein is constructed differently from the earlier ones. We still employ a narrative format to explain the reasoning which leads us to the key determinations that drive our decision, but that narrative reflects only those findings that are relevant to the matters in issue, while omitting recitations of background or noncontroversial facts upon which all parties agree or which are not necessary for comprehension of the reasoning supporting our decision.

I. PROCEDURAL AND SUBSTANTIVE BACKGROUND

In this Part of our decision, for completeness but at the risk of repeating some of what appeared in the opening summary, we first review the procedural history of the litigation over the PFS application, with particular emphasis on the “credible accidents” contention now being decided on its merits. We next provide certain fundamental background information about the tangible aspects of the case: the Skull Valley geographic setting, the Air Force’s training operations, and the Applicant’s facility design. We then go on to recap the accidental aircraft crash decision-making process, including the manner in which our “probability” decision of two years ago, and the information-gathering since then, shaped the substance and timing of today’s “consequences” decision.

A. Procedural History. The Applicant’s proposal was noticed for hearing on July 31, 1997.¹⁷ The State of Utah, along with a number of other parties, responded by requesting a hearing; eventually, those parties filed some 125 contentions challenging the proposed facility for various safety or environmental reasons.¹⁸ On September 19, 1997, a Licensing Board was established to rule on petitions for hearing and for leave to intervene, and to preside over any adjudicatory proceedings that might be held in connection with the license application.¹⁹

The Board granted the State of Utah’s request for a hearing, along with that of several other parties, and ruled that a number of contentions, in whole or in part, satisfied the Commission’s requirements for admission as contested issues in this proceeding.²⁰ Other

¹⁷ See 62 Fed. Reg. 41,099 (1997).

¹⁸ See LBP-98-07, 47 NRC 142, reconsideration granted in part and denied in part on other grounds, LBP-98-10, 47 NRC 288, aff’d on other grounds, CLI-98-13, 48 NRC 26 (1998).

¹⁹ 62 Fed. Reg. 49,263 (1997). The Licensing Board was reconstituted three times during the course of the proceeding. Early on, Judge Murphy was replaced by Judge Lam. Later, a second Board was created with Judge Farrar as Chairman, but with the original Board, chaired by Judge Bollwerk, retaining jurisdiction over certain pending matters. Last year, Judge Kline was replaced by Judge Abramson on the Farrar-chaired Board. See 62 Fed. Reg. 52,364 (1997), 66 Fed. Reg. 67,335 (2001), and 69 Fed. Reg. 5374 (2004).

²⁰ See LBP-99-07, 47 NRC at 247-49.

contentions were raised and ruled upon from time to time thereafter, to which we need not pause to provide references. The last State contention arose very recently, in mid-November of last year; our ruling explaining why it did not warrant further consideration was issued earlier today. See LBP-05-05, 61 NRC ____ (February 24, 2005).

All but one of the contentions originally or later admitted have since been resolved through legal rulings, evidentiary decisions, or settlement agreements, leaving before the Board only the State's "credible accidents" Contention Utah K (its derivation is recounted at pp. A-4 to A-5, below). Of the 45 days of evidentiary hearings in 2002, a good portion was spent on what turned out to be the first phase of Contention Utah K. Our decision on those matters, issued March 10, 2003, eventually led to the second phase of the hearing, which began on August 9, 2004 and finished on September 15, 2004.

Owing to the sensitive information involved, the second hearing had to be closed to the public. That factor, along with the relative ease and assurance of document safeguarding at our DC-area headquarters location (as opposed to space obtained elsewhere), dictated that the closed hearing be held in our courtroom in Rockville, Maryland.²¹

Speeded somewhat by some novel techniques we employed (see App. 10-11, nn.17-20, below), the hearing took 16 days, during which we heard testimony from 18 witness panels, composed of various combinations of 20 different expert witnesses, who among them sponsored some 225 exhibits. That all generated some 4500 transcript pages of live

²¹ It should be noted that, although the hearings were "closed," they were not held in a "secretive" manner -- no information upon which our decision is based was unavailable to the parties, and no decision-makers met privately with any party. To the contrary, at all sessions, all three parties -- the Applicant PFS, the Intervenor State of Utah, and the NRC Staff -- were represented by counsel, and each had full opportunity to present its own witnesses, to cross-examine opposing witnesses, and to introduce (or to oppose the introduction) of documentary evidence.

A court reporter prepared a verbatim transcript of the entire closed proceeding. That Transcript, and all the other evidence in the case, has been available to counsel for all the parties, including the State, and will be available to the Commission and to any federal courts that may be called upon to review our decision.

exchanges, in addition to some 600 pages of pre-filed direct and rebuttal testimony that was, as is typical, bound into the record as if read.

The parties then submitted their two sets of post-trial briefs, in the form of opening and reply “Proposed Findings of Fact and Conclusions of Law” totaling over 900 pages. The last of those briefs was filed on November 19, 2004, and was thought to trigger the formal period for preparation of our decision.²²

Upon examination of those briefs, however, we believed that an assertion by the State in its reply brief concerning an alleged serious deficiency in the NRC Staff position needed further exploration. Having heard nothing from the Staff, on December 1, 2004, we issued an “Order Directing Clarification of Record,” calling upon the parties to provide us in rapid fashion additional position statements and record references that would clarify how the concerns we expressed were addressed in the record.

We duly received materials first from the State, then from the Staff and Applicant. The State then declined a chance to file a final response, expressing the view that it need not do so if no reliance was to be placed on what it viewed as additional materials the Staff had impermissibly provided without seeking to reopen the record.²³ At that point, we indicated in an email advisory to the parties that the State’s filing, received December 22, would be deemed the final brief on the merits.²⁴

²² The Commission urges that a decision should typically be rendered within 60 days of the filing of the final briefs. See Statement of Policy on Conduct of Adjudicatory Proceedings, CLI-98-12, 48 NRC 18, 21 (1998).

²³ NRC Staff’s Response to Licensing Board’s Order Directing Clarification of Record (Dec. 16, 2004) at 9-11, where the Staff urged that the State had impermissibly sought to reopen a closed record while, seemingly inconsistently, presenting its own new materials.

²⁴ See n. 22, above, and accompanying text. During the briefing period, the State had also sought leave to file a new contention based on information that had only recently come to its attention. The briefing of that matter overlapped with the briefing of the clarification we had sought related to the structural evidence. Similarly, the preparation of our decision on that new contention, issued earlier today (see p. A-2, above), overlapped with preparing this decision.

B. Pending Contention. The issue that has thus occupied so much of our attention the past several years had its genesis in the portion of consolidated Contention Utah K that concerned alleged “credible accident” scenarios that could result in impermissible radiological releases from the proposed storage facility.²⁵ The Board combined the State’s contention with similar contentions introduced by two other parties²⁶ that raised similar issues regarding consideration of credible accidents.²⁷

After a series of rulings,²⁸ Contention Utah K was winnowed down to the following:

The Applicant has inadequately considered credible accidents caused by external events and facilities affecting the [independent spent fuel storage installation], including the cumulative effects of military testing facilities in the vicinity.²⁹

In early follow-on rulings, however, the Board dealt with a number of aspects of those military operations.³⁰ Thus, as the time for trial approached, there were left, to be the subject of

²⁵ See LBP-98-07, 47 NRC 142, 190 (1998).

²⁶ The consolidated parties were (1) Confederated Tribes of the Goshute Reservation and (2) Castle Rock Land and Livestock and Skull Valley Company (collectively Castle Rock), and the combined contention was originally designated as Contention Utah K/Castle Rock 6/Confederated Tribes B. See LBP-98-07, 47 NRC at 157, 247 (1998).

²⁷ As first consolidated, the Contention read as follows (see LBP-99-07, 47 NRC at 253):

The Applicant has inadequately considered credible accidents caused by external events and facilities affecting the [independent spent fuel storage installation] and the intermodal transfer site, including the cumulative effects from the nearby hazardous waste and military testing facilities in the vicinity and the effects of wildfires.

²⁸ See LBP-99-34, 50 NRC 168 (1999); LBP-99-35, 50 NRC 180 (1999); LBP-99-39, 50 NRC 232, 237-38 (1999).

²⁹ LBP-99-39, 50 NRC 232, 240 (1999). On May 31, 2001, the Board granted in part, and denied in part, the Applicant’s motion for partial summary disposition of various aspects of Contention Utah K. LBP-01-19, 53 NRC 416, 455-56 (2001).

³⁰ See LBP-03-04, 57 NRC at 86 (citing LBP-01-19, 53 NRC 416 (2001), which disposed of such matters as those related to general aviation, cruise missiles, and the use of military ordnance).

evidentiary presentations, only the matters eventually covered in our earlier “probability” opinion.³¹

C. Substantive Information. As seen above and in the Appendix, this litigation has a complex procedural background. In contrast, its substantive background may be described relatively simply.

1. Geographic Setting. Skull Valley is framed by the Stansbury Mountains to the east and the Cedar Mountains to the west. Its width varies, but for purposes of this general description the Valley can be regarded as some 10 miles wide. To the north of the Valley is the southern end of the Great Salt Lake. A bit south of the Lake, Interstate 80 runs in an essentially east-west direction (paralleled by the main line of the Union Pacific Railroad just to its north).

An exit from I-80 partway across the Valley provides access to Skull Valley Road, which runs north-south down the Valley all the way to the Dugway Proving Ground. Some 25 miles south of I-80, the road passes through the Reservation of the Skull Valley Band of Goshute Indians. The Band has leased some of its land west of the road to the Applicant for the proposed temporary facility for aboveground storage of spent nuclear fuel.

At one point, the Applicant planned to use Skull Valley Road as a truck route to bring the spent fuel on the last leg of the journey from various reactors around the country. But the Applicant later proposed to construct a rail spur, off the main line of the Union Pacific (which by then has cut south of I-80), down the west side of the Valley to the facility. After an evidentiary hearing on the environmental and wilderness issues involved, we rejected the Southern Utah Wilderness Alliance’s challenge to that rail-line proposal. LBP-03-30, 58 NRC 454 (2003).³²

³¹ In addition to considering the F-16s headed down Skull Valley, the evidence at the first hearing, and our decision thereon, involved possible site impacts stemming from flights on the so-called “Moser Recovery Route,” emergency landings at Michael Army Air Field (at the Dugway Proving Ground), dropped ordnance, and operations in the Utah Test and Training Range itself. See 57 NRC at 122-32.

³² Although we held that wilderness values were neither apparent in the area in question nor affected by the rail spur, we noted (LBP-03-30, 58 NRC at 475-76) that the final word as to wilderness designations lay with the U.S. Congress.

2. Military Operations. The matter before us arose because military aircraft from Hill Air Force Base, northeast of Salt Lake City, are regularly flown down Skull Valley on their way to the Utah Test and Training Range (UTTR), the nation's largest overland training area, located to the west of the Cedar Mountains in the State's West Desert. Put simply, the flights down the Valley are relatively routine in nature, as the pilots get themselves and their craft prepared to participate in very intensive training maneuvers in the UTTR, which they enter by, in effect, making a U-turn at the southern reach of the Valley. See 57 NRC at 110 n.68.

As this litigation developed, the focus came to rest on the 7,000 or so flights a year pilots make in the Valley in the F-16, a single engine fighter aircraft. Not surprisingly, the historic crash rate of that aircraft, and the causes of those crashes, as well as the speed and angle of the planes at impact, became the subject of extensive evidentiary presentations in the two sets of hearings we held on this subject.

Although we cover that evidence in detail in Part II below, it is worth noting at this juncture that a good proportion of F-16 crashes stem from engine failure. When faced with that emergency, pilots are trained to "zoom" their aircraft, thereby trading their forward speed for a higher altitude and therefore gaining more time to deal with the emergency. The planes' trajectory and the pilots' activities after the conclusion of the zoom maneuver were the subject of extensive testimony in both sets of hearings, and we discuss in Part II the extent to which the zoom maneuver and its typical aftermath help us in predicting patterns of crash impacts and angles.

