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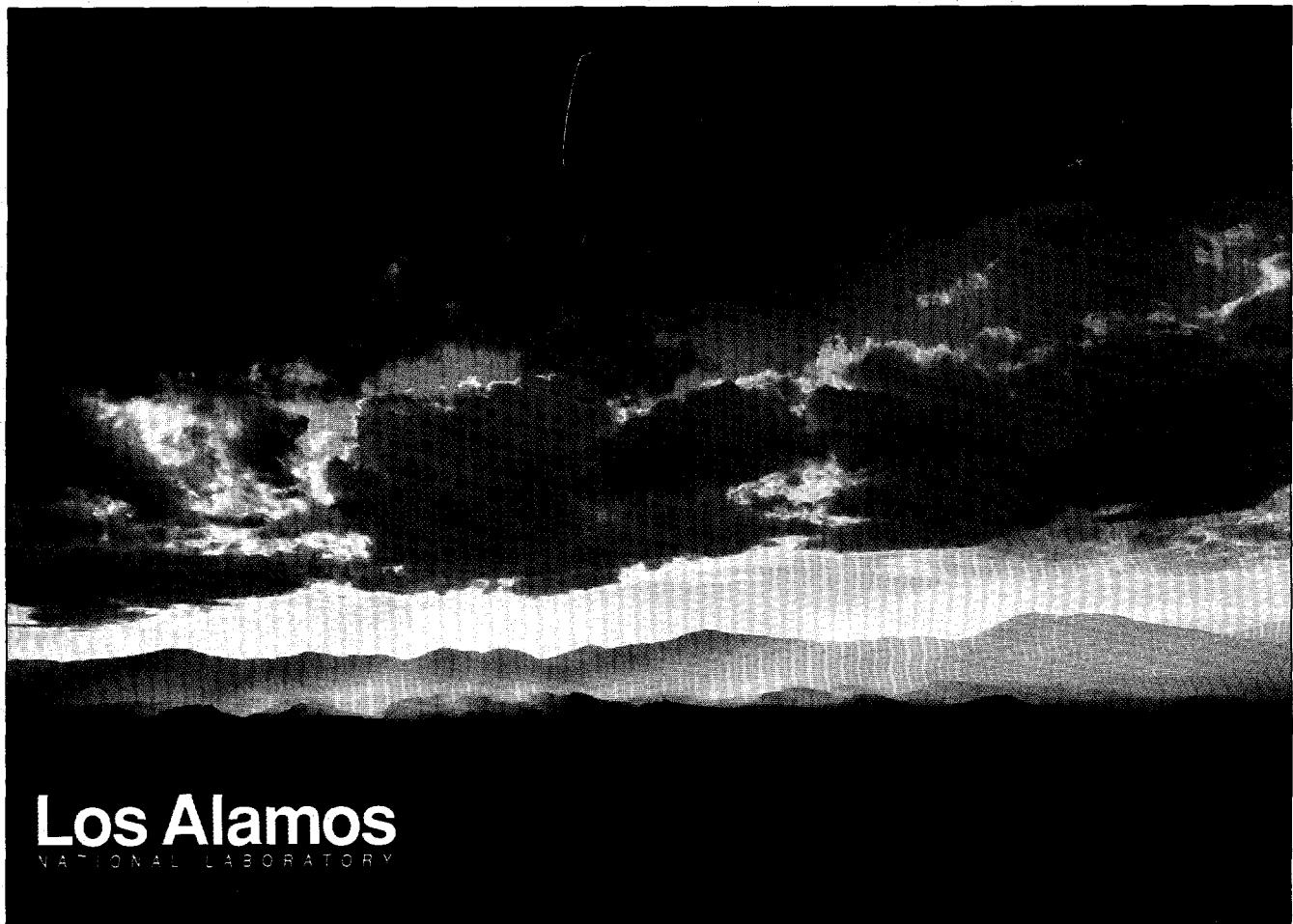
**BOEING MICHIGAN AERONAUTICAL RESEARCH CENTER (BOMARC)
MISSILE ACCIDENT SITE MITIGATION REVIEW**

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Earth and Environmental Sciences Division
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and

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22 May, 1996



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In December 1995, the Los Alamos National Laboratory (LANL) was requested by SAF/MIQ¹ to review the information associated with the BOMARC missile accident site and the November 16, 1992 Record of Decision (ROD)². The purpose of this review was,

“ . . . to help ensure our plans call for using the most efficient and up-to-date technology in our cleanup, and to ensure our plans to ship the contaminated waste meet all regulatory requirements.”

