United States of America
OCCUPATIONAL SAFETY AND HEALTH REVIEW COMMISSION
1120 20th Street, N.W., Ninth Floor
Washington, DC 20036-3457

SECRETARY OF LABOR,
Complainant,

v.

HERCULES, INC.

And

ALLIANT TECHSYSTEMS, INC.[1],
Respondents.

UNITED STEELWORKERS OF AMERICA,
Authorized Employee Representative.

OSHRC Docket No. 93-2790

DECISION

Before: RAILTON, Chairman; STEPHENS and ROGERS, Commissioners.

BY THE COMMISSION:

Hercules manufactures explosives at a facility in Kenvil, New Jersey. Before the Commission for review[2] is a failure to abate notification[3] alleging that Hercules failed to

[1] Subsequent to the commencement of the hearing in October 1994, Alliant Techsystems, Inc. purchased part of Hercules' business, taking over operations at the Hercules facility in question. Upon motion by the Secretary, Alliant was added as a party to this case.

[2] This case originally included several notifications for failure to abate various recordkeeping

abate previously-cited violations of 29 U.S.C. § 654(a)(1)[4], section 5(a)(1) of the Occupational Safety and Health Act, 29 U.S.C. §§ 651-678 ("the Act"), for failure to protect employees from the effects of explosions. The earlier citations were issued following an inspection of an accident involving explosive material at the Kenvil facility that occurred in June of 1989. That accident destroyed several buildings and caused non-fatal injuries to a number of employees. The citations alleged, among other things, that Hercules violated section 5(a)(1) by exposing its employees to hazards associated with four explosive manufacturing operations.

Hercules and the Secretary settled these two citation items on October 21, 1991.[5] As

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violations. The judge severed one of those notifications and issued a separate decision, which is currently before us on review in Docket No. 95-1483. The judge retained the remaining recordkeeping failure to abate allegation in this docket number. The judge's disposition of that item is also before us on review. Because the two recordkeeping notifications involve similar facts and issues, and because the notification for failure to abate the Section 5(a)(1) violations, the Act's general duty clause, involves totally unrelated facts, we sever the recordkeeping portion of this docket number and consolidate it with the recordkeeping notification in Docket No. 95-1483. A copy of the judge's decision as it relates to the failure to abate the Section 5(a)(1) violations is attached.

[3] Section 17(d) of the Act, 29 U.S.C. § 666(d) states that:

> Any employer who fails to correct a violation for which a citation has been issued under section 9(a) within the period permitted for its correction (which period shall not begin to run until the date of the final order of the Commission in the case of any review proceeding under section 10 initiated by the employer in good faith and not solely for delay or avoidance of penalties), may be assessed a civil penalty of not more than $7,000 for each day during which such failure or violation continues.

[4] Section 5(a)(1) states that each employer:

> shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.

[5] The settlement agreement became a final order of the Commission on December 23, 1991.

part of the settlement, Hercules withdrew its notice of contest to the two general duty clause charges and was assessed a reduced penalty. It agreed to abate the cited hazards by December 5, 1991. On February 20, 1992, in accordance with the terms of the settlement agreement, Hercules notified the Secretary that the cited hazards had been abated. On March 9, 1993, the Secretary inspected the facility regarding an unrelated matter and thereafter issued the notification of failure to abate (NFTA) now before us. The notification alleged that these violations remained unabated from December 23, 1991 to March 9, 1993, or 440 days. The Secretary proposed the maximum penalty of $7000 per day for a total proposed penalty of $3,080,000. The notification alleged that neither of the general duty clause violations cited in 1989 had been abated with regard to the Blender Packer operation, one of the four operations originally cited. The gravamen of the charge in the original citation as it relates to the NFTA was that, in the event of a detonation in the Blender Packer Operations building, employees would be exposed to death or serious physical harm from the effects of the blast in two areas. The first area involved employee access to a loop road near the building where, in the event of a blast, employees would be exposed to overpressures of 2.3 pounds per square inch (p.s.i.). The second area concerned employees in the Blender Packer Control building, from which the functions of the operations building were remotely controlled. The failure to abate notice alleged that employees remained exposed in both areas to overpressures in excess of 2.3 p.s.i. and, in the Blender Packer Control building, to flying debris that might be caused by another explosion.

After a lengthy hearing, Judge DeBenedetto issued a decision vacating the failure to abate notification. He carefully analyzed the testimony and computer software programs of expert witnesses produced by each party. He determined that the program developed by the expert for Hercules more accurately predicted the blast effects that would be expected in the event of an explosion. He found that Hercules' expert's program was more sophisticated and credible in light of the situation to be expected in the event of an explosion. Specifically, the judge agreed with the analysis presented by Hercules' expert, that an explosion originating inside the Blender Packer Operations building would be measurably suppressed by its surrounding structure and its three to five foot thick earth covering. Hercules hardened the front wall of the control building after the 1989 accident. The judge agreed that the earth covering would suppress the explosion sufficiently to drive the blast wave out of the uncovered portals at each end of the operations building in a direction away from where the control building and the loop road were located. The judge agreed with Hercules' expert that rather than punching holes through the control building as the Secretary's expert had contended, the blast wave would envelope it like a glove, creating an overall crushing effect upon its earth covering. However, the control building's location, its hardened door, and the earth covering would succeed in keeping overpressure levels inside the control building at no more than .01 p.s.i., just slightly above ambient pressure and materially reduce any hazard of flying objects.

The judge also agreed with the conclusion of Hercules' expert that overpressure levels at the loop road associated with the detonation of 2,000 pounds of explosive material, a limit which was strictly enforced after the 1989 event, would remain well below 2.3 p.s.i.[6]

We have considered the record, the arguments of the parties and the applicable case law. We discern no material error in Judge DeBenedetto's evaluation of the computer software and the testimony of the expert witnesses and find that his decision vacating the notification is otherwise supported by the evidence and applicable legal precedent. *Fabi Construction Company, Inc.,* OSHRC Docket No. 96-0097 (May 30, 2003). That part of his decision is affirmed and is attached to our decision.

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[6] The amount of explosive material processed at the time of the 1989 explosion was of the order of 4000 pounds. Hercules took steps after the explosion to ensure that the amount processed did not exceed the 2000-pound level. It took additional steps to lower the possibility of an explosion, and it took steps to prevent employee access to the loop road while materials were being processed in the Blender Packer Operations building.

Accordingly, it is ORDERED that the Notification for failure to abate the violations of the general duty clause is vacated.

_/s/__________________________
W. Scott Railton
Chairman

_/s/________________________
James M. Stephens
Commissioner

_/s/__________________________
Thomasina V. Rogers
Commissioner

Dated: February 27, 2004

ATTACHMENT

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SECRETARY OF LABOR, Complainant v. HERCULES, INC., and ALLIANT TECHSYSTEMS, INC.,[1] Respondents UNITED STEELWORKERS OF AMERICA, Authorized Employee Representative.	OSHRC DOCKET NO. 93-2790

Appearances:

Jane Snell Brunner, Esq.
Office of the Solicitor
U.S. Department of Labor
For Complainant

Michael J. Connolly, Esq.
Cross Wrock
Detroit, MI
For Respondent

Before: Administrative Law Judge Richard DeBenedetto

DECISION AND ORDER

SAFEGUARDING THE MANUFACTURE OF EXPLOSIVES

On September 8, 1993, Hercules was issued a notification of failure to abate for two violations that were charged under the general duty clause of section 5(a)(1) of the OSH Act, 29 U.S.C. § 654(a)(1),[19] and originally cited in 1989 (Exhibit C-118).[20] The notification alleges that these violations continued unabated from December 31, 1991 to March 9, 1993, or 440 days (Tr. 973-74). Assessing a penalty of $7,000 per day pursuant to OSHA's egregious policy, a total penalty of $3,080,000 is proposed (Tr. 973-74).

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[19]The general duty clause provides:

> Each employer...shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees. 29 U.S.C. § 654(a)(1).

[20] The violations were combined into one for the purposes of the failure-to-abate notification.

Hercules is a large explosives manufacturer with over 10,000 employees (Tr. 1390-91, 2000). On June 3, 1989, an accident involving explosive material occurred at the Kenvil, New Jersey, plant resulting in the destruction of several onsite manufacturing facilities, but only minor employee injuries including a broken collarbone and mild hearing loss (Tr. 824-25, 867-68, 2298-2300, 4078; Gardner Feb. Dep. 25-26; **Exhibit C-102**; **Dep. Ex. 6**).[21] On November 20, 1989, after investigating the accident, OSHA issued Hercules three citations, including one serious and one willful, alleging a total of 71 violations (Tr. 801-02). The serious citation and the willful citation each contained a violation of the general duty clause, alleging that employees at the Kenvil plant were exposed to certain hazards associated with four explosives manufacturing operations (Tr. 876-77, 880; Exhibit C-108).

All three citations were settled by the parties on October 21, 1991 (Tr. 907; Exhibit C-111). With regard to the two § 5(a)(1) violations, Hercules accepted the violations as cited, withdrew its notice of contest, and was assessed a reduced penalty for each (Tr. 910-11). The settlement agreement became a final order of the Commission on December 23, 1991. In accordance with the terms of the agreement, Hercules notified OSHA on February 20, 1992 that these violations, in addition to others, had been abated (Tr. 912-13; Exhibit C-113). However, upon conducting a follow-up inspection at the Kenvil plant on March 9, 1993, OSHA concluded that neither of the general duty clause violations had been abated with regard to one of the four operations originally cited in 1989 (Tr. 913, 916-17). This operation, known as the Blender Packer operation, is thc subject of the failure-to-abate notification at issue here (Tr. 832, 916).

THE BLENDER PACKER OPERATION

At the Kenvil plant, Hercules manufactures various types of smokeless, double-based propellant, an explosive powder which is used to make gunpowder for small arms ammunition (Tr. 833-34, 841-43, 2290; Exhibits C-104 & R-133). The propellant passes through several production stages at various in-plant facilities before reaching the Blender Packer operation (Tr.1353; Exhibit R-116). The manufacturing process originates in a premix area where a predetermined amount of

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[21] **References to testimony or exhibits which are under protective seal will be indicated in bold typeface.**

nitroglycerin is added to dehydrated nitrocellulose, creating a double-based propellant (Tr. 833-34, 1183, 1329, 1353, 1939-40, 2507; Gardner Feb. Dep. 141). If necessary, other chemicals are added to the propellant at operations known as final mix houses (Tr. 1940-41). The propellant is then taken to the blocking house where it is formed into a chunk that is run through a press which extrudes the propellant in long spaghetti-like strands (Tr. 1942). These strands are cut into small pieces the size of salt or rice grains which are "slurry coated" or "glazed" with graphite[22], screened, dried, and then vacuumed with a collection system known as a "roto-clone" in order to remove tiny dust particles known as "fines" (Tr. 848, 1324-25, 1353-54, 1942-43, 1981-82, 2210-11, 2397, 2553-54; Gardner April Dep. 177, 196-97).[23] The propellant is then transported to the Blender Packer operation to be "blended" in a rotating vessel known as a glaze barrel; blending combines the propellant into a composite material (Tr. 826, 847-48, 1943-44, 2344; Exhibits R-148, C-103, & C-107 at I-3; Gardner Feb. Dep. 94-98; Dep. Ex. 51 at 12).[24] After blending, the finished product is packed for

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[22] Glazing the propellant with graphite allows it to flow more easily and helps maintain the integrity of the product (Tr. 848, 2403). After the 1989 accident, Hercules changed the method by which propellants were glazed. Rather than mixing the propellant with graphite in a dry state, graphite is now applied in a wet glazing process known as slurry coating (Tr. 1942, 1979-80, 2210-12, 2394-97, 2403; Gardner Feb. Dep.201-02; Martin Dep. 126-27). **According to an internal Kenvil memorandum, the slurry coating facility was approved to begin on May 8, 1991, for the purposes of debugging the system** (Tr. 2229-30, 2394-95, 2398-99; **Exhibit R-119 at 07473).**

[23] There is a designated roto-clone area located at several Kenvil manufacturing operations including the Blender Packer (Tr. 1981-82, 2317-18, 2534; Gardner April Dep. 177; Martin Dep. 177-78).

[24] At the time of the 1989 accident, glaze barrels were used to either blend or glaze propellant. Since then, Hercules has eliminated the glaze barrel in favor of more efficient equipment. After the installation of the slurry coating facility, propellant was no longer dry glazed in a glaze barrel. For blending, Hercules purchased "ribbon blenders" to replace the two glaze barrel facilities destroyed in the June 1989 accident (Tr. 824, 867-68; Delancey Dep. 89; Gardner Feb. Dep. 95, 130; Gardner April Dep. 195-200; Exhibit C-155).