3. Facility Design. As noted above, the Multi-Purpose Canisters (MPC's) containing spent fuel from various nuclear reactors around the country are to arrive by rail at the facility's Canister Transfer Building. There, each MPC would be removed from the transportation cask in which it traveled from the reactor to the site and place in a concrete and steel storage cask, fabricated on site, which would then be moved to the concrete storage pads by a massive transporter.

The storage area would employ 500 such pads, each 30 feet wide by 67 feet long, sized to hold eight cylindrical storage casks upright in a 2 by 4 array. The pads would be arranged in two cohorts, each consisting of 25 columns of 10 pads laid end to end. The two cohorts of pads would be separated by 150 feet.

The distance between each of the end-to-end pads in a column would be five feet. In contrast, the side-to-side distance between pads in adjacent columns would be 35 feet, providing a passageway for crawler access to the four cask locations on the nearer side of each pad to its left and right.

This pad/cask geometry comes into play, of course, in calculating both (1) the spatial parameters of the “target” that would be presented to a crashing aircraft (the “A” factor, representing site Area, in the screening formula (see p. A-12, below) that was a focus of the first phase of the aircraft proceeding), and (2) the subsequent interaction among casks, and between plane and casks, after an initial crash impact. For example, because the severity of impacts to the side of a cask depends on the flight angle, the array of casks closest to the approaching plane provides to the casks behind them some degree of shielding.

D. Decision Process. Contention Utah K’s long history before the Board was set out in Section B, above. Two key steps we took along the way were to limit the scope of that contention by granting in part the Applicant’s motion for summary disposition (LBP-01-19, 53 NRC 416) and, after lengthy hearings, to decide the “probability” phase of the contention (LBP-03-04, 57 NRC 69). We focus below on that latter phase, and the manner in which it led to the current phase.

1. “Credible Accidents.” Stated simply, of concern during the first “probability” set of hearings was the likelihood of an accidental aircraft crash into the proposed facility, for nuclear facilities have to be designed against only those radiation-releasing accidents that are sufficiently likely to be deemed “credible.” In other words, if the possibility of such an accidental crash occurring proved too remote, then the Applicant did not have to protect against that

possibility. To that simple statement, however, need to be added two explanations -- one very short, the other not so.

In the first place, long-standing Commission precedent circumscribes Board hearings by explaining that they are not the place to consider deliberate terrorist-type attacks. That precedent was followed here.³³

Secondly, the “credible accidents” test deserves more explanation in light of the complicated, two-part proceeding that has taken place here. To go back to the beginning, the admission of the State’s “credible accidents” contention required us, in theory, to undertake a detailed examination of the probability of radiation release from aircraft crashes. In that respect, the Commission has, over the years, developed a standard for determining which events must be considered in the design of nuclear power reactors.

For consideration of aircraft accidents, the standard is that “if the probability of aircraft accidents resulting in radiological consequences greater than 10 CFR Part 100 exposure guidelines is less than about” one in ten million per year,³⁴ that potential accident need not be considered in the design of the facility³⁵ (according to these guidelines, an event which must be

³³ To be sure, one of the reasons behind closing our hearing to the public was to keep crash impact information and analyses out of the hands of those who might deliberately put them to nefarious use. But the scope of the hearing involved only the threat posed by accidental crashes, not deliberate ones. This limitation follows the agency’s long-term practice, dating from the days of the Atomic Energy Commission (see Long Island Lighting and Power Co. (Shoreham Nuclear Power Station), ALAB-156, 6 AEC 831, 851 (Appeal Board, 1973)) and renewed after the events of September 11, 2001, that agency hearings are not the place to attempt to address concerns about terrorism. CLI-02-25, 56 NRC 340 (2002), discussed at 57 NRC at 78 n. 4.

Instead, protection of nuclear facilities against terrorism has been undertaken by the Commission itself -- outside the hearing process -- in conjunction with other federal agencies, civilian and military. In a word, then, the protection afforded the PFS site (or any site housing spent nuclear fuel) against deliberate aircraft crashes is viewed as coming not from a Board hearing attempting to evaluate that possibility, but from the federal initiatives attempting to prevent that possibility.

³⁴ See, e.g. CLI-01-22, 54 NRC 255, 260 (2001), referencing NUREG-0800 at 3.5.1.6, wherein the quoted material is set out, and see .

³⁵ NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (Rev 2) (July 1981) at 3.5.1.6, Section I, and Section II, subsection 1, final paragraph (stating the converse).

considered is referred to as a “design basis event” or a “credible accident”).³⁶ Because of the nature of the facility at issue here, however, the Commission established a different threshold probability for a design basis event -- at a PFS-like facility it is one in a million per year, rather than the one in ten million standard applicable to nuclear power reactors.³⁷

A key to understanding this stage of the proceeding involves appreciating that, while prior rulings may have referred -- in shorthand fashion -- simply to the probability of an aircraft crash into the site, what is now (and always has been)³⁸ at issue is the probability of a radiation release caused by such an aircraft crash. In other words, the event that has to be guarded against is an accident causing a release. This is what the Commission addressed, and it is the event that was examined and described in the Standard Review Plan (NUREG-0800) to which the Commission referred in ruling that the appropriate threshold probability for a PFS-like facility is one in a million (the “designated threshold”).³⁹

To our knowledge, in every previous case before a Licensing Board (and/or the Commission), the determination as to whether or not a potential radiation release from an aircraft crash was a “credible accident” was resolved by simple examination of the probability of a crash into the site. For if that probability itself is lower than the threshold, the inquiry need go

³⁶ See, e.g., CLI-01-22, 54 NRC at 259.

³⁷ At the outset, based on pleadings the parties had filed with us, we sought the Commission’s formal guidance on whether the standard determining the credibility of accidents that might affect nuclear power plants -- one in ten million per year -- should be relaxed for facilities like that proposed by the Applicant here. The Commission responded by setting the one in a million standard, meaning that this facility need be concerned only with events ten times more likely to occur than the even rarer ones that nuclear power plants need to guard against.

More specifically, we made an initial ruling on the design standard for accidental aircraft crashes at the proposed facility and found that the facility need not be designed to withstand aircraft crashes having less than a one-in-a-million (1×10^{-6}) chance of occurring. See LBP-01-19, 53 NRC at 430-31 (2001). But recognizing the novelty of that ruling, and the pivotal role that it would play in the eventual outcome, we sought formal advice by referring our interlocutory ruling to the Commission for its determination. The Commission accepted our referral and upheld our determination. CLI-01-22, 54 NRC at 257 (2001).

³⁸ See LBP 03-04, 57 NRC at 136.

³⁹ Ibid.

no further -- regardless of the potential radiation consequences, the sheer unlikelihood of the accident's occurring at all removes any need to look into how severe it might be. This led to the shorthand way of describing the issue.

On the other hand, if the probability of a crash itself were known in advance to exceed the designated threshold (i.e., the acceptable probability of a radiation-releasing event), an applicant might typically elect not to pursue the site further through the application process, much less the adjudicatory one. That election might be made even though an aircraft crash into a site does not make it certain that radiation will be released (the crash might not hit a radiation-confining structure or, if it did, the structure might not be breached). To our knowledge, no case has been heard before a Licensing Board or the Commission wherein the probability was close to the designated threshold -- because, we speculate, sites for which the probability was seen to be close were rejected by the applicants a priori and they chose, for any number of possible reasons, not to pursue inquiry about such sites any further.

Here, we previously found that the probability of a crash into the site did indeed exceed the designated threshold. Rather than abandon the effort, however, the Applicant (eventually supported by the Staff) took a legitimate but unusual approach -- taking a closer look at the crash sequence to determine the probability, not just of a crash, but of one that would release radiation. In doing so, the Applicant expected to be able to establish that the vast majority of aircraft crashes into the site would not rupture an MPC contained in a cask, and therefore would not release radiation, and therefore would not need to be designed against, notwithstanding the initial site-focused determination appearing to point the other way.

A site-focused probability determination begins with a classic "four-factor formula," which we describe elsewhere (and which the parties to this case accepted as the appropriate way to compute that probability). Use of that formula serves only to determine the probability of a crash into the site, which was all that was involved in our mid-2002 hearing. At that hearing, we were to determine whether the chance that an aircraft would crash into the proposed facility

was (1) greater than 1×10^{-6} , in which case the facility would have to be shown (or redesigned) to withstand the event without significant radiological release, or (2) less frequent than 1×10^{-6} , in which case the accident would be deemed not “credible,” meaning its occurrence and its consequences could be safely disregarded.⁴⁰

After our March 2003 decision on that issue went against the Applicant, the unusual -- but appropriate -- next step was that, at the Applicant’s instance, we were asked to hear evidence on the details of such crashes, studying the spectrum and effects of such crashes and evaluating which crashes would (or would not) cause radiation releases. That examination involved considerations enormously more complex than has been the historical norm. We discuss both hearings in more detail below, devoting considerable attention to the previous hearing because of its relationship to the current one.

2. “Probability” Hearing and Decision. After the Commission set the design basis threshold probability at 1×10^{-6} , the factual issues were ripe for consideration by the Board. Although other military operations were also considered, the primary focus of the hearing was on the F-16 flights from nearby Hill Air Force Base that were passing over Skull Valley on their way to the UTTR.

At the heart of that hearing was the aforementioned four-factor screening formula that the NRC Staff has long used to calculate the risk of an aircraft crashing into an NRC licensed facility.⁴¹ Although the parties disagreed mightily as to what the evidence showed as to the

⁴⁰ Ibid.

⁴¹ The formula is contained in the “Aircraft Hazards” portion of the Staff’s Standard Review Plan, NUREG-0800.

values to be assigned three of the factors, they accepted that the formula itself appropriately focused on those factors as the starting point for our evaluation.⁴²

The formula's notation is $P = C \times N \times A/w$. Those designations represent that the probability (P , in accidents per year) is determined by multiplying the aircraft's historic accident rate (C , in accidents per mile) by the number of flights per year (N) and by the effective area of the facility (A , in square miles) divided by the width of the airway (w , in miles).

The parties presented extensive evidence and arguments about the value we should assign to three of the factors (A , the site area, was not contested). But it became clear early on that, even if the Applicant's values were accepted, it would be unable to prove via the formula that an accidental crash into the site had less than a 1×10^{-6} chance per year of occurring.⁴³

This led to the Applicant's attempt to gain acceptance for adding a controversial fifth factor -- the so-called "R" factor -- to the standard screening formula. Intended to reduce the site impact probability, the R factor seeks to account for asserted "pilot avoidance" conduct, *i.e.*, the claimed action pilots would take, if able to do so, to guide their planes away from vulnerable ground sites before ejecting in an emergency where a crash was likely.

The State made two arguments against the Applicant's R factor. In short, those arguments were that (1) the four-factor formula devised by the Staff was well-established and did not allow for a fifth factor and (2) the value that the Applicant wanted to assign to R -- an 85 percent reduction in accident likelihood -- was not supported by the evidence. LBP-03-04, 57 NRC at 90.

⁴² At the outset of the "consequences" phase, Judge Abramson -- who had been assigned to the case after the "probability" phase -- asked the parties whether the formula, long-used as a rough "screening" device for determining the acceptability of a site, should also be used to determine more precise probability matters (Tr. at 17720). That question would be lingering here, but for the parties' unmistakable agreement that the case should be decided by application of the formula (Tr. at 17720 (Turk), Tr. at 17720-21 (Barnett), 17729 (Soper)).

⁴³ Of course, had the one in ten million standard applicable to nuclear power plants been retained as the guidepost, the Applicant would have been 10 times farther away from a showing of compliance. In this regard, see App-5, n.8, below.

The Board rejected the State's first argument that the formula could not be changed.⁴⁴ We did agree, however, with the State's second argument, that the evidence regarding the R factor did not justify the massive reduction in probability that the Applicant sought.

In doing so, the Board evaluated the R factor on the Applicant's terms, considering how often F-16 pilots are in control of their aircraft during an emergency (R1) and how often pilots in control will attempt to steer the plane away from something on the ground before ejecting (R2). The Board accepted the Applicant's R1 evidence that, taking into account only the F-16 crashes that are "Skull-Valley type events" (that is, crashes that occurred in circumstances that could also exist in Skull Valley flights), pilots are in control of their planes 90 percent of the time. Id. at 98-99.