HISTORY

In November 1992, SAF/MIQ ROD for the BOMARC missile accident site, McGuire Air Force Base, New Jersey was issued. This SAF/MIQ ROD states:

“On June 7, 1960, an explosion and fire occurred in BOMARC Missile Shelter 204. The fire burned uninhibited for about 30 minutes. The force of the explosion destroyed portions of the shelter roof, flames rose to 20 feet, and black smoke blanketed the area. At the time of the fire a north-northeast wind of 2 to 8 knots blew smoke into the surrounding areas. Some of the plutonium contained in the nuclear warhead, which readily adheres to dust and smoke particles, may have been carried aloft on the northeasterly wind and dispersed.”

“Although no nuclear explosion took place, the nuclear warhead was burned and melted, the missile was destroyed, and the launcher shelter was badly damaged. In addition to the severely damaged roof, the floor and concrete walls were pitted by flying

¹ “Boeing Michigan Aeronautical Research Center (BOMARC) Review”, Memorandum from Thomas W. L. McCall, Jr., Deputy Assistant Secretary of the Air Force to Distribution, Dated December 1995.

² “Record of Decision, BOMARC Missile Accident Site, McGuire Air Force Base, New Jersey”, McGuire Air Force Base, United States Air Force, November 1992.

fragments of the helium and fuel tanks, steel roof beams were deformed, and the shelter walls received heat damage. The residue of the burning warhead contaminated the concrete floor. The remains of the warhead and all residue from the floor were placed in plastic bags and then into sealed cans for disposal. The nuclear material was separated by grade, and the high-grade nuclear material was shipped to the Medina Base in San Antonio, Texas, and then to the US Department of Energy (DOE) Pantex facility in Amarillo, Texas. The nuclear material was examined and analyzed. The exact amount of plutonium contained in the warhead is classified. According to an Air Force summary report on recovery and analysis of the nuclear materials, it is estimated that no more than 300 grams of weapons-grade plutonium was unaccounted for."

While this general description is correct, more details are provided in a 1983 report by Caldwell. The actual sequence of events start with the rupture of a high pressure helium tank. This event ignited the missile fuel, and the missile was partially consumed by fire. As recorded in Caldwell³,

"The fire apparently started in the missile fuel storage area, which is housed in the same cement walled building as the missile, about 20 ft from the missile itself. The roof above the fuel storage area was completely burned. The warhead support sagged during the fire, allowing the warhead to slide down to the floor. The HE⁴ around the primary burned completely. F. J. Dunn from Los Alamos wrote, 'The pit⁵ had been converted to a low mound of material, presumably a mixture of oxides. There were several pieces of slag, which looked like aluminum, and one piece of a darker metal, which might have been uranium or plutonium.' Dunn's conclusion, shared by all involved at the scene, was that the HE ignited after the missile fuel fire was out. No significant alpha contamination was observed outside the general area of the 'low mound' on the floor, in spite of the observed raging flames from the fuel fire that shot 75 ft high above the collapsed roof over the fuel storage area."

Based on Caldwell's report, there is no question that the high explosive in the warhead ignited and burned; however, the high explosive did not explode. The

³ Caldwell, J. T., et.al., "Measurement of Nuclear Weapons Accident Residues Stored in Containers, Phase I(U)", Los Alamos National Laboratory, LA-9696-MS, May 1983 SRD.

⁴ High Explosive.

⁵ Pit. The term "pit" refers to the spherical metallic unit that contains fissile material in a nuclear weapon. It is also referred to as a "primary", is surrounded by high explosive, and is an integral part of the weapon.

pit presumably melted and burned, and small quantities of Pu239, U238, and U235 were distributed into the environment.

At the time of the incident, emergency operations included fire fighting, weapons officer response, monitoring, and removal of weapon components. Gross contamination, including the recoverable weapons remains, was placed into containers and shipped offsite. According to the SAF/MIQ ROD,

“Soon after the accident, a coating of fixative paint was applied and a 4- to 6-inch layer of concrete was poured over the most heavily contaminated portions of the asphalt apron and the floor of Shelter 204. These actions have effectively contained contaminants found in these areas through the present time. In addition, an asphalt cover was placed in the drainage ditch leading from Shelter 204 in order to prevent erosion of contaminated soils from the ditch. The site is fenced with a 6-foot chain-link fence topped by barbed wire, precluding access.”