Prior to the 1989 accident, it appears that both blending and dry glazing operations were performed in the Blender Packer glaze barrel (Tr. 826, 847; Martin Dep. 126; Gardner April Dep. 198). Although Hercules maintains that after the 1989 accident, all propellant produced at Kenvil was blended and glazed at an off-site facility in Arizona until the new slurry coating and ribbon blender systems were up and running, there is some indication that glazing continued to be done at the Blender Packer operation (Tr. 2403-04; Exhibit C-144, #17(B); Gardner Feb. Dep. 32; Gardner April Dep. 197-98, 201-02). As the Secretary has indicated, the word "glazing" was specifically added to the titles of all four versions of the Blender Packer operating procedures dated from January 29, 1991 to March 18, 1993 (Dep. Ex. 3). It is also noted that a (continued...)

sale or shipment (Tr. 1944; Gardner April Dep. 191, 353-54).

The Blender Packer operation consists of two buildings, one designated the operation room and the other, the control room (Tr. 832, 868-69; **Exhibits C-101**, R-118, & R-147). The operation room is shaped like a half-cylinder and is made of plywood with at least three feet of compacted soil covering its arched roof (Tr. 833, 869, 1078, 1135-36, 1368, 1584, 1648, 1724-25, 1965, 2315, 2348, 2496-97, 3411, 3648, 3820; Delancey Dep. 90-91; Exhibit R-152).[25] At each end of the operation room are two box-like portals or entries that are almost thirty feet long and eight feet wide (Tr. 3432-33, 3820; Exhibits C-139, Att. 2 & R-147). The center area between the portals measures approximately 37 feet in length and 24 feet in width (Exhibit C-139, Att.2). Located in this area, just a few feet off-center, is the glaze barrel, a large, enclosed, copper container that is mounted on top of a concrete pedestal approximately six feet from the floor (Tr. 828, 1306, 1584, 1590, 1945, 2176, 2910-11; Exhibits C-103, R-123, R-148, & R-173). The barrel has a 24-inch diameter opening that faces upwards at a 30 degree angle (Tr. 1364-65, 1945, 1960-61, 1976, 2344-45, 2356-57, 2693-95; Exhibit R-173).

The Blender Packer control room, positioned to the southwest of the operation room, is an egg-shaped, corrugated steel structure, a portion of which extends below ground with a concrete floor poured inside to make it level (Tr. 956-57, 1087-88, 1367-68, 1557-58, 1965, 2170-71, 2311, 2866-68; Exhibits C-139, Admission No. 757(A), R-118, **C-101**).[26] Like the operation room, at

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[24](...continued)
table containing glazing instructions appears for the first time in the October 27, 1989 version of the Blender Packer operating procedures and in all four subsequent revisions dated through March 18, 1993 (Dep. Ex. 3).

[25] The depth of the earth-cover increases to over five feet as it slopes down the sides of the building at an angle of approximately one and a half to one (Tr. 1136, 1648-49, 1683, 2315-16, 2767-68, 2867; Exhibit C-139, Admission No. 758(D)).

[26] At the hearing, the parties hotly contested whether the corrugated steel making up the side walls and roof of the control room is 5-gauge (1/4 inch thick) or 10-gauge (1/8 inch thick) (Tr. 1700-01, 1749-1808, 2253-77; Exhibit R-112). The Secretary's chief expert witness indicated that he relied upon blueprints of the structure which indicate that the thickness is 10-gauge (Tr. 1688, 1694, 1749, 1760-62; Exhibit C-139, Appendix 5). Moreover, Hercules admitted during discovery that the thickness of the steel in question is 10-gauge and as the record reflects, never amended its response to indicate otherwise (Tr. 1750-51, 1763;
(continued...)

least three feet of compacted soil covers the control room and extends down over the sides of the structure (Tr. 833, 869, 1078, 1135-36, 2311-16, 2315-16, 2867-68; Gardner Feb. Dep. 91; Exhibit C-139, Admission No. 757(G)). The front wall of the control room is made of wood, but after the 1989 accident, Hercules hardened the wall by covering it and the front door with four and a half inch steel plate (Tr. 957, 1086-87, 1128-29, 1142-43, 1146, 2317, 2319-20, 2328; Gardner Feb. Dep. 26, 125-26 ; Dep. Ex. 2; Exhibits R-103, R-142, C-124, & C-139, Admission Nos. 757(F) & (H)). The rear wall is constructed of 1/4-inch-thick corrugated metal (Tr. 1704; Exhibit C-139, Admission No. 757(E)).

At the blending stage of the production process, propellant enters the Blender Packer operation room in four-wheeled, rectangular vehicles known as drop plug buggies (Tr. 881; Martin Dep. 184-85).[27] Each buggy is hoisted up over the opening of the glaze barrel by a hydraulic lift system and propellant is dropped into the barrel through an opening at the bottom of the buggy (Tr. 828, 881-82, 2356-57; Gardner April Dep. 192-94). This process is known as "charging the barrel" and is performed from inside the control room by an operator who observes the operation from a video monitor (Tr. 881-82, 1236, 1239-40, 1945-46, 2356; Gardner April Dep. 192-94).[28] The glaze barrel, which holds up to 1,000 pounds of propellant, then begins to rotate at a rate of approximately 18 rpm for a period of time ranging from 15 minutes to two hours (Tr. 828-29, 848-49, 883, 2173-

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[26](...continued)
Exhibit R-112 & C-139, Admission 757 (D) (i)). Thus, it is concluded that the thickness of the steel is 10-gauge (Tr. 1751-53, 1756-57, 1763-65, 1771-73, 1794-95, 1805-09, 2273).

[27] After the 1989 accident, these buggies were replaced by lighter-weight, plastic carts known as "cruisers" (Tr. 2491-92, 2541-42; Martin Dep. 183-85; Exhibit R-124).

[28] Under certain conditions, an operation setup in this manner is considered "remote", *i.e.* one that has been determined to pose an unacceptable risk to exposed personnel of explosion or detonation and for which appropriate protective measures are taken in order to protect personnel from 2.3 psi overpressure levels (Tr. 1971-72, 2197-98, 2440; Gardner Feb. Dep. 19-20, 23-24, 50; Dep. Ex.7; Dep. Ex. 11 at 4-7 to 4-8; Dep. Ex. 43 at 152, 192; Dep. Ex. 44 at 7-28; Exhibits C-105 at 17-43, C-145 at 4-6). Having determined that the Blender Packer operation does not pose an unacceptable risk of detonation, Hercules claims that it is not a remote operation, but an "unattended" operation (Tr. 970-71, 1001, 1972, 2197-98, 2439-40; Gardner Feb. Dep. 17-21, 103-05; Exhibit C-139, No. 9(c); C-145 at 4-6; Dep. Ex. 7). *See* discussion *infra*, page 35.

74, 2352-53, 2357, 2541, 2693, 2914-15).[29] At the end of the cycle, the propellant is released from the glaze barrel into fiberboard containers approved by the Department of Transportation (DOT) for shipment (Gardner April Dep. 199, 354; L.Smith Dep. 138-39).

THE PROPELLANTS PROCESSED AT BLENDER PACKER

Various types of smokeless, double-based propellant are processed at the Blender Packer operation (Tr. 2382-83, 2502; Gardner Feb. Dep. 34-37; Exhibit R-132). The parties are sharply divided over how these propellants should be classified under a uniform hazard classification system recommended by the United Nations Organization (UNO) for international use and developed for the purposes of storing and transporting explosives (Dep. Ex. 11 at 6-1; Dep. Ex. 12 at 000828; Dep. Ex. 43 at 10, 50; Dep. Ex. 44 at 7-1, 7-2; Exhibit C-105 at 19-1, 19-2; Exhibit C-106 at 3-1 [hereinafter 1992 version]; Exhibit C-107 at I-1, VI-1, VI-2; Exhibit C-160 at 4-1).[30]

Under the UNO hazard classification system, ammunition and explosives are labeled Class 1, then further classified by division to delineate the specific hazards that may be associated with these materials. Two of these divisions are relevant here.[31] Class 1, Division 1, or 1.1, explosives, are characterized as "mass detonating" materials which principally pose "...a blast hazard and may

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[29]About 2,000 pounds of propellant is present in the Blender Packer operation room at any one time; approximately 1,000 pounds inside the glaze barrel and 1,000 pounds contained in two drop plug buggies awaiting the next processing cycle (Tr. 871, 918-19, 1037, 2174-75, 2352-53, 2541, 2914-15; Exhibit C-114; Dunbar Dep. 179-81). *See* propellant limit discussion, *infra*, notes 43 & 73.

[30] Several federal agencies, including the Department of Energy and the Department of Defense, have adopted the UNO hazard classification system, but have expanded its application to the handling, manufacturing, and general processing of explosive materials (Dep. Ex. 11 at 6-1; Dep. Ex. 43 at 50; Dep. Ex. 44 at 7-1; Exhibit C-107 at I-1). However, a 1989 Department of Defense Technical Bulletin, known as TB 700-2 and used by various military organizations, expressly limits use of the UNO system to transportation and storage, stating that the procedures and tests contained therein do not determine hazards occurring "during the various stages of manufacturing" (Tr. 1983-84, 3118, 3123; Exhibit C-160 at 1-1). In fact, a 1980 Army report sets forth testing procedures which can be used specifically to determine the hazard classification of explosive materials that are "in-process" (Tr. 3156-57; Exhibit C-162). These tests evaluate those conditions which may cause an explosive to detonate, such as impact or friction (Tr. 3157-58; Exhibit C-162 at 16-20, 25-29). The report indicates that the structure of its in-process classification system is nearly identical to that of the UNO scheme (Tr. 3157; Exhibit C-162 at 1).

[31] These divisions were previously known as Class A and Class B, respectively (Tr. 860, 1101, 1963; McIntyre Dep. 17, 36-37; Moran Dep. 47).

be expected to mass-detonate when a small portion is initiated by any means" (Dep. Ex. 43 at 50). Thus, materials that are classified as 1.1 are considered high explosives which pose a direct threat of detonation (Dep. Ex. 11 at xii; Dep. Ex. 43 at 191; Dep. Ex. 44 at A-19, A-20; Dep. Ex. 51 at 50). A detonation is defined as "[a] violent chemical reaction ...which proceeds through the reacted material toward the unreacted material at a supersonic [faster than the speed of sound] velocity" (Dep. Ex. 11 at ix; Dep. Ex. 43 at 188; Dep. Ex. 44 at A-10; Dep. Ex. 51 at 30-31; Exhibit C-105 at 2-2; Exhibit C-106 at A-3, C-107 at I-3; C-160 at 2-1; Gardner Feb. Dep. 142; Gardner April Dep. 190; Fry Dep. 42-43; L. Smith Dep 49; F. Smith Dep. 117; Dunbar Dep. at 58). The principal hazard associated with 1.1 materials is the extremely high pressure manifested in the shock wave created when a detonation occurs; this pressure, known as "blast overpressure" and measured in pounds per square inch (psi), is that which exceeds the normal or "ambient" pressure (Dep. Ex.11 at viii; Dep. Ex. 43 at 191; Dep. Ex. 44 at 7-4, A-5; Dep. Ex. 51 at 3, 11; Exhibit C-105 at 2-2; C-106 at 2-1). Depending upon the level of exposure, overpressure can cause serious physical injury or even death, as well as severe structural damage or destruction (Dep. Ex. 11 at 4-3 to 4-6; Dep. Ex. 43 at 95-98; Dep. Ex. 44 at 7-6, 7-44 to 7-48; Dep. Ex. 45 at 2-43 to 2-44; Exhibit C-106 at 2-2 to 2-6; F.Smith Dep. 53-54).

Class 1, Division 3, or 1.3, explosives, are characterized as "mass fire" materials which "burn vigorously" (Dep. Ex. 43 at 51). Materials that are classified as 1.3 are considered low explosives which do not directly pose a threat of detonation, but can be made to detonate under certain conditions (Dep. Ex. 44 at A-23; Dep. Ex. 51 at 59). Thus, the principal hazard associated with 1.3 materials is fire, formally known as a deflagration, which is defined as "[a] rapid chemical reaction.... with the reaction products flowing away from the unreacted material...at subsonic [slower than the speed of sound] velocity" (Dep. Ex. 11 at ix; Dep. Ex. 43 at 188; Dep. Ex. 44 at A-10; Dep. Ex. 51 at 27; Exhibit C-105 at 2-2; Exhibit C-106 at A-3; C-107 at I-3; C-160 at 2-1; Gardner Feb. Dep. 142, 152; Gardner April Dep. 190; L.Smith Dep. 48; F. Smith Dep. 117-18; Dunbar Dep. at 58). Deflagrations can result in heat flux or even, as the reaction approaches the speed of sound, low levels of overpressure (Tr. 1338-39, 2692-93, 3331-36; Gardner Feb. Dep. 85-86, 141; Gardner April Dep. 260-61, 275, 307, 359; Fry Dep. 39-40; L.Smith Dep. 64).