In evaluating R2, however, the Board determined that the Applicant's assertion that pilots will attempt to steer away from objects on the ground in 95 percent of the cases was unfounded. Id. at 99-110. We found that the theory (based on expert opinion, not actual data) that a pilot will, with almost absolute certainty, avoid the facility when in an emergency situation and under considerable stress had not been established. Id. at 100, 107-09.⁴⁵

In other words, the Board determined that the evidence setting a high value for R2 was too uncertain to be relied upon in making a safety decision for nuclear facility licensing. Thus, the Board did not accept the Applicant's and Staff's position on the R factor, and instead relied on the traditional four-factor formula in evaluating the probability of an crash into the proposed facility.

⁴⁴ We reasoned that, while the original formula does not explicitly contemplate the R factor, neither is consideration of such a factor legally prohibited, such as by way of agency regulations or Commission precedent. Therefore, we reasoned, as long as the addition of the R factor has a factual and technical justification, then it could be added to the standard probability formula. Id. at 91-93.

⁴⁵ Although we rejected it for the purpose and to the extent then offered, we did not indicate that the theory had no merit whatsoever. We return to it for another purpose later (see the portion of Part II setting out several conservatisms supporting our decision).

The Board applied the four-factor formula to all of the State's proposed accident scenarios, including F-16 crashes into the facility, other airplane crashes into the facility, and ordnance strikes into the facility. We determined that the evidence was insufficient to establish that the accidents had less than a one-in-one million chance of happening.

To the contrary, we found through use of the formula that the probability of an F-16 impacting the facility is 4.29×10^{-6} , that is, the probability of such an accident is more than four times greater than the standard for a "credible accident" set by the Commission. *Id.* at 122.⁴⁶ Thus, we determined, the Applicant had failed to establish that an aircraft crashing into the facility was not a "credible accident." The Applicant was therefore left to establish, in a subsequent "consequences" phase of the hearing, that the design of the facility is robust enough so that a crashing F-16 would not penetrate a cask or that, if it did, that there would be no significant radiation impact for the public. *See* p. 3, above.

3. The "Consequences" Hearing. After we decided in LBP-03-04 that the probability of a crash of an F-16 fighter jet from Hill Air Force Base into the Applicant's site was too high to permit facility licensing, the Applicant and Staff took an appeal to the Commission, as we had indicated might be appropriate at that juncture. *Id.* at 142-44, 231. In response, the Commission exercised its discretion to decline review of our "probability" decision until we heard the "consequences" part of the contention. CLI-03-05, 57 NRC 299, 282-84 (2003).⁴⁷

⁴⁶ Of course, given the lack of absolute precision in the values found for the formulaic factors (see discussions in our previous decision regarding crash rate, width of airway, and number of flights), the "4.29" result may appear more precise than it is. Regardless of the number of significant digits, the point is the same -- the Applicant's proof failed by a factor of over four.

⁴⁷ As we were preparing for that hearing, the Commission, which does not usually encourage wholesale interlocutory appeals, decided to do so at that stage of this case to "expedite the final stages of a licensing process that has dragged on for a number of years." CLI-03-16, 58 NRC 360 (2003). As a result, challenges to many prior Board rulings in this proceeding were considered and rejected by the Commission last year. *See* n. 13, above.

The Commission noted that it expected the consequences proceeding could be completed by the end of 2003. *Id.* at 284-85. We will return to that point, but need first to indicate what transpired at the beginning of that proceeding.

a. Scope of Hearing. At the outset of this “consequences” phase, the State sought to define its scope broadly enough to allow for the presentation of evidence on the radiological consequences that would result from the breach of a cask’s MPC. The Applicant argued, however, that the scope of the consequences phase should be more narrow, limited to the Applicant’s effort to demonstrate that the probability of such consequences left an MPC breach as a non-credible event. Under that view, it was said, radiological consequences would not need to be examined in detail.

We had foreseen, in our first decision, the possibility of this type of disagreement as we moved ahead. Colloquially, all had talked about a two-part proceeding, one involving “probability” and the other embracing “consequences,” those being the two factors in a risk determination. But we had noted that the risk question could more precisely separated into three parts: probability of a crash into the site, leading to cask/canister breach, leading to radiological consequences. LBP-03-04, 57 NRC at 136 n. 110. As we observed, depending on how the second factor was defined, it could be viewed as either part of the probability (of a cask breach) calculation or as part of the consequences (of a site impact) analysis. *Ibid.*

In that light, we did not view it as necessarily an impermissible approach to separate consideration of the second factor from the third one. At that point, the State was ready to, and pressed to proceed on, the third factor. The Applicant and Staff indicated they were unprepared to do so. We made the pragmatic, time-saving decision to have the hearing focus on only the second factor.⁴⁸ But we took two additional actions as well.

⁴⁸ See unpublished Memorandum Concerning Scheduling (Apr. 15, 2004) at 3-4.

First, we indicated that the State would be permitted to make an offer of proof, pursuant to 10 CFR § 2.743(e), at the outset of the hearing. The State in fact did so. See Tr. at 19689-90.

Second, the Board Chairman advised the Applicant and Staff that, given the posture of the case, their unreadiness to proceed may have engendered lasting prejudice to their cases. Specifically, they may have forfeited any opportunity to address the radiological consequences issue later, if they were unsuccessful on the MPC-breach matters on which they were ready to proceed to trial. See Tr. at 19666-77; unpublished Memorandum Concerning Scheduling (Apr. 15, 2004) at 4.

Against that background, we need add only that the reason we did not entertain the evidence the State proffered is that -- even though the Applicant does not characterize it this way -- in essence the Applicant is, for purposes of this phase only, not challenging the notion that the radiological consequences of an MPC breach could be beyond acceptable norms.⁴⁹ But because in its view the probability of such a breach is below one-in-a-million, then even if the probability of excessive consequences of such a breach is taken as a certainty (expressed as unity), the overall risk of an accident that results in excessive radiological releases (being the product of the two factors) remains at less than one-in-a-million. For that reason, the evidence reflected in the State's offer of proof was, and remains, rejected as not material to the more narrow issue before us.

b. Result of Hearing. Put in layman's terms, the Applicant's approach at the hearing was a simple one. As noted above, we had held at the end of the first hearing that the

⁴⁹ Specifically, the Applicant does not concede, as a factual matter, that even its "unanalyzed events" (see Part II, below) would lead to any, much less excessive, radiological releases (although it does not argue that there is no speed at which a crashing F-16 would breach a canister). In contrast, our analysis in the text above is performed "as if a conservative assumption were made" that such a breach does occur for the accidents that are not "credible," simply to demonstrate how the "probability times consequences equals risk" formulation jibes with the regulatory standard. LBP-03-04, 57 NRC at 138, citing Staff explanation from April 8, 2002 oral argument.

probability of an accidental F-16 crash into the site was just under 4.3 in a million per year. In essence, by analyzing (1) the structural characteristics of the casks and (2) the impact speeds and angles of the applicable universe of historic F-16 crashes, the Applicant attempted to show at the second hearing that there is at least an 80 percent chance that a (hypothetical) future crash into the site would not breach an MPC holding the spent fuel.

If that showing were successful, it would of course point to the converse existence of at most a 20 percent chance that a crash into the site -- itself only a 4.3 in a million probability -- would breach an MPC. Taking the two factors together would yield no more than a .86 (less than one) in a million chance of anything that would cause a radiological release, and success for the Applicant.

In Part II, below, we explain why our decision today essentially holds that the Applicant's evidence established its point. Before turning to the merits, however, we think it important to explain why we are rendering this decision now, rather than much earlier.

c. Timing of Hearing. The Commission's "year-end 2003" goal for our decision was not able to be met, despite the best efforts of the Board and all counsel involved. This was in large part due to (legitimate) extra time consumed by the Staff's Requests for Additional Information from the Applicant, and the Applicant's revisions to its license application, all as reflected in the periodic orders we issued at different stages.

We might leave it at that. But the Commission has placed extensive emphasis in recent times on the need for expedition in the adjudicatory process, and this last phase has taken far longer than the Commission expected -- in a proceeding that it described a while ago (see n. 47, above) as having already "dragged on" for a long time. Thus, we think we owe it to the Commission, which asked us to report on this subject (CLI-03-05, 57 NRC at 285), to shine additional light on the matter. We do so in the Appendix to this opinion.

II. THE MERITS

PUBLIC (NON-Safeguards) VERSION

In this Public Version, we attempt to capture in a very few pages the essence of the detailed and highly technical decision rationale that takes us over 40 pages to explain in the Safeguards Version, which for reasons already explained must be withheld from public disclosure. We here can do no more than outline our ruling, and its technical foundation and reasoning, in rather “untechnical” language and without providing numerical details. In the full Safeguards Version, we explain our reasoning and our findings in considerable detail, rather than in the somewhat conclusory terms used here.

In particular, as to the issues of structural analysis, historical crashes, and ultimate probability, we there make considerable effort to explain our reasoning about which of the competing analytical techniques are more appropriate to use. If creation of a Redacted Version proves feasible, more information about our determinations will become available.

In any event, for purposes of legal effectiveness and appellate review, we deem only the Safeguards Version to be the “official” embodiment of our views. In other words, in the event of any substantive variations between it and this Public Version, the Safeguards Version is to prevail.

On the merits, the issue before us is to determine the probability that an F-16, flying through Skull Valley on its way to the training range, would crash into the PFS site in a manner that would cause the breach of a MPC contained in a spent fuel cask (the Overpack), thereby releasing radiation. If that MPC breach probability exceeds the one in a million per year threshold the Commission has established, protection against that hypothetical crash would have to be incorporated into the design of the facility and/or the casks.

The Board previously found that the probability of an F-16 crash (plus the probability of the crash of one of the ordnance such planes sometimes carry) [hereinafter referred to as an

“F-16 Accident”] into the PFS site exceeded the one-in-a-million threshold by a factor of over four. The inquiry does not end there, however, because the regulatory standard applies only to accidents which have radiological consequences, and that issue cannot be addressed without examination of whether a crash into the site would impact a cask at all, and if so whether it would do so in a manner that would damage the Overpack, and rupture the MPC inside, causing a release of radiation.

The issue before us involves the limited safety question of whether the canister will, in a crash situation, maintain its integrity as a radiation boundary, and not whether it would, when subjected to a lesser crash impact which causes no radiation release, keep the spent fuel bundles from sustaining any damage. In that regard, an incident which does not release radiation, but nonetheless causes the overpack and the MPC to be so damaged that the fuel contained within the MPC is no longer intact, may well be significantly more likely than one which is so damaging that radiation is released. But such incidents are not at issue here. Under the regulatory system, such incidents -- because they are not radiation releasing -- are to be dealt with by a licensee if and when they occur. Under that circumstance, the agency will become heavily involved (as it does in the aftermath of any accidents) to assure that possible effects of radiation arising out of the recovery operations are safely handled. Such incidents may present a serious problem in terms of what it takes of a licensee to clean up, but with no radiation “consequences,” they do not have to be designed against.

In contrast, if an accident which can breach the cask in a manner that releases radiation into the environment has sufficiently high probability, then it is considered a “credible accident” (for the purposes of NRC regulations), and the Applicant would be required to design the facility to withstand such an event. Conversely, if such radiation-releasing accidents are sufficiently improbable, the facility need not be designed to withstand them and the Applicant would prevail for purposes of this proceeding. Viewed in this light, this decision need only determine whether

the actual physical properties of stainless steel are such that the canister will (or will not) fail (i.e., rupture and allow a release of radiation) in the event of an F-16 crash.

To address this next analytical step in our credible accidents determination, the Applicant attempted to ascertain the nature and proportion of F-16 accidents impacting the site (the likelihood of which is around 4.3 in a million per year) that would clearly not rupture the MPC and release radiation. The Applicant noted that if the portion of accidents which would clearly not rupture the MPC is greater than 80 percent, then obviously fewer than 20 percent of accidents could be problematic. If that were the case, the resulting overall probability (20% of 4.3 in a million) of F-16 accidents that could create a radiation release would be less than the one in a million threshold, and the facility or cask design would not need to be modified to withstand such an accident.