The site has since been monitored by Armstrong Laboratory health physicists (multiple times) and staff from the Remote Sensing Lab, Nevada Test Site (once). These data indicate that migration of radioactive material has not occurred.

No additional remediation activities have been implemented. Administrative control has been maintained.

Examination and quantification of the recovered nuclear material was accomplished in the early 1980s. The types of assay used for this study included neutron and gamma-ray spectroscopy, passive-neutron totals and coincidence output, pulsed active neutron-induced fission (prompt and delayed-neutron output) and 8-MeV photofission delayed-neutron measurements. In addition, extensive radiography was used to determine the deposition of materials inside the containers. Analysis of the data from several independent measurements permitted the investigators to estimate quantitatively the fissionable and other radioactive materials.

Based on Caldwell's report, the actual amount of Pu239 left onsite is about 100 grams +/- 20% (rounded to the nearest 100 grams). A much greater uncertainty exists about the actual amount of U235 and U238 left onsite. According to Caldwell,

“We cannot readily explain why our measurements account for almost all of the weapons grade plutonium, but only ____⁶ of the uranium. More uranium than we were able to measure may be

⁶ Intentionally left blank.

inside the containers. Our measurements cannot absolutely rule out that possibility. Additional *oralloy*⁷ in the barrels only strengthens the case for recovery of all fissile isotopes, considering the criticality hazard.”

The measurements taken on the BOMARC missile accident weapons residue were taken to establish whether or not a criticality hazard existed inside the containers and to determine how much material was recovered. These measurements indicate that as much as 2600 grams +/- 50% of U235 and 1400 grams +/- 50% of U238 could remain onsite. However, the scientists taking the measurements felt that most of the fissile isotopes were recovered even though their data do not support recovery of the uranium. Using the assumption that most of the material was recovered, a conservative estimate of the actual amount of U235 and U238 left onsite was made. Based on the assumption that the ratio of recovered uranium was similar to that for plutonium, the actual quantities of material in the weapon were multiplied by these ratios. The resulting number had an arbitrary adjustment made to prevent back calculation to the amounts of material contained in the weapon, and the number was rounded off to the nearest 100 grams. Using this methodology, the U235 left onsite is about 300 grams and the U238 left onsite is also about 300 grams.

AIR FORCE ENVIRONMENTAL DECISION

According to the SAF/MIQ ROD,

“The final selected remedy includes: (1) excavation of soils contaminated above cleanup criteria; (2) demolition and consolidation of structures contaminated above cleanup criteria; (3) transportation and Off-site Disposal of radioactive soils and structural wastes in a permitted US DOE radioactive waste disposal facility. However, the Air Force recognizes the uncertainties associated with disposal of radioactive contaminated waste at a DOE facility. Until an agreement is finalized that allows for cost-effective disposal, the Air Force will retain the option to implement the NEPA No Action [alternative⁸] as an interim remedy.”

On March 22, 1995, DOE⁹ informed the Air Force that DOE had encountered unavoidable delays in selecting a disposal site for the low-level waste from BOMARC. DOE further indicated that,

⁷ Uranium enriched in the U235 isotope.

⁸ Word added to the quotation for clarification purposes.

⁹ Letter from Thomas P. Grumbly, Assistant Secretary for Environmental Management, US Department of Energy to Thomas McCall, SAF/MIQ, US Air Force - Pentagon, Dated March 22, 1995.

"Although the Record of Decision for the BOMARC cleanup selects DOE as the preferred alternative, it also states that the '[NEPA¹⁰] no action' alternative is protective of the environment. This fact, coupled with the State of Nevada lawsuit, leads us to delay taking any action in this matter at this time. The Nevada Test Site Environmental Impact Statement is scheduled to be complete in approximately one year, with a Record of Decision due out in the spring of 1996. Once these documents are final, we will be able to proceed with the BOMARC EA and selection of a disposal site."

This delay by DOE has caused the Air Force to examine other disposal options.