Hercules maintains that the propellants processed through the Blender Packer operation have been tested and classified by the DOT as 1.3 materials (Tr. 2292, 2345-46, 2349-52, 2370-71, 2382-84, 2718, 3073, 3182-83, 4090; Exhibits C-143, R-131, & R-136; Gardner April Dep. 194-95, 260; Fry Dep. 112-13; Dunbar Dep. 263-64; L.Smith Dep. 138-39).[32] The Secretary, however, claims in her post-hearing brief that *both* 1.1 and 1.3 propellants are processed through the Blender Packer operation, noting that four propellants identified by Hercules as processed there - BPJ, WLA, ZKF, and ZLF- are classified in the plant's DOT freight classification manual as 1.1 materials (Dep. Ex. 3; Dep. Ex. 9 at 4350, 4452, 4453, 4454; Exhibit R-132). This point is vigorously disputed by Hercules which claims that the Secretary has mischaracterized the evidence (Hercules Reply Brief at 3-6). *See* discussion *infra*, pages 33-34.

Furthermore, the Secretary contends that even if the Blender Packer operation processed only 1.3 propellants, the *manner* in which these propellants are processed requires treating the operation, from a safety standpoint, as if it were processing 1.1 propellants (Tr. 863-64, 1101-02, 1154-55, 3124-25, 3128; Dep. Ex. 43 at 153). According to the Secretary, the hazard classification of an explosive material that is in-process is fundamentally different from its hazard classification for DOT purposes, requiring an employer to use safeguards that are different from or additional to those used when transporting or storing the material (Tr. 3123-25, 3128, 3155-58; Exhibit C-162; Dep. Ex. 12 at 000828; Dep. Ex. 43 at 153). Hercules does not dispute this conclusion and in fact, acknowledges that under certain conditions, a 1.3 propellant can be made to react like a 1.1 propellant, *i.e.* detonate as opposed to deflagrate, and vice versa (Tr. 2075, 2384-86, 2507; Gardner Feb. Dep. 55-56, 141-42; Gardner April Dep. 263, 301; Fry Dep. 26-27, 111; L.Smith Dep. 63-64, 79-80, 123; Dep. Ex. 51 at 50, 59).[33] However, based upon tests which have been performed both

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[32] Regulations set forth by the DOT require explosives manufacturers to conduct specific hazard classification tests before transporting explosive materials (Tr. 2364-67, 2370-72, 2374-75, 2381, 3124, 4089; Exhibit R-139; McIntyre Dep. 18). These tests must be performed by a DOT-authorized testing body or witnessed by a DOT official (Tr. 2375, 2378-80, 4089-90).

[33] These conditions include confinement, contamination, increased sensitivity, the use of a booster, impact, electrostatic discharge, and friction (Tr. 1322, 1325-26, 1948, 1956, 2073, 2385-87; Exhibit C-105 at 14-8; Exhibit C-119 at 67-68; Exhibit R-117; Fry Dep. 26-27, 111-13; Gardner Feb. Dep. 55-56; Gardner April Dep. 263; **Dep. Ex. 6 at 4214-19, 4221, 4224-29, 4289-96**). The Secretary focuses specifically on the glaze barrel as a source of confinement for the propellant processed at the Blender Packer operation (Tr.
(continued...)

for DOT classification purposes, as well as to specifically analyze in-process hazards, Hercules maintains that the propellants, as processed through the Blender Packer operation, do not pose a detonation hazard and they remain classifiable as 1.3 materials throughout the entire process (Tr. 1944-45, 1988-89, 2346, 2359-60, 2363-68, 2383-84; Gardner Feb Dep. 55-56, 87; Gardner April Dep. 260, 280, 353; L.Smith Dep. 123, 132).

THE BLAST OVERPRESSURE PROBLEM

Given the nature of the propellants processed at the Blender Packer operation and the manner in which they are processed, the Secretary has concluded that this is an operation which poses the threat of detonation.[34] Should a detonation occur, the Secretary maintains that Hercules has failed to adequately protect its personnel from the recognized hazards associated with such an event. Specifically, the Secretary claims that the distances separating Hercules personnel from the Blender Packer operation room, the potential site of a detonation, are insufficient to protect against levels of blast overpressure exceeding 2.3 psi (Tr. 876-80, 1307-08; Exhibits C-108 & C-118). Hercules does not dispute that at or below this level of overpressure, exposed personnel may experience temporary hearing loss or minimal eardrum damage, but claims no serious physical injury would result (Tr. 850-56, 1308; F. Smith Dep. 54; Dunbar Dep. 108 ; Dep. Ex. 4 at 65-66; Dep. Ex. 11 at 4-5 ; Dep. 43 at 96; Dep. Ex. 44 at 7-46; Exhibit C-106 at 2-4, 2-5). According to the Secretary, the 2.3 psi overpressure exposure occurs in two areas: inside the Blender Packer control room and at an intraplant road located to the west of the Blender Packer operation.[35]

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[33](...continued)
1101-02, 1154-55, 1231-32, 1336-37, 2681-83).

[34] In reaching this conclusion, the Secretary also relies upon an assessment of the June 3, 1989 accident. Although the Blender Packer operation was not directly affected by the event, both parties believe that the 1989 accident is highly relevant to this case because it originated in a glaze barrel operation very similar to the Blender Packer and involved the same type of smokeless propellant as that processed at the Blender Packer (Tr. 825-26, 1068-69, 2299-2300, 2334-35, 2508-09, 3577-81; **Dep. Ex. 6 at 4186-87**; Fry Dep. 45 ; Exhibit R-132). Upon evaluating the circumstances surrounding the accident and its aftermath, the Secretary has concluded that a detonation occurred, while Hercules has concluded that a deflagration occurred.

[35] Although the original citation does not make specific reference to the intraplant road, the language used to describe the violation suggests that use of the road was a focus of OSHA's concern ("Employees
(continued...)

The Secretary bases her conclusion that existing distances are insufficient to protect personnel from hazardous levels of overpressure on a "quantity/distance" table which appears in the Department of Defense (DOD) Contractor's Safety Manual known as DOD 4145.26-M, and also in an Army regulation known as AMC-R 385-100 (Tr. 850, 1295; Dep. Ex. 11; Exhibit C-105, Chap. 17).[36] The quantity/distance concept is defined as "the quantity of explosive material and distance separation relationships which provide defined types of protection; [t]hese relationships are based on levels of risk considered acceptable for the stipulated exposures and tabulated in the appropriate quantity/distance tables" (Dep. Ex. 11 at xiv; Exhibit C-105 at 2-7). Separation distances are derived from a standard formula, $D=KW^{1/3}$, where K equals the level of protection desired, a function of overpressure level, and W equals the weight of explosive material present (Tr. 1151, 2013; Exhibit C-105 at 17-6; Exhibit C-106 at 9-3; Dep. Ex. 11 at 4-2; Dep. Ex. 43 at 53; Dep. Ex. 44 at 7-3; Exhibit R-126 at 8; R-153 at 495-30). The calculated separation distance essentially creates a circle or zone around the potential site of detonation at which, given a certain amount of explosive material, it can be assumed the blast overpressure will not exceed a predetermined level.

Using the standard formula, the DOD has developed quantity/distance tables for different types and amounts of explosive materials as they exist under various circumstances. For instance, there are separate tables for materials classified as 1.1 and for those classified as 1.3 (Dep. Ex. 11, Tables 6-1, 6-3, & 6-10). Then, depending upon the type of structure involved, a value for K is determined to allow for a certain level of overpressure protection. To protect inhabited buildings and public traffic routes from 2.3 psi overpressure resulting from the detonation of a 1.1 material,

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[35](...continued)
were allowed to *pass by* [Class 1, Division 1] operations..."), particularly where there is no indication that employees traveled any other part of this area (Exhibit C-105 (emphasis added); Martin Dep. 39). The language of the complaint also supports this interpretation ("Truck drivers and other employees who were not part of the operations being conducted at the Class 1, Division 1 locations regularly passed within 50 feet of the said locations while the operations were being conducted") (Exhibit R-127 at 15).

[36] Similar tables also appear in standards and regulations promulgated by the Air Force and the Navy (Exhibit C-106, Chap. 9; Dep. Ex. 43, Chap. 5, §. B; Dep. Ex. 44, Chap. 7), as well as in non-military publications such as the Institute of Makers of Explosives' "The American Table of Distances", the National Fire Protection Association's "NFPA 495 Explosives Materials Code", and the Department of Energy's "Explosives Safety Manual" (Exhibit R-126; Exhibit R-153 at 495-17, 495-18, 495-30; Exhibit C-107 at III-1, VI-1 to VI-5).

K is assigned a value of 24 (Tr. 1081, 1307-09 ; Dep. Ex. 11 at 6-4; Dep. Ex. 43 at 96; Dep. Ex. 44 at 7-46; Gardner Feb. Dep. 86-87, 100; Gardner April Dep. 271-72; Dunbar Dep. 106; L. Smith Dep. 30-32).[37] Referring to DOD Table 6-1 and assuming 2,000 pounds of 1.1 material, the Secretary claims that a separation distance of 305 feet is required between the Blender Packer operation room, the potential site of detonation, and the Blender Packer control room and intraplant road, to protect personnel located in these areas from overpressure levels exceeding 2.3 psi (Tr. 871, 878, 1069, 1079-80; Dep. Ex. 11, Table 6-1, Column 8).

The parties, however, have been unable to agree on a uniform method of measuring the actual distances between the areas in question.[38] During discovery, Hercules admitted that the distance from the nearest point of the Blender Packer control room to the center of the glaze barrel in the Blender Packer operation room is about 78.5 feet, and from the nearest point of the intraplant road to the center of the glaze barrel is about 152 feet (Exhibit C-139, No. 9 (a) & (h)). The Secretary, however, maintains that this is not the proper method of measuring these distances, citing to industry sources which require separation measurements to be taken from the nearest point of one location to the nearest point of the other (Dep. Ex. 11 at 4-3; Dep. Ex. 43 at 52; Dep. Ex. 44 at 7-15; Exhibit C-105 at 17-5; Exhibit C-106 at 9-4). Lawrence Smith, one of Hercules's expert witnesses, agreed that "[n]ormally, when you're measuring the distance for...two structures[,] [y]ou measure the nearest corner from one to the nearest corner of the other..." (Tr. 2020, 2022-24). Thus, each of Hercules's admitted measurements must be reduced by 14 feet to account for the distance between the glaze barrel and the nearest wall of the operation room, resulting in a distance of 64.5 feet to the control room and 138 feet to the intraplant road, well short of the 305 feet the Secretary believes is required to protect against 2.3 psi overpressure (Exhibit C-139, Att. 2).

[37] Because 1.3 materials do not typically produce the levels of overpressure associated with 1.1 materials, the K factors used to calculate separation distances for such materials are much lower: 8 for inhabited buildings and public traffic routes, 5 for aboveground magazines and intraline or operating building distances (Dep. Ex. 11 at 6-22, 6-23).

[38] Depending upon the locations from which the various measurements were made, the distance between the Blender Packer operation room and control room ranges anywhere from 64 to 78 feet (Tr. 845-46, 883-84, 1731-32; Dep. Ex. 31). Likewise, the distance between the operation room and the intraplant road ranges anywhere from 138 to 177 feet (Tr. 878; Dep. Ex. 31; Gardner Feb. Dep. 143-44).

The 1989 citations suggested abatement measures which included moving the cited facilities further apart to allow for the proper separation distance indicated in DOD Table 6-1 and/or limiting access to these areas while the Blender Packer glaze barrel is in operation (Tr. 917, 955; Exhibit C-108). In the 1993 failure-to-abate notification, the Secretary added that reducing the amount of powder produced at the Blender Packer operation at any one time would also constitute a feasible means of abatement since it would, in effect, reduce the separation distance required under Table 6-1 (Tr. 955; Exhibit C-118). It is undisputed that at the time of the 1993 inspection, the Blender Packer facilities and the intraplant road remained in the same physical location as they did in 1989 (Tr. 917, 955, 1146; Dunbar Dep. 44). Hercules, however, contends that it did institute the two other abatement measures suggested by the Secretary, as well as numerous others, in the months following the June accident, both before and after the issuance of the 1989 citations. According to Hercules, these steps successfully abated the conditions as cited in November of 1989.

Since the June 1989 accident, as discussed *supra*, Hercules has hardened the front wall of the Blender Packer control room by covering it with steel plate[39], replaced drop plug buggies with plastic cruisers[40], and substituted the dry glazing process with a slurry coating facility.[41] Additional abatement measures cited by Hercules, and undisputed by the Secretary, include the following:

- Relocated two of the four facilities accessible from the cited intraplant road in order to reduce the number of reasons for employees to use the road (Tr. 950-54, 1127, 2423-25, 2490-91; Martin Dep. 41, 46-47; Gardner Feb. Dep. 12-13; Exhibit R-129).

[39] Although the cover sheet for the calculations Hercules submitted to OSHA to document its analysis of this abatement step refers only to an operation known as the Air Force Glaze and Screen, Hercules maintains that the calculations were also used to analyze the Blender Packer operation (Tr. 958-63, 1109-11, 1551-52, 2302-06; Dep. Ex. 2; Gardner April Dep. 203-05). It is undisputed that the control room's hardened front wall and door can withstand overpressure levels up to 80 psi (Tr. 962, 1550-56, 1670-74, 1691-92, 1695, 1822-23, 3955; Dep. Ex. 26 at 4387; Gardner Feb. Dep. 25-27; Gardner April Dep. 238).