Proceeding along those lines, the parties each analyzed crashes of F-16s into a cask at various angles and speeds, attempting to find the dividing line between accidents which would breach and those which would not: i.e., the maximum speed and worst angle of impact at which the MPC would not be breached and thus no radiation would be released (while all parties addressed the determination of this dividing line, the State focused on a speed that would breach the MPC, and the Applicant and the Staff focused on a speed that would not breach the MPC). To that end, each of the three parties performed extensive computer simulations, using sophisticated computer codes developed and intended for analysis of this sort of problem. While the parties conducted differing analyses, and thus obtained somewhat differing detailed results, all the analyses yielded one dominant common result: the maximum strain computed to occur in the MPC was well below (by at least a factor of eight or nine) the experimentally determined strain at which the stainless steel MPC material would lose its integrity.

The State's expert civil engineer took issue, however, with the Applicant's reliance upon that maximum experimentally determined strain at failure as the crucial endpoint. Instead, he pressed for use, as the appropriate measure for acceptable loads, of a standard developed by

civil engineers as a design measure. Adoption of his approach would result in an assumed failure at roughly 1/40th of the experimentally determined failure, a result exceeded by the strains seen in the MPC as a result of the analyzed crashes.

Rather than providing a technical reason for our adopting its methodology, the State instead urged that the Board should do so because the U.S. Department of Energy appeared to have done so. Both the Applicant and the Staff strongly disagreed with the State's position, arguing that the DOE methodology has little relationship to the problem being addressed in this case. To support their views, both the Applicant and the Staff presented experimental, documentary, and physical evidence that the material of which the MPC is constructed can indeed withstand strains in the range of the experimentally measured value.

The State did not counter by presenting the testimony of any of the authors of the DOE report or of any person involved with its development. Thus, we had to determine, with only the aid of those non-DOE-involved experts whom the parties did present, how best to evaluate and apply the teachings of the DOE report.

Notwithstanding the size of the safety margin they believed existed (a factor of eight or nine, as explained above), both the Staff and the Applicant urged us to take a more conservative approach than to proceed as though there would be no failure until the full experimentally measured value was reached. Instead, they suggested -- based upon what they viewed as a relatively common practice among engineering professionals -- that applying a safety factor of two or three would result in an acceptably conservative criterion.

On that score, and in direct response to the State's expert's criticism that actual material properties resulting from manufacturing and assembly inconsistencies would lead the as-used stainless steel to have less strong properties, the Staff's expert testified that using a safety factor of two or three would adequately account for all such uncertainties, if they existed. In addition, the Applicant's expert pointed out that all such inconsistencies are accounted for in the A.S.M.E. Code's requirements for manufacture of the material itself and in the A.S.M.E. Code's

requirements for assembly of the components (such as welding procedures). With the Applicant having adopted the A.S.M.E. Code's requirements in its application, it will be required to reject any non-conforming material or procedure. On this basis, and as the Applicant argues, we find that the concerns of the State's expert regarding material properties are misplaced.

We find that the Applicant and Staff's methodology (incorporating a customary safety factor), which, unlike the State's methodology, is strongly supported by experimental, documentary, and physical evidence, is the appropriate methodology for analyzing the ability of stainless steel to withstand strain. This determination is buttressed by the actual physical properties of stainless steel, which has been shown to withstand strains far in excess of what would be predicted if we employed the State's advocated methodology. With all the parties' computer analyses finding that the maximum strain generated in the stainless steel MPC materials for the worst analyzed crash is at least a factor of eight or nine below the experimentally determined failure strain of stainless steel, we are confident in adopting the Applicant and Staff's methodology.

As a prelude to arguing about the probabilities associated with the different speeds and angles at which a crashing F-16 could hit the casks, the parties first established, from the detailed structural analyses discussed above, an upper bound on the speed a plane could hit the cask at the most damaging angle and still not breach the cask and cause a release of radiation hypothetical crash (called the "Bounding Aircraft Impact", the event for which the parties computed the maximum strain on the MPC discussed above). The Applicant and Staff reasoned that any F-16 crash at a lesser speed, or a less damaging angle, could not result in radiation release, and nothing the State presented casts doubt on that approach.

The parties also performed similar analyses of the effect of a dropped ordnance on a cask, and it became clear that the probability of radiation release from such an event was dwarfed by the probability of radiation release from aircraft impact. Therefore, most of the proceeding focused upon examination of the more threatening event (aircraft impact).

After identifying the Bounding Aircraft Impact, the parties next turned to determination of the probabilities of crashes at various speeds and angles by examining the available data from reports of actual accidental F-16 crashes. After examining past F-16 crashes and screening out certain accidents it determined to occur in circumstances that could not occur in the flights through Skull Valley, the Applicant initially identified 61 potentially relevant events, but upon analysis eliminated four, resulting in 57 accidents to employ in development of crash probabilities. The State took issue with the relevance of 18 of those initially identified 61 accidents (including the four subsequently excluded by the Applicant) for various reasons. Based on the in-depth examination of those incidents, we conclude that the 57 accidents utilized by the Applicant are indeed all relevant.

The crash reports show that over 91 percent of those 57 relevant accidents involved loss of engine power. In addition, the crash reports indicate that over 63 percent of those engine failure crashes followed a flight pattern which was in accordance with the combination of the procedures a pilot is instructed to follow after engine loss, and the expected behavior of the automatic flight controls which are activated in such an incident. Thus, over 57 percent (.63 X .91) of all historical incidents follow that pattern, and, as it turns out, that pattern results in a crash impact speed that, at any angle, is well below the speed of the Bounding Aircraft Impact. This elemental, intuitive analysis thus tells us to expect that at least 57 percent of crash scenarios would not cause a radiation release.

In addition, approximately 10 percent of all relevant crashes were characterized in the official crash reports as “deep stall” incidents in which the aircraft, for a variety of causes, drops vertically to the ground with its wings essentially horizontal, a phenomenon also described in layman’s language as “falling like a leaf.” Information from the aircraft manufacturer confirmed that this fluttering type of drop results in crash impacts at speeds well below the Bounding Aircraft Impact speed. An accident of this type, therefore, would also not cause a radiation release.

As a result of the two foregoing observations about expected crash trajectories, it appeared logical to expect to (and we would have been surprised if we did not) find, from the detailed study of the crash reports, that at least two-thirds of all incidents -- the 57 percent involving the expected post-engine-failure trajectory and the 10 percent involving "deep stall" -- would not create an impact severe enough to result in radiation release. This intuitive analysis, based on the aeronautical techniques behind what happens in crash situations, was in many respects borne out by the actual facts revealed by the crash reports.

In that regard, in the Safeguards Version we reach specific conclusions about the ranges of speeds and the pattern of angles that can be derived by analysis of historic crashes. In the course of doing so, we make judgments about which analytical techniques are more appropriate to use.

In the final analysis, then, we were not surprised to find that the Applicant's sophisticated and detailed study and statistical analysis of the crash data indicated that the percentage of incidents which had impact speeds below the Bounding Aircraft Impact was somewhat greater than the two-thirds lower bound derived from the common sense crash trajectory approach (in fact, the Applicant and the Staff each computed a number somewhat in excess of 80%). Conversely, we find physically unrealistic the result put forward by the State's expert, who reported that the results of his analysis yielded an overall probability of radioactive release (i.e., after a crash that resulted in a breach of the MPC) not smaller than two in a million, thereby implying that less than 50 percent of the incidents would have impact speeds below the speed of the Bounding Aircraft Impact.

In this regard, the State's expert advised that the principal reason for the difference between his result and that of the Applicant (and the Staff) was the elimination of consideration of 21 of the 57 incidents, along with a particularly conservative assumption regarding how data should be "fitted." Having examined in depth each of those fourteen incidents and the State's

expert's logic and reasoning for his approach, we find that neither step was the reasonable analytic one to take, and therefore reject the State's expert's projected result.

The end result is that we adopt the Applicant's prediction for probability of release -- a result which was supported by the Staff's analysis -- and find that the probability of a radiation release from an F-16 accident is below the one-in-a-million per year threshold. In reaching that result -- which our dissenting colleague is unwilling to reach because of his concern that the result is too fraught with uncertain judgments, and too close to the pass/fail mark -- we think that our colleague has given inappropriate consideration to the underlying technical merits (see pp. B-10 to B-12, below). We also believe he has not adequately weighed the fact that a number of materially conservative assumptions were incorporated into the analyses, leading to the logical conclusion that the probability computed by the Applicant (and agreed by the Staff) is likely to materially overestimate the probability (perhaps by an order of magnitude). These conservatisms include the following:

(1) in evaluating crash consequences, it was assumed that every hypothetical F-16 crash struck a cask in a manner that maximizes the computed damage, while all experts testified that, as is intuitive, a large fraction of such incidents would be expected to be other than direct hits (one expert roughly estimated that this overstated the probability five-fold);

(2) it was assumed that if an F-16 hits the ground within a certain distance short of the casks, it would rebound undamaged and impact the cask as though it had done so directly -- a clearly overly-conservative assumption, since the pilots testified that the F-16 is too fragile for a pilot to land intact on the desert floor in an emergency, let alone be expected in a post-ejection crash to rebound off the desert without damage and without loss of part of its energy to the ground;

(3) as discussed above, in our previous decision determining the probability of a crash into the site, we disallowed the Applicant's claim of an extremely high likelihood that, prior to ejecting, a pilot would attempt to avoid the site; the way the matter was framed, we ended up thus giving no weight to that possibility in determining the probability of a crash into the site, even though there was evidence that some such efforts should be expected to take place (albeit not sufficient to support the level the Applicant urged us to adopt) -- and any efforts in that regard would thus add an element of conservatism to the result reached today; and

(4) it may be that the Bounding Impact is in fact not the worst case that the cask can withstand without radiation release; in fact the Applicant presented to us one analysis indicating that an impact at a materially higher speed would not result in such a release, thus indicating that further refinement of the analyses could result in a somewhat higher impact speed for the bounding case, thereby reducing the probability that an impact would cause radiation release.

In each of these instances, the built-in conservatism caused the computed probability of radiation release from a crash to be higher than would have been computed by a realistic estimate. In short, the calculated probability was pushed closer to the threshold than is realistic.

Thus, even though we find the probability of an MPC breach to be only slightly less than one in a million (the closeness to that threshold being a principal reason for our dissenting colleague's discomfort), a number of qualitative factors exist that assure us that the probability found by the Applicant and supported by the Staff is indeed an upper bound, and that efforts to more closely model reality would make it lower. We therefore believe that a more refined analysis would result in a lower (and perhaps materially lower) probability of release, and on that basis do not share our dissenting colleague's view that the closeness of the computed probability to the threshold is disqualifying to the Applicant's proposal.

We had at one point considered whether the Applicant should also be given similar qualitative probability credit for the fact that, in its 40-year contemplated life, the facility would theoretically be at capacity -- 4000 casks -- only briefly. That is to say, at the pace outlined (see p. 2, above) it will take a full 20 years to bring 4000 MPCs to the site, and to remove them in the following 20 years at the same pace would require that the removal process begin shortly after the last cask arrives. See 57 NRC at 120. Nonetheless, we determined not to credit the Applicant for a varying degree of such a "less than capacity" conservatism as the facility's inventory rose and fell. For now, by analogy to the Commission's Surry ruling (see App-5, n.7 below), there seems to be some likelihood that the PFS license could be in effect for more than 40 years. There is, correspondingly, likely to be a lengthy period when the facility is at full capacity, defeating a "less than capacity" qualitative conservatism.

In resolving this phase of the case in the Applicant's favor, we have given careful consideration to the discomfort we understand that our colleague Judge Lam has with several aspects of the technical information before us. We believe that, although the concerns he expresses might be theoretically valid in other contexts, the facts and opinions in the record make it clear that, properly considered, the matters he has raised have no application here.