In late 1995, the Army (as the land owner) questioned the legitimacy of the SAF/MIQ ROD.¹¹ The Army was concerned that the SAF/MIQ ROD was not signed by the lead regulatory agency, the New Jersey Department of Environmental Protection and Energy (NJDEPE), and that the proposed cleanup criteria of 10^{-4} (1 in 10,000) excess cancer risk is not acceptable to the NJDEPE. As stated in the SAF/MIQ ROD, the NJDEPE asserts that a cleanup level based on 10^{-6} (1 in 1,000,000) should be established.

The Air Force response to the Army clarifies that the President gave DoD lead agency status. As lead agency, the Air Force considered the proposed 10^{-6} cleanup level and found it to be excessive. After careful consideration, the Air Force established the derived cleanup level based on a 10^{-4} excess cancer risk.

PROPOSED MITIGATION APPROACH

The current US Air Force plan for BOMARC cleanup is to:

1. Remove concrete, asphalt, and soil to 8 pci/gram.
2. Package all material as low level waste ($\approx 8,000 \text{ yd}^3$).
3. Ship material off-site for disposal. (EnviroCare of Utah is one commercial facility currently under consideration.)

The Air Force, in keeping with its policy of being environmentally responsible, has plans to obtain all additional information necessary to develop a detailed removal implementation plan, will obtain all necessary transportation and

¹⁰ Word added to the quotation for clarification purposes.

¹¹ "Incomplete Record of Decision for BOMARC Site", Memorandum from J. Jeffrey Petrucci, Col. AD, Commanding, Fort Dix, New Jersey to Stephen R. Lorenz, Col., Commander, 305th AMW/CC, McGuire Air Force Base, New Jersey, Dated 18 October 1995.

disposal permits, and plans to have an additional public meeting prior to physically cleaning up the site.

PRELIMINARY REVIEW RESULTS

The LANL review identified the following:

1. Unclassified records¹² contain inconsistencies in the sequence of events both during and immediately following the incident.
2. Classified reports reviewed at the Nuclear Weapons Assurity and Safety Group (Kirtland AFB) and LANL were consistent about the events and their sequence during and following the accident.
3. The Air Force description of the potential contamination (only Pu239) from the accident is incomplete. The weapon also contained U235 and U238, both of which were involved in the fire (see previous discussion under History). Specific quantities of Special Nuclear Material¹³ (SNM) contained in the weapon are classified. By definition, the contamination left in the structure and environment from the accident (Pu239 and U235) is SNM.

POTENTIAL ISSUES

It should be emphasized that a final decision has not been made by the Air Force on how it will proceed with the BOMARC site. The following discussion is based on the assumption that the site will be excavated, the material containerized, and the containers shipped offsite for disposal.

1. Following a broken arrow incident, the weapon's remains are returned to DOE for ultimate disposal. However, ownership of the residual SNM left in the environment following emergency response seems to be less certain.

¹² The unclassified records include, but were not limited to: Press Release June 7, 1960; Press Release June 23, 1960; Fire Incident Report June 7, 1960; Telegraphic Brief of Findings and Recommendations of the Investigating Board IM99-A Missile Accident, June 7, 1960; Aircraft/Missile Fire and Rescue Report, June 7, 1960; Historical Record of the 46th Air Defense Missile Squadron (BOMARC) for the Period Ending 30 June 1960; Record of Decision BOMARC Missile Accident Site, November 1992.

¹³ Special nuclear material means: (1) Plutonium, uranium-233, uranium enriched in the isotope 233 or in the isotope 235, and any other material which the Commission, pursuant to the provisions of section 51 of the Act, determines to be special nuclear material but does not include source material; or (2) any material artificially enriched by any of the foregoing, but does not include source material. Source material means: (1) Uranium or thorium, or any combination thereof, in any physical or chemical form; or (2) ores which contain by weight one-twentieth of one percent (i) uranium, (ii) thorium, or (iii) any combination thereof. Source material does not include special nuclear material.

Potential Issue. This review did not find a formal understanding of ownership between the DoD and DOE for SNM left in the local environs following the emergency response to a broken arrow incident.

2. Material to be recovered from the BOMARC site includes Pu239 and U235. Concentrations of these two isotopes in isolated "hot spots" may result in some material that meets the DOE definition of TRU¹⁴ waste. According to the Atomic Energy Act of 1954 and 40 CFR 191, SNM and TRU waste are controlled by the AEC (presently the DOE).

Potential Issue. The use of a commercial disposal facility for TRU is not appropriate. In addition, DOE may have to accept this waste regardless of its current capability to dispose of it.