[40] This change addressed potential ignition sources identified by Hercules as associated with the use of drop plug buggies, including propellant leakage from the bottom plug and accidental spillage during transport (Tr. 2492; Martin Dep. 184-85; **Dep. Ex. 6 at 4198, 4212, 4214-19**).

[41] Slurry coating the propellant reduces the amount of particles or "fines", a potential source of contamination, created during processing, and also addresses the problem of static electricity, a potential source of ignition (Tr. 1980, 2210, 2394-97, 2403; Martin Dep. 126-27; Dunbar Dep. 54).

- Roped off a 300-by-180 foot area surrounding the Blender Packer operation room, put up signs around this area warning personnel to keep out, and installed two, ten-to-fifteen-foot high, red beacon lights at each end of the building that light up whenever the glaze barrel is in operation (Tr. 920, 952, 1105, 1116-17, 1932-33, 1936, 2339-44, 2425-26; **Exhibit C-101**; Exhibits R-144, R-145, R-146, & R-152; Martin Dep. 39-45, 60-61, 102-03; Gardner Feb. Dep. 15-17, 122; Gardner April Dep. 206-07, 236-37).[42]

- Began strictly enforcing the 2,000-pound propellant limit at the Blender Packer operation (Tr. 1034-36, 2360-63; Dep. Ex. 3, Rev. F at § 5.1).[43]

DISCUSSION

In order to prove a failure to abate case, the Secretary must establish that the original citation has become a final order and that the hazardous condition found upon reinspection is identical to that originally cited.[44] *Savina Home Indus., Inc.*, 4 BNA OSHC 1956, 1957, 1977 CCH OSHD ¶ 21,649 (No. 12298, 1977); *York Metal Finishing Co.*, 1 BNA OSHC 1655, 1656, 1973-74 CCH OSHD ¶ 17,633 (No. 245, 1974). In connection with the latter element, the Secretary is required to prove that the condition as originally cited remains hazardous at the time of the reinspection. *See Kit Manufacturing Co.*, 2 BNA OSHC 1672, 1673, 1974-75 CCH OSHD ¶ 19,415 (No. 603, 1975),

[42] Hercules also maintains that training was provided and changes were made to the Blender Packer operating procedures in order to ensure that employees knew not to enter the roped-off area when the red beacon lights were on (Tr. 1424, 1932-34, 2207-08, 2467-76, 2498-99, 2556; Exhibits R-120, R-155, & R-156; Dep. Ex. 3, Rev. J; Martin Dep. 46-47).

[43] Despite Hercules's attempts to characterize this effort as a reduction in the actual propellant limit, the record indicates that the limit at the Blender Packer operation has been 2,000 pounds since 1988 (Tr. 4078-79; Exhibit C-144 at 13; Exhibit C-145 at 6; Gardner Feb. Dep. 126; Gardner April Dep. 191; Martin Dep. 120; Hercules Post-Hearing Brief at 13, 299). According to the Blender Packer operating procedures, on April 28, 1987, the propellant limit was 6,000 pounds; in the next revision dated April 20, 1988, the limit was reduced to 2,000 pounds (Tr. 917-18, 1035-36; Dep. Ex. 3, Revs. E & F at § 5.1; Gardner April Dep. 191). Charles Gardner, the Hercules employee who led the abatement effort at Kenvil, confirmed these limits and their initiation dates (Tr. 2301-02, 2349-50, 2360, 2521). However, according to Gardner, the 2,000-pound limit was not strictly enforced until Hercules learned some time after the June 1989 accident that employees at the Blender Packer operation were routinely processing as much as twice the propellant limit (Tr. 1034-36, 2360-63, 2545-46).

[44] It is undisputed that the settlement agreement resolving all three of the 1989 citations became a final order on December 23, 1991.

citing Franklin Lumber Co., 2 BNA OSHC 1077, 1973-74 CCH OSHD ¶ 18,206 (No. 900, 1974) ("...the Secretary's failure to prove that the alleged violative condition with in fact violative at the time of the reinspection [is] sufficient grounds for vacating the failure to abate [notification]").

After the Kenvil plant was reinspected in 1993, the Secretary concluded that despite Hercules's attempts at abatement, the Blender Packer operation continues to pose a detonation hazard which, should a detonation occur, would expose employees to overpressure levels exceeding 2.3 psi. In essence, the Secretary claims that nothing has changed since the original citations were issued; the cited conditions have not been corrected and remain violations of the general duty clause. According to Hercules, however, the Blender Packer operation has never been violative of the general duty clause and any potential hazards which it may have posed have been fully abated by the measures instituted since the 1989 accident.

This case, therefore, boils down to two issues: does a detonation hazard still exist at the Blender Packer operation and if so, has Hercules taken adequate steps to ensure that its employees are adequately protected from levels of blast overpressure exceeding 2.3 psi.

DETONATION HAZARD

It is common knowledge that working with explosive materials is hazardous. The Kenvil plant's entire operation, with its segregated earth-covered facilities, is based on this very premise (Tr. 858-59). With regard to smokeless propellants of the type processed at the Blender Packer operation, the obvious concern is that the powder may react at any stage of the manufacturing process, exposing employees to any one of a number of hazards including mass fire, blast overpressure, and structural fragmentation (Tr. 844).[45] As the June 1989 accident graphically illustrates, any type of incident in which smokeless propellant reacts - be it a detonation, deflagration, or some combination of both[46] - can cause injury to personnel, as well as significant

[45] Fragmentation is defined as the breaking up of the material which holds or contains a chemical compound or mechanical mixture that explodes or reacts. Fragments may be complete items, subassemblies, or pieces of same, as well as pieces from the building, equipment, or other parts of the surrounding environment (Dep. Ex. 11 at x; Dep. Ex. 43 at 189).

[46] This phenomenon, known as a deflagration to detonation transition or "DDT", was discussed at the hearing as a possible scenario for the June 3, 1989 accident (Tr. 128-29, 2134, 2391-94, 2680-85, 2688; (continued...)

property damage (**Exhibit C-102**; **Dep. Ex. 6**).

Thus, with a total of 2,000 pounds of propellant present during each processing cycle, the Blender Packer operation poses a range of potential hazards; the question is whether one of those hazards is detonation. At its most basic level, this issue could be resolved as the parties propose, simply by determining whether the Blender Packer operation processes any propellants that are classified by the DOT as 1.1 materials, those which pose a direct threat of detonation. This narrow inquiry touched off a flurry of post-hearing documents, initiated by a claim in the Secretary's primary post-hearing brief that four propellants identified by Hercules as processed at the Blender Packer operation are classified as 1.1 materials in the plant's freight classification manual. In its reply brief, Hercules notes that in contrast with the dry, granular propellants processed at the Blender Packer operation, all four of the propellants cited by the Secretary are described in the freight manual as "powder cake, wetted" (Tr. 2291; Hercules Reply Brief at 3-6). Furthermore, Hercules points out that the Secretary has referred to these four propellants by their acronyms rather than their proper names; once the proper names are identified by an exhibit which cross-references this information, the freight manual clearly indicates that these four propellants are, in fact, 1.3 materials (Tr. 2107, 2382; Hercules Reply Brief at 4-5; Exhibit C-156; Dep. Ex. 9).[47] On this basis alone, the Secretary's interpretation of the manual entries cannot stand.

By raising the issue for the first time in her posthearing brief, as a sort of afterthought, the Secretary merely underscores the tenuous nature of the allegation that Hercules used Class 1.1 materials. In her posthearing brief, at 52, the Secretary suggests, in vague and ambiguous language, that Gardner admitted using 1.1 materials. But the evidence clearly reflects that Gardner stated, in substance, that 1.3 materials could, under certain conditions, react like 1.1 materials. The question then becomes whether a detonation hazard exists even if, as the evidence indicates, all of the

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[46](...continued)
Gardner April Dep. 297; Exhibit R-161).

[47] Despite having already issued a reply brief limited to the issue of penalties, the Secretary responded to Hercules's reply brief in a "reply letter" which charged Hercules with attempting to introduce new evidence into a closed record. Shortly after that, Hercules filed its own "reply letter", denying the charge and reiterating its reply brief arguments on this issue.

propellants processed at the Blender Packer operation are properly classified as 1.3 materials for the purposes of storage and transportation (Tr. 2223). As indicated *supra*, the Secretary claims that the process itself requires treating the Blender Packer as a 1.1 operation, i.e., an operation which poses a detonation hazard.

The parties have spent an enormous amount of time and effort debating this matter, conducting tests on various types of smokeless propellant, simulating conditions as they exist in a glaze barrel operation, and analyzing the 1989 accident in an attempt to portray its events as a likely scenario for the Blender Packer operation. The record, however, makes out a strong case for the existence of a detonation hazard even without much of this data. First, the evidence suggests that Hercules treats the Blender Packer operation as if it poses a detonation hazard. As noted *supra*, the explosives industry considers a remote operation to be one that poses an "unacceptable risk" of detonation.[48] Up until October 27, 1989, the Blender Packer operating procedures described the operation as "remotely controlled" (Dep. Ex. 3, Revs. E, F, G at § 5.5); on that date, about one month prior to the issuance of the 1989 citations, the description was revised to read that the operation is "unattended" (Dep. Ex. 3, Revs. I, J, K, L, M at § 5.5). The difference is essentially semantical; no matter what label Hercules assigns it, the Blender Packer operation *functions* like a remote operation in that the operator is physically removed from the operation room during processing and required to conduct the operation from a remote location, the control room (Tr. 1326-27).[49] This is consistent with the fact that blending is typically conducted as a remote operation; in

[48] Using a formula developed by Hercules and based upon the number of hours of glaze barrel operation at two Hercules plants, Kenvil and Radford, from 1941 to 1994, Gardner maintains that he has proven the Blender Packer operation does not pose an unacceptable risk of detonation (Tr. 2198, 2437-42, 2446-48, 2453, 2456-57; Gardner Feb. Dep. 131-332; Gardner April Dep. 282-85; Exhibit R-140). But not only is it unclear why Hercules used a formula different from the one used by the military, Gardner fails to adequately explain how the fact that there was more than one million hours of operation between glaze barrel "accidents" specifically relates to the detonation potential, or lack thereof, of the Blender Packer operation, particularly where his calculations include data from a plant unrelated to this case (Tr. 2438-39, 2441-42; Gardner Feb. Dep. 131-32; Gardner April Dep. 282-85).

[49] After the 1989 accident, Hercules began requiring operating personnel to remain inside the control room for the entire glaze barrel operation; prior to that, operators were allowed to leave the control room after starting the glaze barrel in order to perform other outside tasks usually involving a completely different (continued...)

fact, the Department of Energy considers blending to be an activity with a high accident potential and therefore, one that must be performed remotely (Tr. 1315-16; Exhibit C-107 at II-29, VI-4).

Hercules concedes that the Blender Packer operation was arranged and conducted in this manner to address a "potential risk of harm" to operating personnel, but insists that this risk does not include that of detonation (Hercules Post-Hearing Brief at 103). Indeed, during his second deposition in 1995, Gardner claimed that although the Blender Packer operation was "totally safe" and therefore, could be conducted from inside the operation room, the operation remains "unattended" in order to protect personnel from a potential fire hazard (Tr. 2558-59; Gardner April Dep. 102-06). However, his explanation is directly contradicted by the fact that Hercules has identified the Blender Packer operation as one which poses a mass detonation hazard by placing an orange, octagonal-shaped, sign depicting fire symbol "1" on the operation room (Tr. 1238-39, 1307; Exhibits R-151 & R-152; Exhibit C-105 at 12-7; Dep. Ex. 11 at 10-2; Dep. Ex. 43 at 29-31; Dep. Ex. 44 at 4-34 to 4-36).[50] Hercules's explanation that the sign simply "alerts fire fighters to a *possible higher risk* than, in fact, they would otherwise be exposed to..." is not only confusing, but seems to acknowledge that a detonation is in fact possible (Hercules's Reply Brief at 6 (emphasis added)). Equally questionable is Hercules's claim that leaving this "meaningless" sign in place allows the plant the option to process 1.1 materials at Blender Packer at some future date (Tr. 2150, 2350-51, 2421-22, 2558-59; Hercules's Reply Brief at 7).

Second, many of the propellants processed at the Blender Packer operation contain between 20 and 40 percent nitroglycerine, an ingredient which, according to military sources, is indicative of an explosive material which poses a detonation hazard (Tr. 1329-34; Gardner Feb. Dep. 155; L.Smith Dep 102; Dep. Ex. 8; Dep. Ex. 11 at 5-8; Dep. Ex. 22; Exhibit C-105 at 19-13 to 19-15; Exhibit R-132). **In fact, one of the propellants containing 40% nitroglycerine, known as BMP,**

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[49](...continued)
operation (Tr. 2492-93; Gardner April Dep. 208-11; Dep. Ex. 3, Revision J at § 5.7).