First, we find that the theory advanced by a key State witness and emphasized in the dissent -- that one should apply a tool (the ductility ratio), which is regularly used to assure that structures are designed conservatively, to determine when a non-structural element will actually fail -- was discredited by the physical facts and expert testimony before us (as was the State's belated (and incorrect) suggestion that the ASME Code advises something similar). A structural design criterion, good as it may be for that purpose, does not answer the different question being asked here, and the State simply misapprehended the portion of the ASME Code to which it made reference.

It may be that underlying our colleague's concerns regarding the integrity of the Overpack is the possibility, about which he asked several questions during the hearing, that a crashing aircraft might penetrate a cask and push overpack materials into the canister inside. As we view the record, all the expert testimony and computer simulations confirmed that -- because the cask's ring of concrete is confined by inner and outer steel shells -- if an aircraft were to hit the outer shell, the pressure and loads would be transmitted circumferentially (at the speed of sound) around the overpack concrete, spreading the load and avoiding the result our colleague inquired about. Furthermore, whereas the dissent focuses upon the structural characteristics of the overpack and argues that a ductility ratio should be used to assess its integrity and ability to resist the impact, the record clearly indicates two things: first, the carbon steel rings confining the concrete can withstand a great deal more strain before failure than the approximately 2% which the State's expert (and the dissent) would have us use (the evidence

indicates that failure strain is on the order of 50% or more for such carbon steels); and secondly, although of materially lesser import, the overpack is not serving as a structural member and therefore would, in any event, not be the type of component to which a ductility ratio type test should be applied.

The dissent is also concerned about the uncertainty associated with the fact that the Air Force accident reports do not supply all the data about speed and angle of impact that we would like to have had. The dissent is correct that the set of crashes for which complete data is available is relatively small. But all the experts agree that, through standard, commonly-used statistical techniques, extrapolations can be made (applying correlations appropriately derived from the crashes with complete data) from the valid data that are available for the other crashes, so as to allow expansion of the data set; this is recognized as an accurate way to take advantage of the additional information available from those other crashes. Indeed, the State's own expert did not dispute that principle, and this utilization of additional information was validated by the fact that the regression analysis achieved a correlation coefficient in excess of 90 percent (an unusually strong correlation, which the dissent dismisses as "good but not perfect").

The dissent also points to the expert disagreement about how to fit a curve to, and thus learn more from, the very few high speed crashes reflected in the data set, especially because the State's statistical expert demonstrated that using a particular form of step function to fit that data would lead to a much higher probability of crash at high speed. But there are two ways to apply a step function, and if the State's expert had used the alternative method to fit the data (i.e., if he had the steps start, rather than end, at a data point, a fit which we believe is in fact a better representation of the data), the result would have been a significantly lower (rather than higher) probability of breaching impact than that obtained by the Applicant and the Staff. Even more importantly, because phenomena at the macroscopic level are not "quantized", we do not agree that a step function was appropriate at all -- the proper way to "fit" data on real world

events is to draw a curve through them, which is how the Applicant's and the Staff's experts proceeded.

In sum, we think no concern expressed by our dissenting colleague has the technical support in the record that would transform his theories into a finding of a higher radiation release probability for the situation at issue here. In addition, the dissent does not appear to give any weight to the large conservatisms which are built into the analyses -- conservatisms which indicate to us that these computations overestimate the probability of an MPC rupture by a factor of five or even more. In this regard, in setting the standard for this case, the Commission made clear the legitimacy of evaluating and weighing conservatisms whose impact can be reasonably estimated, and in fact indicated that in such circumstances the threshold probability for a credible accident might be even further increased. See CLI-01-22, 54 NRC at 260 (citing the steps a Licensing Board took in that regard in Consumers Power Co. (Big Rock Point Plant), LBP-84-32, 20 NRC 601, 639-52 (1984)).

For the foregoing reasons, we remain unpersuaded by our colleague's concerns.

For the foregoing summary of the reasons expressed in full in the 43 pages of the Safeguards Version of Part II, we determine that there is reasonable assurance that the probability of release of radiation from an accidental F-16 crash is below the "design basis" threshold. But we should not end this discussion of the merits without once again acknowledging, as we did in our seismic decision (LBP-03-08, 57 NRC at 298), the extraordinarily valuable contribution the State made as it attempted to support its challenge to the Applicant's proposal. Because of the State's effort, this important issue has been examined, analyzed and tested much more thoroughly than it otherwise would have been -- and that degree of study was justified before allowing the Applicant's choice of a problematic site (see App-5, n. 8, below) to pass muster.

To be sure, the seismic challenge ended with what we viewed as a fundamentally reassuring decision that no real problem existed. In contrast, even those of us in the majority recognize that the F-16 accidental crash challenge presents a close case, in which the demonstrated margins are, by our lights, narrow (and not persuasive to our dissenting colleague). Notwithstanding that the State did not prevail, the illumination it helped shed on this issue will stand as a beacon of what a competent, determined intervenor can accomplish in its own interest and in the public interest.

III. CONCLUSIONS OF LAW
AND
CONCLUSION OF THE PROCEEDING

This Licensing Board has considered all of the material presented by the parties on Contention Utah K (“credible accidents”). Based upon our review of the evidentiary record relative to this contention and of the two sets (initial and reply) of proposed findings of fact and conclusions of law submitted by the parties, the Board has decided the matters in controversy concerning this contention in the fashion delineated in the views set forth above -- which we believe are supported by a preponderance of the reliable, material and probative evidence in the record, and are in accord with applicable laws and regulations.

This Initial Decision does not attempt to address explicitly all aspects of the parties’ proposed findings. To the extent a particular proposal was not so addressed, it is either because we have determined that to do so was unnecessary to our decision, or because our reasoning addresses it implicitly.

In accordance with the views previously expressed herein, the Board reaches the following ultimate legal conclusions in favor of the Applicant Private Fuel Storage, LLC (and the NRC Staff):

1. The evidence establishes that the probability is less than one-in-a-million per year that there will be an accidental crash into the PFS site by an F-16 from Hill Air Force Base that has the consequence of breaching a multi-purpose-canister containing spent nuclear fuel and thereby causing a radiological release.

2. Because of that low probability, an accidentally crashing F-16 impacting a cask while traveling beyond the structurally-related “bounding speed and angle” utilized to determine that probability is not a “credible accident” as defined in agency regulations.

3. The proposed PFS facility need not, therefore, be designed to withstand such an accident and no inquiry need be made into the radiological consequences of such an accident.

Accordingly, for the reasons set forth herein, we determine that the Applicant has met its burden with respect to Contention Utah K and we rule in its favor thereon: Contention Utah K is RESOLVED on the merits in favor of the Applicant Private Fuel Storage, LLC (and the NRC Staff) and against the intervenor State of Utah.

All the Intervenors' Contentions admitted into the proceeding have now been resolved, whether by voluntary withdrawal, summary disposition, negotiated settlement, Board decision following an evidentiary hearing, or other means. There has been no ultimate resolution of an admitted Contention of a nature that would preclude issuance of the license requested by the Applicant and, with the conclusion of substantive Licensing Board proceedings, the question of whether to issue a license is now properly before the Commission for determination pursuant to 10 C.F.R. § 2.764(c). See also LBP-05-05, 61 NRC at ___ (slip opinion at 23-25) (February 24, 2005).

We close with three additional thoughts (in which Judge Lam joins):

A. Scope of Decision. In its recent decision on the length of the required Yucca Mountain isolation standard, the United States Court of Appeals for the D.C. Circuit spoke eloquently about the magnitude and importance of the national debate about how to address the presence at reactor sites of spent nuclear fuel. See Nuclear Energy Institute v. EPA, 373 F.3d 1251, 1257, 1258 (2004):

Having the capacity to outlast human civilization as we know it and the potential to devastate public health and the environment, nuclear waste has vexed scientists, Congress, and regulatory agencies for the last half-century. After rejecting disposal options ranging from burying nuclear waste in polar ice caps to rocketing it to the sun, the scientific consensus has settled on deep geologic burial as the safest way to isolate this toxic material in perpetuity. Following years of legislative wrangling and agency deliberation, the political consensus has now selected Yucca Mountain, Nevada as the nation's nuclear waste disposal site.

* * * * *

Radioactive waste and its harmful consequences persist for time spans seemingly beyond human comprehension. . . . As of 2003, nuclear reactors in the United States had generated approximately 49,000 metric tons of spent nuclear fuel. Most of this waste is currently stored at reactor sites across the country. (Citations omitted).

In issuing today's decision, we must stress that our rulings do not purport to address the questions raised by the debate to which the D.C. Circuit referred. Put another way, we do not sit, and it is not our role, to determine the optimum method by which the Nation should manage spent nuclear fuel.

Rather, what is before us is a specific proposal by the Applicant for making an away-from-reactor temporary spent fuel storage facility available for use by the nuclear utility industry. Our role has been only to pass judgment on the series of safety and environmental challenges to that proposal -- not to determine the wisest course of action for the country in terms of what should be done with spent nuclear fuel in either the short or the long term. On that score, the Commission has already indicated herein (CLI-04-04, 59 NRC at 40) that a matter like that borders on being a "political" question (in the sense, not of partisan party politics, but of policy choices, about competing societal values, that are for our elected and appointed representatives to make) -- and, as such, is a question that the Commission "do[es] not believe that NEPA charges . . . the Board, in its hearing process, with answering . . ."

The resolution of that political question must also factor in how spent fuel can be best protected from deliberate (e.g., terrorist) attacks. Especially to the extent that such anti-terrorism factors are concerned, that debate is even more expressly outside our jurisdiction, being reserved to the Commission for consideration outside the adjudicatory process (see p. A-8, n.33, above).

In short, all determinations on overarching matters like those are for others to make. Debates on such matters will have to take place in forums other than ours.

B. Fairness to Parties. In its decision a few months ago upholding a district court's rejection, on preemption grounds, of a series of laws enacted by the Utah legislature and intended to block this project, the United States Court of Appeals for the Tenth Circuit expressed the hope that the State would receive fair treatment in the federal nuclear regulatory process that the Court recognized as paramount:

[w]e also note that many of the concerns that Utah has attempted to address through the challenged statutes have been considered in the extensive regulatory proceedings before the NRC We are hopeful that Utah's concerns -- and those of any state facing this issue in the future -- will receive fair and full consideration there.

Skull Valley Band of Goshute Indians v. Nielson, 376 F.3d 1223, 1254 (2004).

We suppose that, after Commission review of our decision today, the losing party will appeal, and the 10th Circuit (or its counterpart, the D.C. Circuit) will have the opportunity to determine whether the hope expressed above was realized. The Court will be able to measure our decision against the underlying record that the parties compiled and that our rulings and our questions shaped.

Whether the agency's decision, and the manner in which the record was shaped, is ultimately upheld or not, we would expect the reviewing Court to come to the conclusion that the State, and the other parties, were, to the best of our ability, treated fairly, as the 10th Circuit had hoped. According them that fundamental right has been a paramount concern of ours. See Tr. at 15208-10, 19701-02; see also United States v. Steel Tank Barge H 1651, 272 F. Supp. 658, 659 n. 1 (E.D. La. 1967), referring to John M. Kelley, Audi Alteram Partem, 9 Natural Law Forum 103 (1964), authorities which we also cited three years ago. See LBP-02-08, 55 NRC 171, 201 n.60 (2002).

C. Consideration of Settlement. This proceeding has been hard and long fought, by parties fully committed to the justice of their cause. The Applicant and the State have along the way, however, settled several varied matters (e.g., those relating to (1) bird habitat [before the first aircraft trial, see Joint Motion to Dismiss Contention Utah DD -- Ecology and Species (Mar. 15, 2002); Prehearing Memorandum: Summary and Order (Mar. 22, 2002), at 5]; (2) sewage disposal [during the first aircraft trial, see App-4, below, and Joint Motion to Dismiss Contention O - Hydrology (June 18, 2002)]; and (3) cask design [after the first aircraft trial, see App-7, n.12, below]). Those settlements were built essentially on the principle that, if the license application were to be approved, a more safe or a more benign facility was in the interest of all concerned.