3. To achieve containerization, the concrete slab will be cut into pieces and these pieces will be placed into shipping containers along with the contaminated soil.

Potential Issue. Making the assumption that all material is low level waste (LLW¹⁵) may not be appropriate. The pieces of slab from the isolated "hot spots" may have radioactive concentrations that exceed the 100 nanocuries per gram threshold for TRU. Removal of this material as LLW could result in additional release of SNM into the environment and unacceptable cleanup personnel exposures.

For the isolated "hot spots", a better approach might be splitting the cap from the slab, removing the paint/contaminant layer, and treating these materials as TRU. The decontaminated cap and slab could then be safely discarded as LLW. Another approach could be cutting out the cap and slab for each isolated "hot spot", packaging the whole unit (cap and slab together) as TRU, and shipping it to DOE for treatment and disposal.

4. SNM shipping criteria must be carefully analyzed to ensure compliance with DOT and DOE requirements for transporting LLW and TRU wastes.

¹⁴ Transuranic Waste (TRU): Without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram of material.

¹⁵ Low Level Waste (LLW): Radioactive material that is not high-level radioactive waste, spent nuclear fuel, transuranic waste, or byproduct material (as defined in the Atomic Energy Act of 1954, (42 U.S.C. 2014(e)(2))). Note: The definition of LLW is based on type of waste rather than activity. When this type of waste has radioactive concentrations greater than 100 nanocuries per gram it is TRU.

Potential Issue. If it is determined that the material from the isolated "hot spots" is indeed TRU, then these materials will require special handling. Transportation requirements differ for LLW and TRU wastes.

5. The Air Force Air Mobility Command is concerned about taking actions that might result in reopening the current SAF/MIQ ROD.

Potential Issue. Reopening the SAF/MIQ ROD would provide NJDEPE an opportunity to influence the cleanup criteria. Subsequent to the signing of the ROD, NJDEPE promulgated standards more stringent than those in place when the ROD was signed. These more stringent cleanup criteria would result in much greater costs for remediation, and have been proven excessive by the evaluations done in preparation of the ROD.

RECOMMENDATIONS:

1. Locate and remove the isolated "hot spots". Containerize all material exceeding 100 nanocuries per gram as TRU, and transfer the TRU to DOE. This transfer will require coordination with DOE to assure all DOE requirements are met.
2. Excavate all remaining material, containerize it as LLW, and ship it to DOE or a permitted commercial facility.
3. The Air Force should proceed with its planned review of the final implementation plan when it has been prepared.

Response to Air Force Comments
on
Boeing Michigan Aeronautical Research Center (BOMARC)
Incident Mitigation Review

Air Force Comment: Cover memo. Please help us by referring to the site under discussion as the "BOMARC missile accident site," in order to minimize confusion with other BOMARC sites. There are 6 Installation Restoration Program (IRP) sites at the BOMARC facility, of which this is just one. The IRP code for the BOMARC missile accident site is RW-01; this is an acceptable shorthand reference.

LANL Response: The title of the review paper was changed to read, "Boeing Michigan Aeronautical Research Center (BOMARC) Missile Accident Site Mitigation Review".

Air Force Comment: Page 2, para 2. There is no intent in the ROD wording to accurately define the sequence of events. It is a summary of what happened. Please revise wording so it does not appear the ROD is in error. Perhaps: "While this general description is correct, more details are provided in a 1983 report by Caldwell." You might include the phrases from Caldwell where it states the events started with rupture of the high pressure helium tank.

LANL Response: The sentence "These statements are essentially correct." was not meant to imply that the ROD was in error, but rather was used as a lead in for the quote from Caldwell. This sentence was replaced with the supplied wording, "While this general description is correct, more details are provided in a 1983 report by Caldwell."

Air Force Comment: Page 2, para 4. Please define "pit." There is a launcher pit, but this is primarily to provide room for launcher parts when in the down position. This "pit" would not melt and burn.

LANL Response: The term pit, as used in this paragraph and in the material cited from Caldwell, refers to the spherical metallic unit that contained the fissile material. The pit, of any nuclear weapon, is surrounded by high explosive and is an integral part of the weapon. It is also referred to as a "primary". To assist readers not familiar with weapons terminology, the word "pit" has been footnoted.