[50] Although it is not clear from the record exactly when the sign was installed, it is present in photographs taken in June of 1994 and was observed by two of the Secretary's experts who visited the plant in 1995 (Tr. 2338-39; Exhibits R-151 & R-152). In its reply brief, Hercules suggests that the sign was installed in response to a 1978 Defense Logistics Agency audit of the Kenvil plant (Exhibit C-142; Hercules Reply Brief at 7).

was involved in the 1989 accident and is described in Hercules's investigation report as detonable in an unconfined state (Tr. 1334-36; Exhibit R-132; **Dep Ex. 6 at 4200, #55, 4289**). Hercules acknowledges that nitroglycerine, defined as "an explosive chemical compound used as a sensitizer in dynamite", is detonable; as a result, Kenvil facilities in which nitroglycerin is present in its raw form are designated as areas which pose a detonation hazard (Tr. 2074, 2346-47; Dunbar Dep. 264, 267; Dep. Ex. 51 at 66).

Third, and most important, conditions at the Blender Packer operation are such that a detonation could potentially occur at almost any stage of the operation. It is undisputed that smokeless propellants which are classified as 1.3 materials can be made to detonate under certain conditions, including confinement, contamination, impact, or friction. According to the record, all of these conditions are present at a glaze barrel operation like the Blender Packer and Hercules, despite its claims to the contrary, seems well aware of this fact. For instance, the Secretary has identified the glaze barrel as a source of confinement which could cause propellant inside the barrel to detonate (Tr. 1101-02, 1154-55, 1231-32, 1336-37, 2118, 2681-83). Although Hercules vehemently denies this claim, glaze barrel confinement was clearly an issue with which Hercules was concerned after the 1989 accident. In its responses to interrogatories, Hercules acknowledged that a "potential for confinement" existed in all three of the glaze barrels involved in the 1989 accident, one of which Gardner testified was identical to the Blender Packer glaze barrel (Tr. 2300; Exhibit C-144 at 12, #17(C); Gardner April Dep. 198).[51] Thus, in order to "eliminate the potential confinement of the glaze barrels", two of the operations were replaced with a ribbon blender, a device which has "proven to be non-confining during tests..." (Exhibit C-144 at 12, #17(C); Gardner April Dep. 198). At his April 1995 deposition, Gardner indicated that the Blender Packer glaze barrel was about to be replaced with a ribbon blender (Gardner April Dep. 199-200). Apparently, the potential for a detonation due to such confinement remained at the time of the reinspection.[52]

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[51] This is also consistent with Gardner's concession during his 1993 interview with OSHA that placing powder inside a glaze barrel could cause it to detonate (Exhibit C-119 at 67-68).

[52] While it is true that under this scenario, the detonation would originate with the propellant contained inside the glaze barrel, propellant contained in nearby buggies would, according to Gardner, (continued...)

Propellant can also be confined by its own weight, a concept known as critical height or depth; at a certain height, a given propellant could detonate due to self-confinement (Tr. 1231-33, 1336-37, 1960, 2073, 2118, 2358; McIntyre Dep. 129-30). Of the more than ninety types of propellant identified as processed at the Blender Packer, only two were tested in connection with this case to determine their critical height; as such, these tests provide very limited information (Exhibit R-132). However, an in-process hazard classification test performed by Frederick McIntyre, one of the Secretary's expert witnesses, suggests that at least one smokeless propellant processed at the Blender Packer operation could reach its critical height while contained inside the glaze barrel (Tr. 3138; Exhibit C-161 at 2, 9-10). McIntyre concluded that the propellant he tested, known as Red Dot, had a critical height of 15 inches which, given the glaze barrel's maximum depth of 21 to 23 inches, could be exceeded each time Red Dot is processed at the Blender Packer operation (Tr. 2694, 2725, 2913-14, 3138-41, 3151-52, 3176-77).[53]

In 1981, Hercules conducted its own tests on Red Dot, along with one other propellant processed at the Blender Packer, and claims that its test results prove the critical height for both of these materials is well over the barrel's maximum depth (Tr. 1946-47, 1961-63, 2113-15, 2358-59, 2363-64, 2532-35; Gardner April Dep. 319-21 ; Dep. Ex. 17; Dep. Ex. 18). However, according to their accompanying reports, these tests were designed by Hercules to assess the venting capability

[52](...continued)
detonate within milliseconds of the initial reaction (Tr. 2352-53). Thus, at least 2,000 pounds of propellant would be involved in such an event.

[53] According to the critical-height test procedure, propellant is placed inside a pipe of any length that is sealed at one end with a steel cap and ignited from the bottom with a twelve-gram mixture of black powder and casting powder, and a device known as an Atlas match; the amount or "height" of the propellant is then varied until a detonation, defined as a rupture or fragmentation of the pipe, occurs (Tr. 3139-40; Exhibit C-161 at 9-10).

Instead of a steel cap, McIntyre testified that he sealed the end of the pipe with duct tape in order to create a less confining medium that is more representative of the open-mouthed glaze barrel (Tr. 3140, 3143, 3211). He also eliminated the twelve-gram powder mixture, igniting the propellant with only the Atlas match (Tr. 3139-42, 3210-11). Finally, as permitted by the test procedure, McIntyre opted to determine detonation visually rather than through the use of a velocity probe (Tr. 3142, 3145-46, 3211-13; Exhibit C-161 at 9). Although McIntyre acknowledges that these changes represent deviations from the test's established procedure, he credibly explained that such modifications were consistent with the conservative approach he took in performing the test and did not affect the test's results (Tr. 3141-50, 3210-11).

of a newly designed drop plug buggy, not to determine the critical height of the tested propellants (Dep. Ex. 17; Dep. Ex. 18). In addition, having developed its own testing procedure, Hercules did not use an established test protocol and provided little information as to how these tests were actually performed (Tr. 2533-34; Dep. Ex. 17; Dep. Ex. 18). Finally, in relying upon these tests, Hercules seems to suggest that they somehow establish a "universal" critical height which applies to any type of vessel or container, including a glaze barrel, no matter what type of propellant is being processed (Tr. 1946-47, 1960-61, 2130-31, 2359, 2363-64, 2533-35; L.Smith Dep. 124-25; Dep. Ex. 17; Dep. Ex. 18). But critical height, as defined, varies from propellant to propellant and is not determined as a function of the external medium in which the propellant is contained (Tr. 2130, 3185). Under these circumstances, it would be unreasonable to base any evaluation of the confining potential of a glaze barrel upon Hercules's drop plug buggy data (Tr. 1960-62, 2113-15, 2134, 2363-64, 2533; Gardner April Dep. 306-07, 324-25).[54]

In addition to confinement, there are numerous other operational sources of initiation which could potentially cause propellant processed at the Blender Packer operation to detonate. **Indeed, the report Hercules compiled after its investigation of the 1989 accident contains no less than six pages listing potential sources of friction, impact, contamination, and electrostatic discharge, present at each stage of a glaze barrel operation (Dep. Ex. 6 at 4214-19, 4222-40).** These sources include cracks in the surface of the glaze barrel which can trap and pinch propellant; foreign objects, such as a loose screw or bolt, which may fall inside the glaze barrel and contaminate and/or impact the propellant; and even friction from the rollers of the conveyor belt that transports propellant inside the operation (Tr. 1323-26, 1940, 1948-49, 1988-89, 2136-38; L.Smith Dep. 124; **Dep. Ex. 6 at 4214-19, 4221-22, 4238**). **With specific regard to the Blender Packer operation, Hercules found that the drop plug buggy lifter alone had a "large number of potential impact and friction initiation [sources]" (Dep. Ex. 6 at 4212).** Even the ribbon blender, designed to replace the confining glaze barrel, was found to pose a range of potential initiation hazards including

[54] Similarly, Hercules's attempts to draw any conclusions regarding confinement from variations of the DOT "stack" tests are misplaced (Tr. 2364-67, 2370-78; Exhibit R-139). Unlike the critical-height test conducted by McIntyre, a stack test is intended to evaluate hazards during transportation and storage, not in-process hazards (Tr. 2365-66; Exhibit C-161 at 2).

friction, impact, and contamination (Exhibit C-155 at 1-2, 5-9).

In arguing that none of these conditions "exist" at the Blender Packer operation, Hercules contends that they have all been adequately addressed or eliminated by the abatement measures instituted after the 1989 accident, as well as various quality control programs and general safety procedures (Tr. 1937-43, 1946-49, 1956, 1979-80, 2006-07, 2136-37, 2353-54, 2386-87, 4090-92; Gardner Feb. Dep. 77). It is true that many of Hercules's abatement efforts touch upon these areas. As discussed *supra*, the switch from dry glazing to slurry coating minimizes a source of contamination by reducing the number of fines created and minimizes a source of ignition by reducing the presence of static electricity. Similarly, replacing drop plug buggies with light-weight cruisers eliminates two potential ignition sources – propellant leaking from around the buggy's plug and spilling during transport. There is also nothing in the record to suggest that Hercules's quality control or safety programs are deficient. To the contrary, OSHA gave Hercules's safety program the highest rating possible and Lawrence Smith, one of Hercules's expert witnesses, testified that he found quality control procedures at the Blender Packer operation, such as daily barrel inspections and safety-wired hardware, to be more than adequate (Tr. 1118-20, 1937-43, 1949, 1979-80, 2136-38; Exhibit R-102).

But these efforts can only go so far in guarding against a propellant reaction (Tr. 1323). Hercules's actions serve only to *minimize* the likelihood of a detonation, or any other type of reaction, occurring at the Blender Packer operation; they do not control or eliminate the hazard completely, nor do they render the possibility of a detonation so unlikely that the hazard may be considered remote. As the record demonstrates, there are simply too many variables for Hercules to reasonably claim that it has anticipated and controlled all aspects of the glaze barrel operation so that a detonation could never occur at the Blender Packer operation. Even Lawrence Smith admitted: "[Hercules has] done the things that I thought should be done, and I...don't think [a detonation] can happen; *but we all are in the business [and] we know things do happen sometimes*" (Tr. 1949 [emphasis added]).

Even if all potential operational sources of detonation were neutralized and eliminated, employee conduct remains the most unpredictable factor. The manufacture of explosive materials is an inherently dangerous industry and the slightest deviation in standard operating procedure – the push of a wrong button, a careless glaze barrel inspection, a partial clean-up of a propellant spill – can create an environment in which a reaction will occur. Indeed, employee conduct played a significant role in the 1989 accident. According to Gardner, the incident which triggered the 1989 incident occurred when operating personnel placed a drop plug buggy in the wrong area and it was accidentally struck by a second buggy being lifted above the glaze barrel (Tr. 2400-02). During its accident investigation, Hercules also discovered that personnel working in several operations were routinely exceeding each operation's propellant limit by as much as four times over; one of these operations, as indicated *supra*, was the Blender Packer, where personnel were found to be processing as much as twice the propellant limit (Tr. 2299-2300, 2360-63, 2407, 2513, 2545-46; **Dep. Ex. 6 at 4268, 4273-76**). Such conduct, when combined with the myriad of potential initiation sources present in a glaze barrel operation and the high nitroglycerine content of many of the propellants being processed there, establishes a risk of detonation that cannot be dismissed as remote, let alone acceptable. *See Waldon Healthcare Center*, 16 BNA OSHC 1052, 1060, 1993 CCH OSHD ¶ 30,021 (No. 89-2804, 1993) (existence of a hazard under general duty clause is established if hazardous incident can occur under other than a freakish or utterly implausible concurrence of circumstances).

In their attempts to resolve this issue, both parties strenuously sought to prove that their version of the events which occurred on June 3, 1989, produced a likely scenario for the Blender Packer operation. But in the final analysis, the 1989 accident provides no real definitive answer to the question of whether a detonation will or will not occur at the operation. While it is true that a "real-time" incident such as that which took place on June 3, 1989, can be instructive, the record demonstrates that such an event is highly susceptible to widely varying interpretations and cannot be relied upon as decisive proof of what may or may not occur in the future under different circumstances (Tr. 1984-85, 2309, 2349, 4078).[55] Over a two-year period, Charles Gardner, with

[55] Despite their best efforts, tests conducted by the parties to determine the general detonability of various propellants also fail to resolve this issue decisively for either party. Most of these tests are irrelevant since they were not conducted on any of the actual propellants identified as processed at the Blender Packer operation (Tr. 3186-87, 4086-87; Exhibit R-130; McIntyre Dep. 33-34, 60-61, 122-23, 127; Dep. Ex. 52). Taken together, the few tests that were conducted on Blender Packer propellants, a short list which includes the critical-height tests discussed *supra*, do not conclusively rule out one type of reaction over another and in some cases, do not even relate to conditions as they exist at the Blender Packer operation. For instance, (continued...)

his 26 years of experience in the explosives industry, ranged from believing that a detonation had occurred in at least one location of the plant to agreeing that the entire event was no more than a deflagration (Tr. 2280, 2415-16, 2565-67; Exhibit C-119 at 65; Gardner Feb. Dep. 87-89; Gardner April Dep. 261-62).[56] Thus, in the end, after all the employees were interviewed, processes were analyzed, tests were performed, and damage was scrutinized, this accident produced no blueprint for accurately predicting how a propellant will react at a similar operation in the future.