While the evidence on the major safety issues remained to be considered, however, there appeared to be no possibility of settling the overall proceeding. Now that all the evidence has been taken and all our decisions have been rendered, the likely outcomes are easier to see. The Applicant is in position to obtain its license (see p. C-2, above) and to hold on to it unless the State is successful, at the Commission level or in the federal courts, in overturning -- on either procedural or substantive grounds -- determinations resulting from the past seven-plus years' work.

Put another way, with aircraft crash impact probabilities now ascertained, each party can more readily assess the likelihood that it will achieve its long-term objectives. The Applicant seems to have qualified to receive its license in the short-term, but could lose it in the long-term. The State will have to count on demonstrating to the Commission or the federal courts error in some important part of the proceeding to block the license permanently.

Commission policy strongly favors settlements, and settlements sometimes are possible in unlikely circumstances. See generally CFC Logistics (Materials License), LBP-05-01, 61 NRC ___ (Jan. 11, 2005) (in which both members of today's majority were involved in the achievement of a difficult settlement, albeit one that involved a much less consequential matter). The accidental aircraft crash issue was the most difficult and most closely contested one in this entire proceeding. The outcome is a close one, as evidenced by our rationale and by our split vote. Close cases are prime candidates for settlement.

The parties may thus want to consider whether an overall resolution might be obtained through, for example, (1) the Applicant agreeing to further enhance the safety of the facility against potential aircraft crashes, such as by the construction of a berm (see Tr. at 15580-81) or of a pole-and-cable system (or a combination thereof) that would protect the casks from aircraft approaching the site in horizontal flight on the predominant azimuthal flight path; in return for (2) the State's dropping all appeals and accepting the existence of the facility as so modified. Such a settlement would truly have come about as a direct result of the State's efforts to protect

the safety of its citizens through the hearing process, and would in fact be in furtherance of that end, as well as of the Applicant's interest in further protecting its facility from accidental -- or appellate -- harm.

Absent a further Commission directive, the Board's substantive role in the case is complete (the Farrar-chaired Board does intend later to work with the parties administratively to prepare a *Redacted Version* of this decision, and the Bollwerk-chaired Board is carrying out a similar task related to the proprietary aspects of the financial qualifications issue). For the final time, then, we thank the parties for their professional, high quality presentations and participation, while also commending to their attention our thoughts about possible settlement.

Pursuant to 10 C.F.R. § 2.760(a), this Final Partial Initial Decision will constitute the FINAL ACTION of the Commission within forty (40) days of this date unless a Petition for Review is filed in accordance with 10 C.F.R. § 2.786(b), or the Commission directs otherwise.

Within fifteen (15) days after service of this Final Partial Initial Decision (which shall be considered to have been served by regular mail for the purpose of calculating that date), any party may file a PETITION FOR REVIEW with the Commission on the grounds specified in 10 C.F.R. § 2.786(b)(4). Any such Petition for Review should also cover any interlocutory rulings of ours that were not previously appealable either by NRC Rule or by Commission Order. The filing of a Petition for Review is mandatory in order for a party to have exhausted its administrative remedies before seeking judicial review. 10 C.F.R. § 2.786(b)(1).

Within ten (10) days after service of a petition for review, any party to the proceeding may file an ANSWER supporting or opposing Commission review. 10 C.F.R. § 2.786(b)(3).

The petition for review and any answers shall conform to the requirements of 10 C.F.R. § 2.786(b)(2)-(3).

It is so ORDERED.

THE ATOMIC SAFETY
AND LICENSING BOARD

/RA/

Michael C. Farrar, Chairman
ADMINISTRATIVE JUDGE

Peter S. Lam *
ADMINISTRATIVE JUDGE

/RA/

Paul B. Abramson
ADMINISTRATIVE JUDGE

* As indicated at the outset, Judge Lam dissents from the result reached in the foregoing Initial Decision, and is therefore not signing it. His signed dissent follows, on pages D-1 to D-7.

Rockville, Maryland
February 24, 2005

Copies of the Public Version of this Initial Decision were sent this date by Internet e-mail transmission to counsel for: (1) Applicant PFS; (2) Intervenors Southern Utah Wilderness Alliance, Skull Valley Band of Goshute Indians, OGD, Confederated Tribes of the Goshute Reservation, and the State of Utah; and (3) the NRC Staff.

So that all parties receive it at approximately the same time, hard copies of the full Safeguards Version are being sent by overnight delivery to the State of Utah and to the Applicant PFS, and will be hand delivered tomorrow morning at 10:00 AM EST to the NRC Staff.

Opinion of Judge Lam, DissentingI. Introduction

I dissent from the majority opinion for the basic reason that the proposed PFS facility has not been demonstrated to meet an established safety standard for accidental aircraft crash hazards. This safety standard, which was established in an earlier Board decision¹ and subsequently affirmed by the Commission,² requires that the PFS facility be designed to withstand aircraft crashes if the annual probability of such crashes exceeds one in one million (1×10^{-6} per year). The Board previously ruled in a partial initial decision³ that the proposed PFS facility did not meet the 10^{-6} per year safety standard, and accordingly the Board did not approve the PFS license application at that time.

In this current proceeding, the Applicant has performed an extensive probability analysis and a structural analysis to rehabilitate its license application. As explained below, the Applicant's probability and structural analyses both suffer from major uncertainties. These uncertainties fundamentally undermine the validity of the analyses. Accordingly, I would hold that the Applicant has not met its burden of demonstrating that it has satisfied the 10^{-6} per year safety standard.

II. DiscussionA. Uncertainties in the Applicant's Probability Analysis

Three inter-related issues contribute significantly to the uncertainties in the Applicant's probability analysis: (1) the scarcity of F-16 crash data; (2) the quality of the F-16 crash data, as expanded by regression analysis; and (3) the sensitivity of the complementary cumulative

¹ LBP-01-19, 53 NRC 416 (2001).

² CLI-01-22, 54 NRC 255 (2001).

³ LBP-03-04, 57 NRC 69 (2003).

distribution function (CCDF) to different fitting methods, and its large impact on the final calculated crash probability.

Issue 1: Scarcity of Documented F-16 Crash Data

First, there is no dispute by the parties that the data on F-16 crashes in general, and on crash impact speed and angle in particular, are sparse. Only 57 F-16 accident reports were deemed suitable for analysis by the Applicant, and only 15 reports have documented impact speed. Even if Utah's challenges to the suitability of some of these reports were entirely disregarded, these reports collectively represent a small sample.

The uncertainties inherent in using a small data set were explored by the Board in this proceeding. The Board requested that the Applicant perform its analysis using only documented crash data from the 15 reports that contain documented impact speed to assess how sensitive the results might be to such a small data set. The Applicant's results⁴ indicate that using such a small set of data would imply a crash probability exceeding the 10^{-6} per year safety standard, but that the standard errors of the estimate would be unreliably large. This of course is no surprise, as it only confirms the obvious: the use of a small data set leads to large uncertainties.

Issue 2: Quality of Expanded F-16 Crash Data

The scarcity of data, the Applicant asserts, necessitates the expansion of the small data set of documented impact speeds to a larger set of estimated impact speeds by using regression analysis. The uncertainties inherent in using a small data set are now compounded by the uncertainties introduced by the regression analysis. Note that the correlation coefficients in the Applicant's regression analysis are above 0.9, but not quite 1.0, indicating there is a good, but not perfect, fit of data. This implies that additional uncertainties are now being introduced by the regression analysis. The Applicant advocates the theory that the expanded set is as good

⁴ See State Exh. 278, Summary Table for Board's Requested Calculation, by PFS expert Dr. Cornell, August 20, 2004. See also Tr. 18078-102 (Cornell explaining exhibit).

as the original set, while Utah argues that the expanded set may not adequately represent the actual F-16 crash parameters. The truth probably lies somewhere between these two opposing positions.

The uncertainties inherent in the use of a small set of F-16 crash data, compounded by additional uncertainties introduced by regression analysis, must not be ignored for two important reasons. First, the Applicant's calculated crash probability (0.74×10^{-6} per year), even if assumed to be accurate and reliable (an assumption Utah vigorously challenges), leaves scant margin for error in meeting the 10^{-6} per year safety standard. Second, the Applicant's calculated crash probability is sensitive to small uncertainties introduced by how crash data is manipulated (see discussion of the CCDF curve below).

Issue 3: Sensitivity of CCDF Curve to Fitting

The uncertainty raised by the third issue, namely how different methods of fitting the CCDF curve in the region of high impact speeds affect the final calculated crash probability, is also critical. Utah's expert Dr. Thorne, in State Exhibit 285,⁵ indicates that by using actual discrete values of the CCDF for three particular impact speeds higher than the Applicant's threshold value, the annual probability of an F-16 crash breaching a spent fuel storage cask is 0.506×10^{-6} per year. This represents a significant increase from the Applicant's value of 0.375×10^{-6} per year, which is obtained by fitting the CCDF curve into a smooth curve between the aforementioned impact speeds.⁶ This increase alone would bring the accidental F-16 crash probability to slightly above 1×10^{-6} per year, hence failing the 10^{-6} per year safety standard. This observation of CCDF sensitivity is important because it demonstrates quantitatively that the annual probability outcome is sensitive to a seemingly small uncertainty introduced by how crash data is manipulated.

⁵ State Exh. 285, Additional Probability Analyses, September 13, 2004.

⁶ See Tr. at 18869-83 (Thorne explaining exhibit).

B. Uncertainties in the Applicant's Structural Analysis

A singularly important but unresolved dispute with respect to the Applicant's structural analysis is the Applicant's declination to adopt the DOE ductility ratio standard⁷ as the failure criterion for the spent fuel storage cask. The DOE ductility ratio standard was developed by a group of experts, assembled by the Department of Energy, to protect facilities containing radioactive or chemical materials from the hazards of an accidental aircraft crash. Experts from the Defense Nuclear Agency, Federal Aviation Administration, and Environmental Protection Agency participated in that development process, with an NRC expert having observer status.

The evidence provided by Utah persuasively shows that the concrete overpack of the spent fuel storage cask is exactly the type of structure (concrete structure with carbon steel shells) to which the DOE ductility ratio should be applied as a governing failure criterion. When, as a result of an F-16 crash, the strain in the carbon steel shells of the concrete overpack reaches the failure strain set by the DOE ductility ratio standard, the overpack should be considered to have failed in performing its intended function. All parties' analyses in the evidentiary record show that the strain in the overpack's carbon steel shells significantly exceeds the DOE ductility ratio failure strain. Therefore the overpack is expected to fail in an F-16 crash scenario.

How this overpack failure would occur under the DOE ductility ratio standard, and how it would subsequently impact the stainless steel multi-purpose canister, has not been identified in this proceeding, despite numerous inquiries by Board members. This lack of clarity about how the overpack fails under the DOE ductility ratio standard is not a valid basis for asserting that the overpack would not fail. Nor is it a valid basis for asserting that the DOE ductility ratio standard does not apply to the overpack.

⁷ See State Exh. 254, United States Department of Energy Standard (DOE-STD-3014-96) Accident Analysis For Aircraft Crash into Hazardous Facilities (Oct.1996).

The caution urged by Utah's expert Dr. Sozen in advocating the adoption of the DOE ductility ratio standard for both the carbon steel shells of the overpack and the stainless steel canister should be heeded. As Dr. Sozen testified in this proceeding,⁸ there are numerous uncertainties associated with how a structure would fail under aircraft crash impact. These uncertainties include: uncertain loading; the actual shape of the stress/strain curve; presence of residual stress; large strain gradients; presence of welds; potential fabrication and installation errors; and high strain rates. To appropriately deal with these uncertainties, the failure strain should be set as close as reasonable to the yield strain, namely to stay close to the elastic range. This rationale is the underlying premise of the DOE ductility ratio standard. Its adoption in this proceeding as the governing failure criterion for the concrete overpack, perhaps even for the stainless steel multi-purpose canister as urged by Utah, would have been prudent.⁹

The use of the DOE ductility ratio standard is also bolstered by the latest theory advanced by Utah regarding how Appendix F to section III of the ASME code should be applied to determine the failure strain of the multi-purpose canister.¹⁰ Here, Utah argues persuasively that using material properties for stainless steel provided by the ASME code, taking into account neither strain hardening nor transformation of engineering strain to true strain, would predict a failure strain of less than 10 percent. This 10 percent value is significantly less (by a factor of about 4) than the value the Applicant used in its analysis for failure strain in the stainless steel multi-purpose canister.