Air Force Comment: Page 3. Please insert after paragraph one, information on removal of gross contamination and general information on disposition ('sent to appropriate holding facility' or something). There is no previous reference to "the containers" discussed in para 5. Insertion of the suggested information both makes the report more comprehensive and provides the initial discussion for the later reference.

LANL Response: The following sentence was inserted after the first sentence of the paragraph: "Gross contamination, including the recoverable weapons remains, was placed into containers and shipped offsite."

Air Force Comment: Page 3, Para 7, last sentence. Please provide additional context for this sentence. Does it mean the oralloy "strengthens the case" that all fissile isotopes were recovered, or that they need to be recovered? Is it considering the "criticality hazard" in the barrels, or in the environment?

LANL Response: This quote was made to establish the case that the scientists examining the barrels felt that most of the fissile isotopes were recovered even though their data do not support recovery of the uranium. The concern was criticality in the barrels not the environment. To make this point clear, the first part of the paragraph following the quotation was changed to read: "The measurements taken on the BOMARC missile accident weapons residue were taken to establish whether or not a criticality hazard existed inside the containers and to determine how much material was recovered. These measurements indicate that as much as 2600 grams +/- 50% of U235 and 1400 grams +/- 50% of U238 could remain onsite. However, the scientists taking the measurements felt that most of the fissile isotopes were recovered even though their data do not support recovery of the uranium. Using the assumption that most of the material was recovered, a conservative estimate of the actual amount of U235 and U238 left onsite was made."

Air Force Comment: Page 4, para 1. Please delete or modify the first sentence. This estimate, by the information in the rest of the paragraph, is considerably higher than is reasonably possible. Remember, this will become a public document. Suggest starting the paragraph with sentence two revised to: Based on the report's conclusion. . . recovered, an estimate of the actual amount. . . left onsite was made.

LANL Response: This request would result in a false summary of the Caldwell report. The changes made, as shown in the previous response are true statements based on Caldwell's report. The total quantities of material given were not accounted for by measurements taken on the weapons residue. However, the conservative estimate takes into account the assumption made that most of the material was recovered even though the data do not support recovery of the uranium.

Air Force Comment: Page 4, Para 3, last line. Suggest adding "[alternative]" after "Action" for clarity.

LANL Response: The suggested word was added and footnoted.

Air Force Comment: Page 4, Para 4. Recommend you include information indicating that the selection of a DOE facility was driven by cost considerations. It is not outside the context of the entire ROD to utilize a commercial facility, if it is cost effective. This is important since consideration by the Air Force of a commercial facility is discussed later in the document and the portion of the ROD quoted seems to indicate we emphatically stated we would either use a DOE facility or implement NEPA No Action.

LANL Response: This comment does not track with the copy of the ROD reviewed (Gary Vest, November 16, 1992). The Decision paragraph on Page 3 of the ROD states: "I have decided to pursue excavation and Off-site Disposal of contaminated waste at a Department of Energy (DOE) disposal facility. This is a cost-effective, permanent remedy, and it is the environmentally preferred alternative. I have also decided that if the Air Force is denied the use of a DOE facility, or if other events should dramatically decrease the cost effectiveness of this remedy, then as an interim remedy, the Air Force will maintain the BOMARC site in accordance with the NEPA No Action Alternative." In addition, the selected remedy statement on page 75 states, "The selected remedy - Off-site Disposal at a U.S. DOE radioactive waste disposal facility - will address risks posed by contaminated soils, concrete, asphalt, and structures." Perhaps these were not meant to be emphatic statements, but the ROD does contain them. The concept of using a commercial facility as a cost effective measure is a good idea; it just isn't listed as part of the decision of the ROD.

Air Force Comment: Page 4, Para 5, Line 2. Please insert "[NEPA]" before "no action." While this word was not included in the DOE letter, the issue has caused considerable confusion. The "no action" alternative evaluated in the RI/FS, and described in the ROD, is CERCLA no action; meaning uncontrolled use. This is most certainly not what the ROD says. The NEPA No Action alternative maintains present controls. If we had found that the "no action" alternative was protective of the environment, we would not be doing a cleanup; we found the "NEPA No Action alternative" to be protective.

LANL Response: The suggested word was added and footnoted.