OVERPRESSURE EXPOSURE

As evidenced by its actions following the 1989 accident, Hercules has recognized that a glaze barrel operation such as the Blender Packer poses a range of potential hazards and therefore, has made a valid effort to address those hazards. However, given that the worst possible scenario involves the detonation of at least 2,000 pounds of propellant, the Secretary contends that Hercules must also ensure that its employees are adequately protected from the dangers associated with such an event, specifically exposure to dangerous levels of overpressure.

According to the Secretary, the potential for overpressure exposure exists in the Blender Packer control room and at the intraplant road. While Hercules does not dispute that employees are present inside the control room during most of the glaze barrel operation, it maintains that measures instituted after the 1989 accident limited access to the road such that employees would not be traveling on it while the glaze barrel is actually in operation. As discussed *supra*, a detonation can

[55](...continued)
a series of "burn tests" conducted by Hercules in 1992 involved igniting a 16-foot long, one-inch thick bed of Red Dot propellant, conditions which obviously do not exist at the Blender Packer operation (Exhibit R-128). Similarly, McIntyre conducted a detonability test in which Red Dot smokeless propellant is completely confined inside a pipe that is tightly sealed at both ends; a glaze barrel, however, with its 24-inch opening at the top, does not provide total confinement (Tr. 1195-99, 1989-90, 1213, 1230, 1251, 2385, 2696-98, 3066; Exhibit C-127).

[56] Gardner stated in his 1993 interview with OSHA that a minimal detonation had occurred in one of the glaze barrel operations involved in the 1989 accident (Exhibit C-119 at 65). During his February 1995 deposition, however, he indicated that a detonation occurred only outside a facility known as the No. 15-16 Dry House and involved an experimental propellant contained inside a tram or transport vehicle (Gardner Feb. Dep. 87-89). **Hercules's report of investigation refers only to the Dry House detonation; mention of a glaze barrel detonation is limited to the context of a hypothetical scenario (Dep. Ex. 6 at 4205, 4289, 4336).** At the hearing, Gardner testified that after reviewing data from Dr. Mark Fry, Hercules's chief expert witness, he agreed that only a deflagration had occurred (Tr. 2415-166, 2565-67, 3036-37).

occur at almost any stage of the glaze barrel operation; the hazard is not limited to the relatively brief periods of time during which the glaze barrel is actually rotating. Moreover, despite Hercules's efforts to limit access, the road remains open to personnel at all times; although employees are instructed to stay away from the area surrounding the Blender Packer operation whenever the red warning lights are on, it is not clear whether the lights are visible from the road and the road itself is never physically blocked off in any way (Tr. 920-21, 2208, 2425-31, 2555-56; Martin Dep. 43, 62-63; Gardner Feb. Dep. 121-22; Exhibit C-119 at 51). Thus, employees requiring access to the Blender Packer operation or the nearby maintenance shed were never actually prevented from using the road at any time (Tr. 951-54, 2424, 2490-91). *See Pennsylvania Steel Foundry & Machine Co.*, 12 BNA OSHC 2017, 1986-87 CCH OSHD ¶ 27,671 (No. 78-638, 1986), *aff'd*, 831 F.2d 1211 (3d Cir. 1987) (access to violative condition is found if it is reasonably predictable that employees during course of normal work duties might come within the zone of danger created by condition). Under these circumstances, a detonation at the Blender Packer operation room could potentially affect employees located both inside the control room and along the intraplant road, unless appropriate protective measures are taken.

As noted *supra*, Hercules acknowledges that unprotected personnel who are exposed to overpressure levels which exceed 2.3 psi may suffer serious physical injury. In fact, Hercules admits that its abatement efforts were geared towards protecting personnel from such exposure. The record indicates that the explosives industry has also recognized this risk. Various military sources specifically state that where there is an unacceptable risk of detonation, personnel must be protected from overpressure levels exceeding 2.3 psi (Tr. 2192; Dep. Ex. 7 at 10; Dep. Ex. 11 at 4-8; Dep. 43 at 152; Dep. Ex. 44 at 7-28; Exhibit C-105 at 17-43; C-106 at 4-2). While it is true that such a requirement cannot be enforced against Hercules as a contractual obligation if, as the company argues, the Blender Packer operation does not process propellant manufactured pursuant to a military contract, the mere identification of this hazardous level of overpressure is relevant for the purposes of industry recognition (Tr. 851-52, 913-16, 1046-48, 1295, 1347, 1910, 1915-16, 1926-27, 1998, 2000, 2196; Dep. Ex. 11 at 1-1; Exhibit C-106). *See Kelly Springfield Tire Co.*, 10 BNA OSHC 1970, 1973, 1982 CCH OSHD ¶ 26,493 (No. 78-4555, 1982), *aff'd*, 729 F.2d 317 (5th Cir. 1984); *Natl. Realty & Constr. Co.*, 489 F.2d 1257, 1265 n.32 (D.C. Cir. 1973). As indicated at the hearing, the government is as much part of the explosives industry as its private counterparts; therefore, its safety requirements constitute evidence of industry practice (Tr. 851-54, 857-60, 1047-48, 1997-98, 2002-04, 2224-27). In fact, in discovery materials, Hercules itself cited to many of these sources as industry standards (Exhibit C-139, No. 9(c), (j), (q); Exhibit C-145 at 4-5).

In arguing that Hercules's personnel have not been adequately protected from overpressure levels exceeding 2.3 psi, the Secretary relies upon the separation distances established by the DOD in Table 6-1 of its 4125.26-M manual (Dep. Ex. 11 at 6-4). As indicated *supra*, there is no question that the distances separating the cited areas from the Blender Packer operation room, the site of a potential detonation, fall short of the 305-foot distance indicated by the table as the proper K24/2.3 psi separation distance for 2,000 pounds of explosive material. But distance alone does not settle the exposure issue. As witnesses for both parties indicated, when an operation is sited at a distance less than that required to protect personnel from a given level of overpressure, alternative precautions can be taken in order to protect personnel accordingly (Tr. 1111-12, 1310-11, 1360-61, 1964-65, 2081-84, 2187, 2218-19; Dep. Ex. 11 at 4-1, 6-1; Gardner Feb. Dep. 80). Indeed, the DOD manual specifically states that the distances set forth in its quantity/distance tables may be "...reduced if structural data/engineering demonstrate that explosion effects will be reduced or eliminated through containment, direction/suppression shields, or building volume" (Dep. Ex. 11 at 6-1; Dep. Ex. 43 at 48; Exhibit C-105 at 17-1). The focus of our concern, then, is to determine whether the Blender Packer operation's earth-covered facilities, each with their own structural characteristics, will protect personnel located in the control room and at the intraplant road from actually experiencing 2.3 psi overpressure should a detonation occur (Tr. 1311-12).

Such an analysis is critical where the K24 distances that appear under column 8 of DOD Table 6-1 do not take such safeguards into account. As one of the Secretary's witnesses explained, these distances assume that overpressure exposure occurs "in the open", *i.e.* the exposed individual is standing in an open field and the detonation occurs in an open field (Tr. 1308, 1360, 2089-90, 2223). This is consistent with the DOD manual's definitions of "public traffic route" and "other potential explosive site", the two locations between which the column 8 distances are measured; neither phrase explicitly assumes the existence of a surrounding structure, let alone the presence of any safeguards such as an earth cover (Dep. Ex. 11 at 6-4).[57] As such, the column 8 distances are based on a straightforward calculation of the $D=KW^{1/3}$ formula, *e.g.* for 1,000 pounds of explosive material and a K factor of 24, a 240-foot distance is required to protect personnel from overpressure levels over 2.3 psi (Tr. 1096, 1309). In contrast, the distances set forth under columns 6 and 7 specifically take into account the protection provided by a standard earth-covered magazine; thus, for the same amount of explosives, the distance to a public traffic route is reduced from 240 feet to 150 feet and 210 feet. It cannot be assumed, then, solely on the basis of their distance from the potential detonation site, that overpressure levels will exceed 2.3 psi inside the control room and at the intraplant road.

Before turning to the expert testimony of the parties' chief witnesses regarding actual overpressure exposure, a final note on quantity/distance tables is necessary. Hercules contends that the only quantity/distance table relevant here is The American Table of Distances ("American Table"), a table originally developed by the Institute of Makers of Explosives, a commercial industry safety group, and adopted by the National Fire Protection Association, as well as OSHA, which made an abbreviated version of the table part of its explosives standard set forth at 29 CFR § 1910.109 (Tr. 1133-35, 1927, 2280; Exhibit R-126 at 4; Exhibit R-153 at 495-17).[58] The section of

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[57] According to the DOD manual, a potential explosive site or "PES" is defined as "the location of a quantity of explosives that will create a blast, fragment, thermal, or debris hazard in the event of an accidental explosion of its contents" (Dep. Ex. 11 at xiii). A "public traffic route" is defined as "any public street, road (including any on an establishment or military reservation), highway, navigable stream, or passenger railroad that is routinely used for through traffic by the general public" (Dep. Ex. 11 at xiv). Although the intraplant road cited here is not routinely used by the general public, it cannot be seriously argued that the employees who travel this road should be afforded anything less than the same level of overpressure protection as that required for a "public" road (Tr. 1082-83, 1316-17, 1340, 1935, 2459-62).

Given the definition of public traffic route, it may also seem that the "inhabited building" section of Table 6-1 more accurately describes conditions as they exist at the Blender Packer control room. However, the definition of an "inhabited building" specifically *excludes* an operating building, a structure "...in which operations pertaining to manufacturing [or] processing...of ammunition and explosives are performed" (Dep. Ex. 11 at x, xiii). Furthermore, the DOD manual expressly provides that the K24 level of overpressure protection is directly associated with the distances labeled as "public traffic route" distances, and is also the level of protection specifically required for personnel at control stations located at distances less than that provided by K24 (Tr. 2183; Dep. Ex. 11 at 4-8; Dep. Ex. 43 at 49; Gardner Feb. Dep. 86-87).

[58] Hercules also argues that even if the DOD manual does apply, the separation distances set forth (continued...)

the American Table cited by Hercules, however, has no application here since it governs the separation of "magazines", defined as "any building, structure, or container *other than an explosives manufacturing building*, approved for the storage of explosive materials" (Tr. 1134-35, 1927; Exhibit R-126 at 6 n.5 (emphasis added)). The only section of the American Table which may be relevant for our purposes is that titled "Public Highways" (Exhibit R-126 at 4). Although it is not indicated at what level of overpressure the distances found under this section protect personnel, the first set of calculations apparently take into account the presence of one barricade. In any case, as with the DOD separation distances, Hercules has failed to satisfy the 185-foot distance required under this section for 2,000 pounds of explosive material.

With regard to § 1910.109, Hercules claims that the Secretary improperly cited the original 1989 allegations under the general duty clause when a specific standard was directly applicable. Although the standard's scope section does state that § 1910.109 applies to the manufacture of explosives, a careful review of the standard indicates that virtually none of its requirements address the hazards associated with manufacturing explosives, only those associated with storage and transportation (Tr. 3226-30).[59] *See* § 1910.109(k). For instance, smokeless propellants are addressed at § 1910.109(j)(3), but only in the context of storage (Tr. 3222-23). Similarly, Table H-21, the

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[58](...continued)
in tables which assume the presence of 1.3 materials or which establish "intraline" distances should be used instead of Table 6-1 (Tr. 1965-66; Dep. Ex. 11 at 6-9 [Table 6-3], 6-22 [Table 6-10]). Neither of these tables, however, is based upon a K24/2.3 psi protection level; the 1.3 table assumes a protection level of K8 and K5, while the intraline table assumes a protection level of K9 and K18 (Dep. Ex. 11 at 6-9, 6-23 n.3). According to the DOD manual, a K9 protection factor corresponds to 12 psi of overpressure (Gardner Feb. Dep. 79-80; Dep. Ex. 11 at 4-6). In addition, Lawrence Smith testified that the intraline separation distances are not intended to protect personnel, but to address the potential spread or propagation of a propellant reaction between explosives manufacturing buildings (Tr. 2228; Dep. Ex. 44 at 7-34).

[59] The OSHA project officer assigned to § 1910.109 testified that the mixing of water gels, referred to under subsection (h)(3), could be considered an explosives manufacturing operation (Tr. 3220-22). But with no indication that water gels have ever been used at the Kenvil plant, the requirements for such a process are irrelevant here.

It should be noted that § 1910.109(k)(2) provides that the manufacture of explosives is also subject to the requirements of § 1910.119, the process safety management standard (Tr. 3226-27, 3246-47). According to the project officer, as well as the preamble to the final rule, the latter standard was, in part, promulgated to address explosives manufacturing because § 1910.109 fails to do so (Tr. 3229-30, 3246-47; Exhibit C-163 at 6367).

standard's quantity/distance table that is based in part on the American Table, sets forth only those separation distances required between magazines (Tr. 1037, 1041-43, 1086, 3223-25, 3232-33, 3236).