⁸ See Tr. at 16243-44 (Sozen).

⁹ I do not join in the majority's belief that the DOE ductility ratio standard is merely a design tool, and that a significant violation of that standard will pose no threat to the concrete overpack or the stainless steel canister. However, even if the DOE ductility ratio failure strain were merely a design failure strain, prudent safety practice (and the position advocated by Utah) would still require preventing the strain in the overpack and the canister from greatly exceeding the ductility ratio failure strain. To greatly exceed a design failure strain is to erode whatever conservatism is incorporated in the design.

¹⁰ See State of Utah's Reply Findings of Fact (Nov. 19, 2004) at 15-25; State of Utah's Response to Board Order Directing Clarification of Record (Dec. 8, 2004).

III. Conclusion

Simply put, in contrast to the demonstrated robust safety margin against design seismic events found in our earlier decision LBP-03-08,¹¹ the proposed PFS facility does not currently have a demonstrated adequate safety margin against accidental aircraft crashes. Even if the Applicant were to overcome all of the aforementioned uncertainties in its analyses, the proffered probability of 0.74×10^{-6} per year of aircraft crashes leading to unacceptable consequences has a margin of only 26 percent when measured against the safety standard of 1×10^{-6} per year. This 26 percent margin rapidly disappears when one or more of the aforementioned uncertainties are considered. For example, if either the documented impact speeds alone were used, or the DOE ductility ratio standard were adopted as the concrete overpack and multi-purpose canister failure criterion, the proposed PFS facility would immediately fail the 10^{-6} per year safety standard.

This lack of adequate safety margin is a direct manifestation of the fundamentally difficult situation of the proposed PFS site: 4,000 spent fuel storage casks sitting in the flight corridor of some 7,000 F-16 flights a year. The venerable four-factor aircraft crash formula in NUREG-0800,¹² which has been used for years to steer reactor license applicants away from difficult sites facing significant aircraft hazards, has already indicated once¹³ that the proposed PFS site fails to meet the safety standard of 10^{-6} per year.

The Applicant's current analyses, which are fundamentally undermined by large inherent uncertainties and narrow safety margins, should not be relied upon to demonstrate the safety of the proposed site. More needs to be done. The Applicant should demonstrate that a breached spent fuel storage cask would not result in a site-boundary radioactive dose exceeding

¹¹ 57 NRC 293 (2003).

¹² NUREG-0800, Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants (Rev. 2) (July 1981).

¹³ See LBP-03-04, 57 NRC 69 (2003).

regulatory limits, or should implement other remedies such as the installation of physical barriers. Such a decisive demonstration, or the implementation of genuine remedies, would ensure the adequate protection of public health and safety.

/RA/

Peter S. Lam
Administrative Judge

APPENDIX TO LICENSING BOARD DECISION
OF FEBRUARY 24, 2005
IN PRIVATE FUEL STORAGE PROCEEDING

In this Appendix, all three Board members provide additional information about both the earliest and the latest stages of the case.

In Part A, we set out the procedural history of those aspects of the proceeding not related to the one remaining Contention, and cover as well certain principles that govern our proceedings. This should be of assistance to those readers who have not previously followed the PFS proceeding.

In Part B, we explain why it has been nearly two years since our decision on the first phase of the hearing on that Contention, and detail what has been accomplished during that period. In this fashion, we have completed the report that the Commission sought from us if the proceeding took longer to conclude than it expected.

A. Early History.

1. The PFS Application. The PFS consortium of nuclear-powered electric generating companies filed its application with the NRC on June 20, 1997, seeking a temporary solution to the industry's perceived need to take action with respect to the growing quantities of spent nuclear fuel accumulating at reactor sites. The uncertainty and delays being generated by the Department of Energy's inability to fulfill its mandate to take that spent fuel from the utilities (such as by moving it to the proposed permanent underground repository at Yucca Mountain in Nevada) led PFS to seek NRC approval to build a facility for temporary above-ground storage of that spent fuel. The understanding -- which we discussed in another decision issued earlier today (see LBP-05-05, above, 61 NRC at ___) (slip op. at 1-2) -- is that the PFS facility would

store the spent fuel rods, currently housed at nuclear reactor sites around the country, until they could be moved directly to the permanent repository.¹

The Applicant seeks to store the spent fuel on the Reservation of the Skull Valley Band of Goshute Indians, within the 99-acre secured portion of a larger site being leased from the Band for that purpose. While the Reservation is within the boundaries of the State of Utah, the special sovereign status of recognized Indian Tribes essentially protects the proposed activity from being subject to the State's ordinary regulatory jurisdiction. As mentioned earlier, then, one way the State has expressed its concerns over, and objections to, the proposal was by bringing its safety and environmental contentions to us for resolution.

The PFS application was reviewed by the NRC Staff. That process consumed over three years, during which time the Staff made any number of requests for additional information, and the Applicant revised its application nineteen times. The NRC Staff approved the application on September 29, 2000.²

2. The Hearing Opportunity. Early on during the Staff review of the application, the NRC published in the *Federal Register* the July 1997 notice of hearing. The notice stated that anyone opposed to the issuance of the license could request a hearing before an Atomic Safety and Licensing Board.

The Licensing Board is an independent adjudicatory branch of the NRC, whose judges are appointed,³ and whose decisions are reviewed, by the Commissioners who head the NRC.⁴

¹ At this writing, it appears that DOE's application to the NRC for approval of the Yucca Mountain facility will not be filed any earlier than the end of 2005.

² LBP-03-04, 57 NRC at 82. By the time of our original 2002 hearing on the State's "credible accidents" contention, the application had been amended four more times.

³ Although the Commissioners appoint judges to the overall Licensing Board Panel, it is generally the Panel's Chief Judge who assigns judges to particular Board proceedings.

⁴ LBP-03-04, 57 NRC at 92 n. 28. Our decisions are reviewable by the Commissioners, with whom we have no interaction other than through our decisions and their formal, on the record, review thereof.

The Board's existence provides individuals and organizations who oppose any licensing action the NRC Staff proposes to take, or has taken, the opportunity to present the concerns they have to an independent, quasi-judicial forum within the agency.

As mentioned previously, several parties took that opportunity and presented some 125 issues that they wished to have adjudicated before the Board. The Board admitted those parties who it determined had demonstrated their legal "standing" to participate and who had proffered admissible contentions.

3. The Parties' Contentions. Several petitioners sought to oppose the PFS facility.⁵ As mentioned above, the petitioners submitted some 125 contentions challenging the proposed facility. The number of contentions was reduced as the proceeding progressed. Many were dismissed initially on procedural grounds, such as not being filed within the proper time frame or for being outside the jurisdiction of the Board. Other issues, though appearing appropriate for consideration by the Board, were later decided on legal grounds, through "summary disposition" procedures, as they did not involve a significant factual dispute that would require evidentiary presentations. Some matters were settled. In other instances, a party that introduced a contention later withdrew it after determining that it no longer wished to litigate the issue.

⁵ Along with the State of Utah, the Southern Utah Wilderness Alliance also presented several contentions, one of which went to evidentiary hearing. Other petitioners who participated to a lesser extent included the Skull Valley Band of Goshute Indians, Ohngo Gaudadeh Devia, Confederated Tribes of the Goshute Reservation, David Pete, Castle Rock Land and Livestock, Skull Valley Company, and Ensign Ranches of Utah. See LBP-98-07, 47 NRC 91, 156-57 (1998).

The several contentions that remained were the subject of full evidentiary hearings.⁶ In that regard, the 45 days of evidentiary hearings conducted in 2002 on aircraft crashes, seismic standards, and environmental/wilderness values (as well as on a hydrological issue that was settled in mid-trial (see 57 NRC at 81 n. 6; p. C-4, above)) were all open to the public, with the vast majority of those sessions held in Salt Lake City.

We have commented previously on the concern, sometimes expressed by observers of our hearings, as to the NRC Staff's appearing to be too much on the side of an applicant. LBP-03-04, 57 NRC at 82, 83-84. As this case illustrates, that alignment occurs only after the Staff has conducted its lengthy review and the Applicant has responded by making changes that the Staff has insisted upon. The Staff's support of an applicant's position at the hearing does not, then, establish that the Staff has failed to carry out its duty to protect the public interest.

While the Staff's regulatory review plays an important role in the application process, and the presentation of its position based thereon is an important aspect of the hearing process, we insist upon treating the NRC Staff (with whom we have no extra-judicial organizational interaction) the same as any other party at the hearing. In particular, we subject the Staff's evidence to the same scrutiny as that of the other parties. See LBP-03-04, 57 NRC at 140 n.124 and accompanying text; see also n. 13, below.

B. Recent Timing

⁶ The Bollwerk-chaired Board (see p. A-1, n.19, above) conducted an evidentiary hearing in 2000 on the merits of several contentions, including financial assurance and emergency planning. Some of that Board's partial initial decisions include: Emergency Planning, LBP-00-35, 52 NRC 364 (2000), petition for review denied, CLI-01-9, 53 NRC 232 (2001); Financial Assurance (May 27, 2003) (unpublished pending review of propriety information); Decommissioning (May 27, 2003) (unpublished pending review of propriety information).

In addition to hearing the aircraft crash matter, the Farrar-chaired Board took evidence and issued partial initial decisions on Geotechnical Issues, LBP-03-08, 57 NRC 293 (2003), petition for review denied, CLI-03-08, 58 NRC 11 (2003); and Rail-line Alternatives, LBP-03-30, 58 NRC 454 (2003).

In deferring its review of our March, 2003 decision on aircraft crash probabilities, the Commission indicted its expectation that we would be able to reach a decision on the subsequent “consequences” phase by the end of that year. Today’s decision comes nearly 14 months after that target.

If someone were to ask “what went wrong”, the simple answer would be:

Nothing. Analysis of the progress of this case over the past two years illustrates that: (1) the Staff’s regulatory review process functioned as it should; (2) the Applicant used large amounts of time to refine the justifications for its application; and (3) during the periods that the process was under the Board’s control, the diligence of all parties and our case management efforts kept the adjudicatory process moving on schedule.

This proceeding was convened to determine the safety of a proposal that could result in the Nation’s stockpile of spent nuclear fuel resting aboveground, at an away-from-reactor site, for a very long time.⁷ The current “consequences” phase involves a complicated and significant question that was a direct outcome of the Applicant’s choice of a site about which safety concerns were triggered by the overflight of 7,000 F-16s a year.⁸ As the parties

⁷ That period was initially thought to be 20 years. The State unsuccessfully challenged its extension to 40 years. See CLI-04-22, 60 NRC 125, 148-50 (2004). Recently, the Commission approved a 40-year extension for on-site aboveground cask storage at one reactor site (see NRC News, No. 04-156, “NRC Approves 40-Year License Renewal for Independent Spent Fuel Storage Installation at Surry Nuclear Plant” (Dec. 8, 2004)). That decision indicated a continued belief that spent fuel could be stored in dry casks for at least 100 years without significant environmental impact because the additional years do not pose any obvious “aging-type” safety issues. Our decision today, then, could conceivably lead ultimately to very lengthy storage of spent nuclear fuel in Skull Valley.

⁸ In other words, the issue we decide today was brought on by the Applicant’s own election to move forward with a site that could readily be seen -- with a look upwards and a look to the standard screening formula -- to be a problematic one.

proceeded with this phase, and as is not uncommon in complex proceedings like this one,⁹ the NRC Staff found the Applicant's submittals wanting, and therefore pursued clarification through a number of requests for additional information (RAIs). Because of these apparent shortcomings in the Applicant's submittals, additional (iterative) work was required to get the application to a stage where the Staff could support it. Those two parties' needs for more time to "get it right" led to the periodic (temporary) suspension of the formal adjudicatory process at the Applicant's request; all agreed that no purpose would have been served by wasting time (and effort) on adjudicating an incomplete or unsupportable application.