Air Force Comment: Page 5, para 3. The ROD and Air Force response also state that we gave NJDEPE an opportunity to comment. Your paraphrase implies we went forward without any consideration for regulator opinion. We treated the unpromulgated NJDEPE cleanup level as a "To Be Considered." It was fully considered, and our reasons for not utilizing the 10E-6 level were provided in the ROD. The Air Force not only "maintains" the derived cleanup level meets the legal requirement, it DOES meet the legal requirement. Please revise to remove what we perceive as negative connotations (sic) regarding Air Force actions and responses.

LANL Response: This paragraph was not meant to imply that the Air Force did anything wrong, rather it was meant to state that the Air Force has lead agency status, and as lead agency is expected to make decisions. The paragraph has been rewritten as follows: "The Air Force response to the Army clarifies that the President gave DoD lead agency status. As lead agency, the Air Force considered the proposed 10E-6 cleanup level and found it to be excessive. After careful consideration, the Air Force established the derived cleanup level based on a 10E-4 excess cancer risk.

Air Force Comment: Proposed Mitigation Approach. Please include information in this section regarding our plans to obtain the additional information necessary to obtain all transportation and disposal permits and determine our specific implementation procedures. We will coordinate our plans with the Air Force Radio-isotope Committee, the regulators, and LANL. We have also committed to having another public meeting once we develop our removal implementation plan.

LANL Response: This section was included to concisely state what will be done. It was assumed that everything would be done correctly with the appropriate permits. To clarify this assumption, the following verbiage has been added after item 3. "The Air Force, in keeping with its policy of being environmentally responsible, has plans to obtain all additional information necessary to develop a detailed removal implementation plan , will obtain all necessary transportation and disposal permits, and plans to have an additional public meeting prior to physically cleaning up the site."

Air Force Comment: Preliminary Results, 1. We do not feel it is reasonable to associate the same level of accuracy to newspaper accounts and official Investigation Board Results. Point one connotes there are differences in records which can be held to a high degree of accuracy. Please be more specific about what types of inconsistencies are present between what types of documents.

LANL Response: It was not felt that identification of the specific inconsistencies was necessary, just that some inconsistencies did exist. What you refer to as newspaper accounts were the official military news releases of the accident as so stated in the footnote. These news releases would be expected to be accurate statements of fact, even if some facts were omitted for security purposes. The other documents listed in the footnote cover the range of accounts expected within the open literature. The types of inconsistencies referred to include not having the warhead involved in the accident to having it completely destroyed. For purposes of this review, it is important only to establish that inconsistencies do exist in the unclassified accounts of the accident. The fact that these types of inconsistencies exist should not be a surprise to anyone.

Air Force Comment: Page 6, line 1. Air Force records DO account for where most of the residue was shipped. Please revise and be more specific.

LANL Response: The ROD does state where the residue was shipped; however, the classified reports reviewed at Kirtland AFB do not state where the material was shipped. In fact, the only Air Force record reviewed by LANL that states where the material was shipped is the ROD. This point is not important, what is important is that the material was examined at Pantex and the amount missing was identified. Therefore, the sentence stating that the Air Force reports do not include information on where the nuclear weapons accident residue was shipped has been deleted.

Air Force Comment: Page 6, 4. Suggest wrapping this point into point 3.

LANL Response: This was done.

Air Force Comment: Potential Issues, 2. We understood this report would be prepared after LANL had an opportunity to review all the information on the BOMARC missile accident site. It appears this report is still based essentially on only the ROD. What is the evidence that concentrations over 100 nanocuries per gram are present at the site?

LANL Response: The review was supposed to focus on the ROD. Therefore, the ROD was used along with data from the previous radiological investigations. The rewrite was done based on the written comments received. The evidence that over 100 nanocuries per gram may be present at the site include the following:

- 1. ROD page 39. "Concrete core samples had levels of plutonium as high as 1,070 uCi/sample on the contact between concrete and underlying asphalt. This seems to be a fairly high reading, and the sample would have to weigh well over 20 lb. to achieve less than 100nCi/sample concentrations. In addition, this value seems to track with other data from the apron in front of structure 204.*
- 2. Radiological Survey, McGuire AFG, NJ, 19-23 March 1973, USAF Radiological Health Laboratory, Wright-Patterson AFB, Ohio., Attachment 1. Soil samples collected in 1970: Sample point 1 - 743 nCi/gm were found in the asphalt below 6 inches of concrete. Sample point 2 - 73 nCi/gm were found in the soil beneath the asphalt in the drainage ditch. Sample point 3 - 100 nCi/gm were found in the asphalt. 130 nCi/gm were found in the base material beneath the asphalt.*
- 3. After Action Report - Ft. Dix BOMARC Site, 30 October 1972, Page 2. "This survey indicated an 'L' shaped contaminated area within the missile site fence of over ten acres with contamination levels ranging from a few to several million micrograms Pu239 per square meter."*