In adapting the American Table for its own purposes, however, OSHA apparently neglected to remove language which suggests that these magazine separation distances apply to manufacturing buildings as well (Tr. 3231-33, 3235-36; Exhibits C-164 at 62782 & C-165 at 49734-35). Indeed, footnote 5 of Table H-21 specifically states that the table applies to the manufacture of commercial explosives, language which appears verbatim at explanatory note 14 of the American Table (Exhibit R-126 at 7). While this language, as well as that found at § 1910.109(k)(1), is admittedly confusing, it remains evident from the face of the standard not only that its requirements are limited to storage and transportation, but that the standard contains nothing which would address the hazards cited here.[60]

The final issue for consideration is whether the manner in which Hercules arranged the Blender Packer operation is sufficient to protect personnel located inside the control room and at the intraplant road from overpressure levels exceeding 2.3 psi. To address this complex question, each party engaged its own expert, Dr. Frank Tatom for the Secretary, and Dr. Mark Fry for Hercules. Both men have impressive backgrounds, with considerable experience and/or education in fields, such as physics and engineering, that are relevant to this inquiry (Exhibit C-130; Exhibit R-159). Using two highly specialized computer software programs, Dr. Tatom and Dr. Fry attempted to simulate conditions as they exist at the Blender Packer operation in order to determine the actual levels of overpressure which would occur in the cited areas (Tr. 2633-34; Tatom Dep. 7). Dr. Tatom used the latest version of a high explosive damage assessment code he developed known as HEXDAM which, as its name suggests, is designed specifically to assess the damage associated with a detonation (Tr. 1056, 1487-88, 1513, 1516-23, 1653-54, 1720, 1836; Exhibits C-132, C-133, &

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[60] As part of its continuing effort to revise duplicative, unnecessary, and/or inconsistent standards, OSHA recently amended § 1910.109, eliminating footnote 5 from Table H-21, as well as language from subsection (c)(1)(vi) referring to the three sections of the American Table not included in the final rule. 61 Fed. Reg. 37849 (July 22, 1996).

C-134).[61] Dr. Fry used a code which he developed known as PCBLAST, a program which measures the strength of a detonation's blast wave as it interacts with a structure, also known as overpressure (Tr. 1056, 2634, 2645, 2678-78, 3990; Fry Dep. 86-87; Exhibit R-192).

The differences between these two programs stem mainly from the fact that PCBLAST is a "first principles" code, while HEXDAM is an "engineering" code.[62] A first principles code is one that is based on solving standard physics equations of mass, species, momentum, and energy, in a time-dependent way (Tr. 1468-69, 2590-92, 2635-36, 2645, 3434, 3451-54, 3636-39; Tatom Dep. 72-73; Fry Dep. 29, 100). According to both experts, first principles codes are highly complex and must be run on a "super computer" in order to reduce response time (Tr. 1467-68, 2591-92, 3047). An engineering code, on the other hand, is less complex and provides quicker answers than a first principles code since it takes less time to run (Tr. 2591-92, 2608-09, 2662, 3047). This type of code does not solve equations, but is based upon a set of models or parameters that provide predetermined levels of overpressure, pulse, and damage, given a certain set of facts (Tr. 1809-11, 2636, 2665-70, 3639, 3997-98; Tatom Dep. 72-73).[63]

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[61] The actual level of damage is predicted numerically based upon a predetermined scale representing slight, moderate, and severe damage; HEXDAM's default values for these levels are 5%, 30%, and 75%, respectively (Tr. 1514-15, 1594-95, 1732-34, 1843-45; Exhibit C-134 at 2-3). For a standard run, HEXDAM predicts damage at 50%, *i.e.* half the time the damage will be worse than that predicted and half the time it will be less (Tr. 1533, 1564-65, 1600-01, 1661, 1735, 2676-77; Tatom Dep. 16-17; Exhibit C-134 at 1-3). Here, HEXDAM was used to assess the damage which the control room would experience during a detonation. In doing so, Dr. Tatom manipulated the code in order to predict the damage that can be expected at other statistical levels ranging from 40% to 5%; thus, under the 40% run, the damage will be worse than that predicted 40% of the time, and less than that predicted 60% of the time, while under the 5% run, the damage will be worse than that predicted 5% of the time, and less than that predicted 95% of the time (Tr. 1564-66, 1594-95, 1600-06).

[62] This difference was also described by the experts respectively as a deterministic versus probabilistic approach to the problem. According to the record, a deterministic approach assumes that a problem has essentially only one answer given a certain set of known facts, while a probabilistic approach assumes that a problem contains too many unknown factors for there to be only one answer (Tr. 1464-68, 1470-71, 2665-66, 3045-50, 3623-27).

[63] HEXDAM consists of essentially four features: a universal overpressure curve, scaled as a function of yield, distance, and height of burst; a pulse duration curve, similarly determined as a function of yield and distance; a shielding model, which essentially factors in a "disturbance" when the blast wave encounters an obstruction; and a damage model, which predicts a level of damage using a given structure's assigned

(continued...)

For the layperson, it can be extremely difficult to grasp the significance of the many differences between HEXDAM and PCBLAST, and how they relate to the problem at hand. At the same time, however, it is obvious that these codes must be equipped to accurately assess the impact of the Blender Packer operation's design upon the overpressure levels created by a detonation. Two significant limitations of the HEXDAM code seriously affect Dr. Tatom's ability to accomplish this task. First, as an engineering code, HEXDAM is incapable of analyzing a detonation blast wave as a multi-dimensional force. This is critical since intuitively, a blast wave is not a static occurrence; on the contrary, a blast wave is nonlinear and "unsteady" in that it ebbs and flows over time, its force affected by the physical objects in its path(Tr. 2607-08, 2620-22, 2632-33, 2778, 2928-29, 3051-52). In recognition of this fact, PCBLAST incorporates physics principles such as "vorticity" and "Mach disk" into its code in order to represent the forces that drive the shape and flow of a blast wave; as a result, PCBLAST is capable of analyzing a blast wave in any one of three dimensions (Tr. 2625-26, 2629-33, 2637, 2645, 2654, 3007-08, 3414-35, 3649-50).[64] An engineering code, however, treats a blast wave as a linear, "steady state" event, referencing overpressure and pulse duration as a point on a scaled universal curve whose main variable is distance; by definition, this type of code does not include the relevant physics principles required to actually calculate these elements as a function of time (Tr. 1472-73, 1490-92, 1496-99, 2607-08, 2620-22, 2630-31, 2633, 2636-37, 2667-70, 3051-53, 3639, 3996-98, 4008; Fry Dep. 160-61, Moran Dep. 41). As a result, HEXDAM cannot accurately capture the multi-dimensional features of a blast wave.[65]

[63](...continued)
"vulnerability index" (Tr. 1491-1515, 1705-06, 1809-11, 2591-92, 2637, 3996-97; Tatom Dep. 73; Exhibit C-131).

[64] Dr. Fry testified that he analyzed the Blender Packer operation in both two and three dimensions, but explained that there is little difference between each analysis because the third dimension is essentially symmetrical with the first two (Tr. 2645-50, 2920-24, 3005-09, 3414-15, 3437-38, 3446-47, 3993-94, 3999; Dep. Ex. 38 at 25; Exhibit C-175).

[65] This is not to say that HEXDAM cannot display three-dimensional results. Indeed, Dr. Tatom's testimony regarding the three-dimensional nature of HEXDAM related primarily to the graphic capability of the code, *e.g.* the use of three line "doublets" to represent the presence of a shield; "showing" pressure and damage contours in three dimensions (Tr. 1509-12, 1525-26, 1530-32, 1598; Exhibit C-134, Appendix E; Exhibit C-140). As the Secretary stated in her post-hearing brief, "HEXDAM models a *three-*
(continued...)

HEXDAM is also limited in its ability to account for the multiple reflections a detonation blast wave may experience. As both experts testified, when a blast wave comes into contact with the surface of a structure, the wave will repeatedly reflect off of that surface in different directions, creating an interaction of shock waves and an increase or shift in overpressure (Tr. 1533-35, 1713-14, 1842-43, 1856, 2658-62, 2803-04). Thus, multiple reflections are important not only to understanding the physics of a blast wave, but to accurately determining overpressure levels as they exist over the life of the wave. While PCBLAST automatically calculates the effect of all reflections as a function of time, making no assumptions about the angle of reflection, HEXDAM measures only one reflection and assumes that it consistently occurs perpendicular to the direction of the blast (Tr. 1535, 1714-15, 1819-21, 1842-43, 2661-63, 2667, 2670). This feature so limits HEXDAM's application that its user's manual specifically cautions: "Because multiple shock reflections are not considered, HEXDAM [version] 5.0 cannot accurately predict damage caused by confined explosions occurring within strongly reinforced structures" (Exhibit C-134 at 1-3; Dep. Ex. 25).

Given these shortcomings, HEXDAM cannot be considered an appropriate tool with which to analyze the Blender Packer operation. As Dr. Tatom himself recognized:

> "The problem of the propagation of a blast wave in the current [Blender/Packer] situation is basically three dimensional. We have the surface of the earth. We have a boundary layer. *We have the interaction with three dimensional structures. We have a three dimensional shaped discharge from the Blender Packer [operation room] and this produces a flow field that varies not only in the horizontal - that is north, south, east, west -- but it also varies in the vertical.*"

(Tr. 1476) (emphasis added). Even the warning found in its user's manual raises serious doubts as to whether HEXDAM can reliably assess an explosion that occurs inside a structure like the Blender Packer's earth-covered operation room. Without the ability to consider the multiple reflections that would occur once the blast wave comes into contact with the surrounding structure or to evaluate the wave in more than one dimension, HEXDAM cannot accurately determine whether Hercules

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[65](...continued)
dimensional picture of the scenario to be analyzed" (Tr. 1531-32; Secretary's Post-Hearing Brief at 162 (emphasis added)).

personnel are adequately protected from overpressure levels exceeding 2.3 psi.

Support for this conclusion can also be found in each expert's analysis of the Blender Packer operation. A comparison of the two sets of data reveals that Dr. Fry's analysis is more scientifically sophisticated than Dr. Tatom's, and more credible in light of the problem presented (Tr. 2676). Dr. Fry's analysis specifically takes into account the design of the Blender Packer operation room which, he maintains, would respond dynamically to a detonation (Tr. 2776-77, 3094, 3100, 4003-04).[66] Accordingly, he concluded that a blast wave originating inside the operation room would be measurably suppressed by the surrounding structure and its three-to-five-foot earth covering such that the wave would be driven out of the uncovered portals at each end of the room with great force (Tr. 2630-31, 2650-51, 2769, 2771, 2776-77, 3081-83, 3094-95, 3100, 3107, 3409, 3485-87, 3610, 3636-38, 3652, 4021-22; Exhibit C-177; Dep. Ex. 38 at 25; Fry Dep. 44, 67-75). This effect, which Dr. Fry likened to a gun muzzle blast, results in an elliptical blast wave that has elevated levels of overpressure at its top and bottom in the north/south direction, but significantly reduced levels of overpressure in the perpendicular, east/west direction (Tr. 2626-27, 2652-53, 2769, 2845, 2906, 3081-83, 3086, 3099-3101, 3403-04, 4002; Tatom Dep. 137-38; Exhibits C-177, R-160, & R-182).[67] Therefore, at the intraplant road, located almost directly west of the Blender Packer operation room, Dr. Fry found that overpressure levels associated with the detonation of 2,000 pounds of explosive material would remain well below 2.3 psi (Tr. 2679-80, 3058-60, 3079-80, 3082-83, 3085-88, 3639;

[66]In her post-hearing brief, the Secretary repeatedly criticizes Dr. Fry for failing to properly "model" several components of the Blender Packer operation such as the glaze barrel, the drop plug buggies, the wood and metal of the operation room (Secretary's Post-Hearing Brief at 166-67, 171, 192, 203-04). Most of these complaints, however, are centered upon the videos Dr. Fry created to explain his results (Tr. 2760-66, 2910-13, 3411-13, 3426-33; Tatom Dep 77-80, 140-41; Exhibits C-173, C-174, C-176, R-168, & R-175). As Dr. Fry indicated at the hearing, these videos are merely a graphical representation of his analysis; they are not part of his calculations, but are animated images that illustrate the concepts on which his analysis is based (Tr. 2759-66, 3327-28, 3331, 3509-10).

[67] Dr. Fry identified two sets of tests conducted by the military which validate his conclusion that the earth-covered operation room reduces overpressure levels in the perpendicular direction (Tr. 2879-2905; Exhibit C-157; Dep. Ex. 54; Exhibit R-171; Exhibit R-172). As he noted, these tests were conducted with earth-covered magazines that had only one open end; with two open ends, like the Blender Packer operation room, the reduction would be expected to be even greater (Tr. 2901).

Exhibits R-182, R-183, & R-184; Dep. Ex. 38).[68] At the control room, he determined that the blast wave would envelope the structure like a glove, creating an overall crushing effect upon its earth-cover, but concluded that the control room's location to the southwest of the operation room, as well as its earth-cover, would succeed in keeping overpressure levels inside the room at no more than .01 psi, just slightly above ambient pressure (Tr. 2670-73, 2675-76, 2869-76, 2966, 2969-70, 2985-89, 3000-02, 3005-09, 3051-53, 3079-80, 3082-83, 3087, 3100-01, 3653; Exhibits R-177, R-183, & R-184; Dep. Ex. 38).[69] This is consistent with the testimony of one of the Secretary's expert witnesses who admitted at the hearing that he believed employees inside the earth-covered control room would be adequately protected from overpressure levels of 2.3 psi (Tr. 1311-12).