In various procedural orders,¹⁰ we explained each resulting alteration of the original schedule we had set out for the parties, a schedule which had initially targeted a year-end 2003

⁹ See Duke Cogema Stone & Webster (Savannah River Mixed Oxide Fuel Fabrication Facility), CLI-01-13, 53 NRC 478, 484-86 (2001) where the Commission set forth an aggressive adjudication schedule, which the Board was prepared to implement (see unpublished Memorandum and Order (setting Phase I schedule) (July 17, 2001)). The Applicant notified the Board on January 24, 2002, however, that it needed to amend its Construction Authorization Request and Environmental Report. The Applicant's changes, and the Staff's review of those changes, ultimately led to a two-year scheduling delay beyond the Board's control.

¹⁰ See the following unpublished prehearing orders in which we dealt with scheduling:
Scheduling Memorandum and Report (July 31, 2003);
Scheduling Memorandum and Report (Aug. 15, 2003);
Scheduling Order and Report (Sept. 9, 2003);
Order Suspending Schedule (Oct. 10, 2003);
Order Convening Conference Call (Regarding Contention Utah TT and Hearing Schedule) (Feb. 5, 2004);
Order Summarizing Prehearing Conference Call (Regarding Contention Utah TT, Hearing Schedule, and Related Matters) (Feb. 19, 2004);
Order Summarizing Prehearing Conference Rulings (Regarding Contention Utah TT and Hearing Schedule) (Feb. 27, 2004);
Memorandum Concerning Scheduling (Apr. 15, 2004);
Scheduling Order (Apr. 23, 2004);
Memorandum of Conference Call (June 2, 2004);
Memorandum and Order (Summarizing June 15 and July 1 Prehearing Conference Call) (July 14, 2004);
Memorandum and Order (Summarizing July 15 Conference Call) (July 22, 2004).

decision and had set forth a roadmap for achieving that goal.¹¹ But all those scattered thoughts are worth recounting in one place, because together they demonstrate how additional time was necessary to enable the NRC's licensing process to follow its design course, and how this process eventually benefitted the public interest (and, as will be seen, even the interests of the Applicant, who, not untypically, indicated at every possible juncture a strong preference for agency rulings that come sooner rather than later).

1. We begin by observing that the agency's regulatory process can accommodate the evolving needs of an applicant to enhance its proposal from a safety standpoint,¹² or to develop a better information base to demonstrate its safety. As that preparatory process unfolds, however, the time consumed by an applicant's preparation cannot necessarily be attributed to the adjudicatory process or to the Board's oversight of that process. Moreover, all involved recognize that we have no supervisory power whatsoever over the Staff's performance of its regulatory review activities. See Duke Energy Corp. (Catawba Nuclear Station, Units 1 and 2), CLI-04-06, 59 NRC 62, 74 (2004) (citing, e.g., Curators of the University of Missouri, CLI-95-01, 41 NRC 71, 121 (1995)).

¹¹ See June 25, 2003 transcript of Conference Call, where we built on the parties' June 19, 2003 "Joint Report on Proposed Schedule," at 9-10, to set forth a schedule (referred to in our July 31, 2003 order, above) that would have met the Commission's year-end decisional timeframe; see also the schedule that superseded it (set out on p. 6 of our Sept. 9, 2003 order, above) that, even with the slippage encountered by then -- attributable to the Applicant's delay in filing expert reports, filing more reports than expected, and need to evaluate the timing of its response to Staff RAI's -- would have led to a decision in mid-April of last year. That second schedule was itself suspended at the Applicant's behest a month later for what proved to be a very lengthy period.

¹² For example, in the midst of the preparation for the consequences hearing, the Staff's questions led the Applicant to discover an accident-related shortcoming in an aspect of cask design. The Applicant devised a solution and amended its license application to reflect the change (its Safeguards aspects preclude our detailing it here). This change, in turn, prompted the State to file on January 9, 2004, a new contention, denominated Utah TT, challenging the change as creating a different kind of problem, this one of an operational nature. At our suggestion, the parties were able to avoid litigating the new contention by settling the underlying dispute, by way of the Applicant's agreeing to do test runs that would eliminate the operational concern. See our unpublished Orders, above, of February 19, 2004 (at 3) and February 27, 2004 (at 2). This all took some time -- but cask design and facility operations were both made safer because of it.

Accordingly, it is paramount to recognize that the schedule for the adjudicatory process is not wholly, and sometimes not even largely, within the Board's management and control. In this instance and in others, one should expect a not insignificant portion of the time to be consumed by the interactions between the applicant and the NRC Staff, as the applicant polishes the application and its supporting data to enable the staff to accept its approach and conclusions.

Here, early on the Applicant needed additional time to provide its initial round of expert reports setting forth its position on the "consequences" issue, and then actually proffered more reports than were anticipated. This, in addition to the delays in generating the reports themselves, resulted in additional time for responsive filings.

At the same time, perhaps to ensure there was no possibility of the types of shortcomings identified in the positions it advanced before us in the course of the first aircraft hearing,¹³ the Staff, apparently finding the application to be falling short of what was needed for its approval, made a concerted effort to pursue additional information prior to the hearing. Thus, it presented the Applicant with a series of RAIs, the second set of which resulted in the proceeding going into abeyance for an additional period of over four months -- at the Applicant's behest -- while the Applicant developed its answers.

The course followed here demonstrates how the process sometimes works. To fulfill their respective roles, the Applicant must submit a thorough and compelling application demonstrating that it meets the regulatory requirements, and the Staff must diligently seek out thorough answers to its concerns. In such a process, it should be expected that, as was the case here, the applicant will, of necessity, expend considerable effort and consume considerable time and resources in the course of responding (and perhaps in revising its application).

¹³ See LBP-03-04, 57 NRC at 97 n.38, 109 n.66 (sensitivity analysis); 118-19 (aircraft formation analysis); 133-35 ("order of magnitude" evaluation); 133 n.97; 134 n.02 ("one-way" outlook); 135, n.105 (failure to sharpen focus); and 138 (lack of parallel action).

The extra time involved should be expected to benefit the public interest, as the Staff assures that the application satisfies the regulatory requirements. The additional information developed should as well put the Applicant in a better position to defend its proposal at the hearing, and it should allow the Staff to take a more forceful position at the hearing in support of the Applicant. In the hearing on seismic matters, for example, the Staff's support (albeit derived from a source other than RAI responses) played an important role in this Applicant's success.¹⁴

As it turns out, in the instant case, the extra time and effort also benefitted the Applicant -- after all, it has today obtained a favorable decision. In contrast, had the evidence in this phase of the aircraft hearing been submitted in time for us to render a late-2003 decision, the Applicant might not have had the Staff's support. And whether it did or not, the Applicant's evidence available at that time may have proved inadequate for it to carry its burden of proof.

In thus indicating the Applicant may have benefitted from the extra time it devoted to preparing the information to support its application, we hasten to add that we have no interest in whether an applicant or an intervenor prevails in any of the matters that come before us. Two years ago, we ruled against the applicant on the first aircraft crash phase; today we rule in its favor on the second phase. In both instances, we did have an interest in the record being developed in a manner that "allow[s] us to make an informed decision" (LBP-03-04, 57 NRC at 141) on the merits without regard to which party our decision favors.

2. The foregoing observations apply to the great portion of the process, taking place in the nearly two years since our probability decision, that was not under our control. As they illustrate, we -- like other Boards -- control only a portion of the period during which an application is under agency consideration, which sometimes has been inaccurately attributed to time consumed by the adjudicatory process. The relative amount of time consumed by the adjudicatory process, compared to the Staff's regulatory review, will in large measure depend

¹⁴ See discussion of Dr. Luk's work in LBP-03-08, 57 NRC at 352, 354-55, 357 (2003).

upon the degree to which the application, on which the hearing is to be held, comes with a thorough foundation at the outset.

In this particular instance, the part of the two-year process that was under our control was managed, we think it fair to say, in an efficient manner that sped both the hearing and our decision along, and was fair to all involved. Once the matter came back to us after being in abeyance, we set a schedule and adhered to it. This was due both to the diligence exhibited¹⁵ and accommodations made¹⁶ by all three parties (for which we commend counsel from the Applicant, the Staff and the State), and to our innovative management of both anticipated¹⁷ and

¹⁵ For all practical purposes, once the hiatus ended and a new schedule was instituted, the parties met their filing obligations in a timely fashion.

¹⁶ For example, the parties on their own made major adjustments to their cross-country deposition schedules to accommodate the serious medical problems encountered by a key witness.

¹⁷ For example, we required the parties to submit, during the run-up to the hearing, not only pre-filed direct testimony but pre-filed rebuttal testimony as well (a step not required by the former version of the Rules of Practice, still applicable here). Having done that, we were able to institute a practice, when a witness took the stand to adopt orally his written pre-filed direct and pre-filed rebuttal testimony, of having that witness also be asked on initial examination by his counsel to respond to any issues raised in the other parties' pre-filed rebuttal testimony. This avoided as much as possible having witnesses return to the stand on repeated occasions to provide rebuttal and other forms of responsive testimony, an approach which had seemed particularly inefficient during the earlier seismic hearings. See Telephonic Prehearing Conference of July, 15, 2004, Tr. at 15162-63. This technique worked here; whether it would work in other circumstances is an open question.

unexpected¹⁸ matters, some of which were of a routine nature,¹⁹ and some of which could have been confounding.²⁰

In the final analysis, then, the fourteen month extension beyond the Commission's target date for completion of this stage of this case was simply attributable to the need to fulfill properly

¹⁸ We found it helpful on occasion to depart from the usual order and to construct an impromptu "debate" between the witness on the stand and a prior witness from an opposing party. In this fashion, the competing views of both could meet head-on, or those views be reconciled on the spot, rather than through seriatim appearances. This not only promoted the efficient use of time, but it enabled, to the maximum extent practicable, sensible resolution of issues.

¹⁹ We imposed measures to simplify the hearing logistics -- avoiding wasting time on housekeeping procedural matters -- that shortened the hearing's overall length. For example, we required the parties, not only to pre-file all their exhibits for our prehearing review, as is customary, but also to pre-stamp the copies to be formally introduced. In uncomplicated cases, that step might not be necessary -- but in this proceeding that simple pre-arranged administrative measure conserved enormous amounts of hearing time compared to earlier portions of this case.

In that regard, much time was consumed during the 2002 hearings by the need to stop the proceeding, each time an exhibit was identified and offered, to allow the court reporter to stamp each of the several copies and insert on each the necessary information (party name, exhibit number, date offered, and sponsoring witness). This proved especially burdensome and inordinately time-consuming when many exhibits were submitted simultaneously. During this phase, we required the parties to stamp and mark their exhibits in advance, thus allowing our law clerk simply to take possession of the exhibits without causing any interruption of the court reporter or of the proceeding. This was especially useful upon each party's starting to present its witnesses, occasions which led to the submission of a combined total of approximately 100 exhibits.

²⁰ For example, it was apparent that a variety of looming scheduling conflicts would have prevented the hearing's resumption for a considerable period if it were not concluded by September 15. We thus took the precaution of convening an unusual Sunday session on September 12 to assure that we finished on time.

This concern about ending the hearing served as a book-end to how we began it. To assure that the hearing started into substantive business promptly, without losing time for housekeeping matters, we had made arrangements for the parties to set up in their conference rooms off our hearing room on Sunday, August 8, the day before the hearing began.

the Atomic Energy Act's demands: to carry its burden of proof, an applicant must provide information sufficient to allow the agency to pass knowledgeable judgment on whether the license being sought is consistent with the protection of the public health and safety and the environment. Much of that is done outside our control. Where the process was within our control, we can report that there was no failure in the adjudicatory process or in our supervision of that process.²¹

This completes the Appendix.

²¹ We note that this decision is being issued (for all practical purposes) within the time-frame the Commission typically expects (see p. A-3, n.22, above), even though (1) the hearing was long and the issues quite complex and (2) there arose another matter, also decided today (LBP-05-05, involving a recently-filed contention) that required our attention along the way.