4. *Health Physics Consultation, McGuire AFB, New Jersey, 21-24 November 1966, Report NR. 67W-1, Table II. A sample collected from the inner manhole cover of manhole number 2 measured $7.96E5$ pCi/gm Pu239.*
5. *Radiological Survey Data, 46th ADMS, 22-27 Aug. 1971, USAF Radiological Health Laboratory, Wright-Patterson AFB, Attachment 1. Sample locations near structure 2-8 have readings of 130K, 81K, 110K, 78K, 45K, 65, and 140K micrograms per square meter of PU239. Sample locations near structure 2-6 have readings of 618K, 501K, 1.14M, 610K, 534K, 931K, and 1.37M micrograms per square meter of PU239.*
6. *Annual Radiological Survey of the Fort Dix BOMARC Site - Instrumental Data - 1976, 17-20 May 1976, USAF Radiological Health Laboratory, Wright-Patterson AFB, Figure 3, Intensive Area - FIDLER Data (ug/m²) - 1976. Data points shown include: 540K, 10.7M, 614K, 855K, 185K, 1.1M micrograms per square meter.*

Air Force Comment: Page 7, 3. We do not feel it is not appropriate to assume the Air Force will use a technique that may cause additional releases. As you mention, we have not yet determined the details. Please revise. You may restate that we have not yet determined a procedure, then assume that the Air Force will thoroughly evaluate all alternatives and select one protective of the environment and the worker's health. Under "potential issue," please recast to merely provide your suggestions, since we haven't yet developed a procedure.

LANL Response: If the Air Force intends to containerize the material and ship it offsite for disposal, the slab will have to be cut, broken, or otherwise reduced to pieces, and these pieces will have to be placed into containers. Though the Air Force has not developed a procedure, unless the slab is left intact, reduction will occur. The potential issue presented here is that there may be "hot spots" which exceed the 100 nanocurie per gram level, therefore, the assumption that everything is LLW may be false. If levels of contamination exceeding 100 nanocuries exist, treating them as LLW could create a problem. The text as written does not suggest that the Air Force will purposely use an inappropriate technique, nor do we intend to imply such. We have stated elsewhere that we think the Air Force did a good job. Though you seem to take umbrage with this statement, it is a potential issue that should be raised. The text was left as written.

Air Force Comment: Page 7, 4. We normally use the term "ensure," not "insure" since we are not in the insurance business.

LANL Response: Touché. The word has been changed.

Air Force Comment: Page 7, 5, statement. Please note that our organization is the Air Force Air Mobility Command. We are not so much concerned about "modification," but in taking actions that might reopen the ROD.

LANL Response: Your name has been correctly placed into the text. The word modification has been replaced by "reopening" to avoid confusion. The text now reads,

- 5. The Air Force Air Mobility Command is concerned about taking actions that might result in reopening the current SAF/MIQ ROD.*

Potential Issue. Reopening the SAF/MIQ ROD would provide NJDEPE an opportunity to influence the cleanup criteria. Subsequent to the signing of the ROD, NJDEPE promulgated standards more stringent than those in place when the ROD was signed. These more stringent cleanup criteria would result in much greater costs for remediation, and have been proven excessive by the evaluations done in preparation of the ROD.

Air Force Comment: Page 7, 5, Potential Issue. Please revise. The issue is that NJDEP has now promulgated standards more stringent than those in place when the ROD was signed. We feel we should meet the ROD criteria. NJDEP has always had "an opportunity to influence" the cleanup criteria.

LANL Response: See the text changes made above.

Air Force Comment: Page 8, 3. Please revise. As stated above, our plans have always included review of the final implementation plan by the Air Force Radioisotope Committee and the regulators. Since we now know of your interest, we plan to include LANL in all future reviews. This recommendation incorrectly implies we planned to proceed without any review whatsoever.

LANL Response: Again, no implication of wrongful doing by the Air Force was intended. For clarity, the text has been changed to read: "The Air Force should proceed with its planned review of the final implementation plan when it has been prepared."

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