Although Dr. Tatom on rebuttal tried to refute Dr. Fry's analysis of the Blender Packer operation, arguing that Dr. Fry had given too much credit to the suppressive effect of the operation room and its earth-cover, his testimony was neither persuasive nor supported by the record. Having admitted he could find no experimental data that examined how a detonation blast wave will respond when it occurs inside an earth-covered structure with two open ends, Dr. Tatom based his argument largely upon data dealing with structures that have only one open end which he then scaled and manipulated to "simulate" the effect of two openings (Tr. 3828-38, 3848-54, 3866-72, 3875-76, 3878-79, 3887, 4004, 4056; Exhibits C-203, C-204, C-205, & C-206; Dep. Ex. 35). But placing two,

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[68] Dr. Fry used PCBLAST to determine the overpressure levels associated with both propellant and TNT reactions (Tr. 2915, 2918-19, 2941; Exhibits R-182, R-183, & R-184). For the run which considered the reaction of 2,000 pounds of propellant, Dr. Fry assumed a burn rate that is consistent with a high-speed deflagration, just short of a detonation (Tr. 3077, 3336-37; Fry Dep. 25-26, 29-30). However, for those runs which considered the reaction of varying amounts of TNT calculated as "equivalent" to 2,000 pounds of propellant, he assumed a detonation (Tr. 1214-15; Fry Dep. 26, 29-30). Although the parties could not agree on the rate at which propellant can be calculated as equivalent to TNT, Dr. Fry's analysis assumed a range of TNT equivalence rates, including the 114% rate used by Dr. Tatom in his analysis and the 25% rate proposed by Hercules (Tr. 1551-52, 1558, 1571, 1590, 1649-50, 2018, 2029, 2308, 2549, 2572, 3084, 3091-92; Dep. Ex. 2 at 556; Dep. Ex. 10 at 417). At both of these rates, overpressure levels remained below 1 psi at the intraplant road (Exhibits R-183 & R-184).

[69] Although Dr. Fry's results assumed that the cited areas were between ten and fourteen feet further away from the operation room than determined *supra* to be the actual distances, his calculations remain valid given that the predicted overpressure levels at the same distances for a detonation of 4,000 pounds of TNT, which assumed a TNT equivalence rate of 200%, remained under 2 psi (Tr. 2941, 3079-80, 3091-92; Exhibit R-184).

three-walled "cubicles" back-to-back completely misrepresents conditions as they actually exist at the Blender Packer operation room; indeed, the room does not consist of individual compartments separated by two parallel walls (Tr. 3831-32, 3836-38, 3869-74, 3879-80, 3883, 3887-88, 3891-94, 3899-3900, 3953-55, 3958, 4010-20; Dep. Ex. 35). Furthermore, it is not entirely clear how this data explains anything about the affect that the operation room's earth-cover has upon a blast wave since the cubicles referenced by Dr. Tatom have a roof, but no apparent earth cover (Dep. Ex. 35 at 7). Having made an invalid comparison of this data with the uniquely designed operation room, Dr. Tatom's attempts to undermine Dr. Fry's conclusions lack credibility.

Moreover, Dr. Tatom's claims directly conflict with statements he made on direct examination which suggest that he agreed with Dr. Fry's basic theory regarding the affect the operation room and its earth-cover will have upon a blast wave. At that time, Dr. Tatom testified that he had rejected an earlier HEXDAM run prepared for this case precisely because it failed to account for the shielding effect of the operation room's earth-cover to the east and west (Tr. 1573-75, 1598).[70] Echoing Dr. Fry's analysis, Dr. Tatom explained that a blast wave emanating from the earth-covered operation room would not occur as a perfect circle, but would be pronounced or bulge at the north and south due to greater overpressure levels in these areas (Tr. 1573-75, 1598, 1716-17).

Despite this recognition, Dr. Tatom's final series of HEXDAM runs continued to treat the blast wave as an almost symmetrical set of concentric circles, its shape and force relatively unaffected by the earth-covered structure surrounding it (Tr. 2630-31, 2768-70, 2906, 2965, 3051, 3101; Exhibits C-140 & R-176). In fact, HEXDAM's blast wave appears in one exhibit to be virtually identical to that associated with an open air, unconfined detonation (Tr. 3909, 3947-50; Exhibit C-206). Under these circumstances, it is difficult to believe, as Dr. Tatom contends, that HEXDAM has accurately considered the protection provided by the operation room and its earth-cover, particularly where his testimony on this issue was far from clear (Tr. 3050-53).[71] Hence, it

[70] Over the course of this case, Dr. Tatom rejected several runs of HEXDAM due to what he considered to be either inaccurate information or inconsistent results (Tr. 1559-64, 1567, 1571-75, 1580-90, 1593, 1670-71, 1822-26; Exhibit R-114; Dep. Exs. 26, 27, 31, 32 & 33; Tatom Dep. 27-39, 51-54).

[71] Rather than determine, as PCBLAST does, how a blast wave will react when it comes into contact
(continued...)

is not surprising that Dr. Tatom's overpressure results at the intraplant road range between 3.7 and 5.5 psi, the latter of which actually *exceeds* the overpressure levels found at the same distance from an open-air, unconfined detonation (Tr. 1596-99, 3949; Exhibit C-140 at 2-6; Exhibit C-205, Notes).

Equally troubling is Dr. Tatom's analysis of the control room. Instead of enveloping the control room like a "glove", Dr. Tatom concluded that a blast wave originating in the Blender Packer operation room will impact or hit the control room in a localized area; as a result, he found that "holes", increasing in size with each statistical run performed by HEXDAM, would develop in the northeast portion of the control room's roof and side wall, the area located nearest to the potential detonation site (Tr. 1557-58, 1609, 1613-15, 1621-23, 1627-29, 1642-49, 2669-75, 2869-76, 3052; Exhibits C-140 & C-141). But this type of damage seems inconsistent with the overall damage levels predicted by HEXDAM. Indeed, over six different statistical runs, HEXDAM predicted that the control room would experience relatively moderate levels of overall damage ranging from 27% to 41% on the default damage value scale, yet the holes which developed in the area of impact were predicted to reach as much as 20 square feet in size (Tr. 1607, 1620-21, 1632, 1642-45; Exhibit C-141). Even more confusing is the fact that the overpressure levels associated with these levels of damage apparently remained below 2.3 psi for all but one run (Tr. 1609-12, 1619-20, 1633, 1640-41;

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[71](...continued)
with the structures around it, HEXDAM predicts how a particular structure will respond to the blast wave; in other words, it predicts the damage the structure will sustain (Tr. 1513). To do this, each structure is assigned a "vulnerability index", which is calculated as a function of overpressure and pulse duration (Tr. 1513-14, 1531). Although HEXDAM contains a master file of vulnerability indexes for 104 different structures, a vulnerability assessment code known as VASDIP may also be used when a structure is not represented in the file (Tr. 1520, 1531-32, 1855 ; Exhibit C-134, Appendix B). Here, Dr. Tatom indicated that he was unable to use either of these sources to determine the vulnerability index of the side wall and roof of the Blender Packer control room; instead, he adapted experimental data from other sources to consider the strength of these structural components (Tr. 1686-87, 1690-91, 1695-97, 1724, 1839-42, 1857-59; Exhibit R-107). It is not clear from the record how vulnerability indexes were assigned to the various components of the operation room.

With regard to the earth-cover, which was represented as a multi-layered structure, Dr. Tatom initially testified that he used the density of the soil and the thickness of the layers to determine that it provided protection equivalent to 2 psi of overpressure; he later stated that this level of protection was associated only with a severe level of damage and therefore, the earth-cover's protection was actually much greater, yet never indicated by how much (Tr. 1512-13, 1523-25, 1682-84 , 1714-15, 1717-20, 1729-30, 1811-18, 2777-78, 2868-69, 3061-62, 4009).

Exhibits C-140& C-141 at 2).[72] According to Dr. Tatom's data summary, in only 500 cases out of 10,000 (5% run) would a detonation of 2,000 pounds of propellant result in overpressure levels in excess of 2.3 psi inside the control room and even then, such exposure would occur only at the ceiling of the control room, nowhere near the operator's position (Tr. 1633-34, ; Exhibit C-141). These inconsistencies merely serve to confirm that HEXDAM cannot be reliably applied here.

Based upon Dr. Fry's analysis, Hercules employees located inside the control room or at the intraplant road are adequately protected from overpressure levels in excess of 2.3 psi. However, contrary to Hercules' claims, it cannot be assumed that this protection existed at the time of the original inspection (Tr. 2422). Although Dr. Fry's analysis of the Blender Packer operation is based upon essentially the same structural layout which existed in 1989, his calculations specifically assume an amount of propellant which, according to the record, may not have been processed at that time. As noted *supra*, Hercules learned some time after the 1989 accident that the Blender Packer operation was routinely processing up to twice its 2,000-pound propellant limit. [73] According to Gardner, Hercules has since made a concerted effort to enforce this limit and the Secretary has introduced no evidence to suggest that the amount of propellant processed at the Blender Packer operation at the time of the reinspection was anything other than 2,000 pounds (Tr. 2362). *See*

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[72] Although during the hearing, Dr. Tatom referred to overpressure levels in excess of 2.3 psi as occurring inside the control room, it is virtually impossible to associate his testimony with the information contained in the charts depicting pressure and damage contours for each statistical run of HEXDAM (Tr. 1592, 1620-21, 1625-27, 1632-34; Exhibit C-140 at 34, 36, 41-43, 48-49). Fortunately, the summary of data which Dr. Tatom prepared from these charts is not only easier to read, but also, according to Dr. Tatom, more accurate than the charts themselves (Tr. 1638-41; Exhibit C-141).

[73] Although confirmed by the testimony of the lead compliance officer in this case, quoted *infra*, the Secretary has accused Gardner of being "inventive" on this point in a zealous attempt to prove that Hercules had actually reduced the propellant limit at the Blender Packer operation (Tr. 1034-37, 1074-75, 1114; Secretary's Post-Hearing Brief at 137-38, note 157). As "documentary proof" that there has never been any overloading at the Blender Packer operation, the Secretary cites to Hercules' 1989 accident investigation report, as well as the 1989 willful citation, finding it significant that neither of these documents mention overloading at the Blender Packer. **Not surprisingly, however, the investigation report lists propellant inventories only for those operations that were involved in the accident, of which the Blender Packer was not one, and the inventories themselves represent amounts that existed only on the day of the accident (Dep. Ex. 6 at 4197-98, 4202, 4205, 4267, 4272-76)**. Likewise, it does not follow that overloading at the Blender Packer operation never occurred simply because OSHA did not cite Hercules for that condition (Exhibit R-158, Citation 2, Item 4).

discussion *supra*, notes 29 and 43. On the contrary, the lead compliance officer specifically testified as follows:

> Q: You've been, at some times, you've been at that facility, have you not, when there were reductions in the powder, correct, at the Blender Packer?
>
> A: (No verbal response.)
>
> Q: I mean, back in '89 and then in '93, there was a reduction from one, what went off in '89 and what was processed there versus '93? That's true; isn't it?
>
> A: *If you're relating to the loading of the building and not the load limits, you're absolutely correct.*
>
> Q: Okay. Tell us how many pounds you believe the[y] lowered?
>
> A: I believe in '89, there was 4,000 pounds in there. The load limit was 2,000.
>
> Q: Okay.
>
> A: *Reduced it to the load limit.*
>
> Q: *So, they went, at least you're testifying that they went, in '89, from 4,000 pounds to 2,000 pounds; correct, in 1993?*
>
> A: *Correct.*
>
> Q: *Prior to '93, but when you were there, it was 2,000 pounds; correct?*
>
> A: *That is correct.*

(Tr. 1034) (emphasis added). Where Hercules has taken affirmative steps to ensure that the amount of propellant potentially involved in a detonation at the Blender Packer operation remains at a level which, according to Dr. Fry's analysis, will not expose personnel to overpressure levels in excess of 2.3 psi, the Secretary has failed to establish that the violative conditions cited in 1989 remained hazardous at the time of the reinspection. Accordingly, the charge of failure to abate the explosives manufacturing operations is not warranted.

Based upon the foregoing findings and conclusions, it is

ORDERED that the notifications of failure to abate in connection with recordkeeping and the explosive manufacturing operation are **vacated**.

RICHARD DeBENEDETTO
Judge, OSHRC

Dated: April 21, 1997
Boston, MA

Based upon the foregoing findings and conclusions, it is

ORDERED that the notifications of failure to abate in connection with recordkeeping and the explosive manufacturing operation are **vacated**.

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RICHARD DeBENEDETTO
Judge, OSHRC

Dated: ____________________
Boston, MA