

**FINAL**

**ARCHIVES SEARCH REPORT**

**PRELIMINARY ASSESSMENT OF ORDNANCE CONTAMINATION  
AT THE FORMER BLACK HILLS  
ARMY DEPOT, SOUTH DAKOTA**

Contract No. DACA-87-91-D-0037

Prepared For:

U.S. Army Corps of Engineers  
Huntsville Division  
Huntsville, Alabama 35807-4301

October 1992

9222

**TCT-ST. LOUIS**

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# TCT - St. Louis

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U.S. Army Corps of Engineers  
Huntsville Division  
Attn: CEHND-ED-PM (Bob Britton)  
106 Wynn Drive  
Huntsville, Alabama 35807-4301

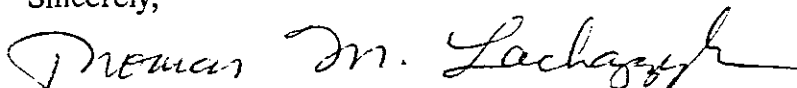
Re: Contract DACA-87-89-D-0037  
Delivery Order Number 1  
Final Archives Search Report  
Former Black Hills Army Depot  
South Dakota

Gentlemen:

The subject document is submitted in accordance with Section 3.2 of the Scope of Work. Aerial photographs and photographs taken during TCT-St. Louis' site visit were presented under separate cover entitled "Photo Documentation" and have not been reproduced. The Response to Comments are located in Appendix A.

A Risk Assessment Code (RAC) form has been prepared and is included under separate cover entitled "Final Archives Search Report - Conclusions and Recommendations".

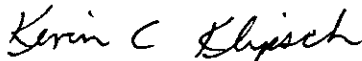
Sincerely,



Thomas M. Lachajczyk  
Program Manager



Nancy M. Dickens  
Environmental Scientist



Kevin C. Klipsch  
Environmental Scientist

NMD/kld/ND187/8  
Enclosure

cc: 543rd Ordnance Detachment  
548th Ordnance Detachment

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## **SECTION 1**

### **1.0 EXECUTIVE SUMMARY**

#### **1.1 Introduction**

The U.S. Army Corps of Engineers, Huntsville Division, contracted with TCT-St. Louis to perform archives searches and site visits at three former Department of Defense (DOD) sites including the former Black Hills Army Depot (BHAD) under Contract DACA-87-91-D-0037, Delivery Order No. 1. This work is part of the Department of the Army's Defense Environmental Restoration Program (DERP).

The former BHAD consisted of approximately 21,095 acres located 8 miles southwest of Edgemont, South Dakota.

##### **1.1.1 Project Objectives, Scope and Approach**

The scope of this project was limited to an archives search and site visit (for the purpose of interviewing the local populace).

The objective of this Archives Search was to obtain, review, and evaluate historical records related to the potential presence of any unexploded ordnance (UXO) and explosive waste (OEW) that may exist on the former BHAD property, which was owned and operated by the U.S. Army Ordnance Department. In addition, the significance of a potential explosive accident at the former BHAD was assessed. The Risk Assessment Code (RAC), presented under separate cover, together with Conclusions and Recommendations, contains the results of the evaluation of safety hazards at the site.

In order to achieve the objectives within the scope, TCT-St. Louis performed a records review, which included visiting several repositories of information, telephone and in-person interviews, and a site visit.

##### **1.1.2 Information Sources**

Several agencies/people, thought to have knowledge about the former BHAD, were contacted. Records were reviewed and/or obtained from several repositories of information. Of the places visited, the following maintained the most important or pertinent information: National Archives in Suitland, Maryland and Washington, DC; Aberdeen Proving Grounds in Aberdeen, Maryland; U.S. Army Environmental Hygiene Agency, Aberdeen, Maryland; U.S. Government Records Center in St. Louis, Missouri; Omaha District Corps of Engineers, Omaha, Nebraska; Huntsville Division Corps of Engineers, Huntsville, Alabama; and General Services Administration in Washington, DC and Denver, Colorado.

Information concerning the current land ownership, demographics, topography, geology, and soils and vegetation was obtained. Aerial photographs were also obtained and reviewed. A bibliography of the information sources was compiled and is included at the end of the report.

## **1.2 Site Characteristics**

### **1.2.1 Physiography, Geology, Hydrology, Soils, Topography, Vegetation**

The former BHAD lies on the northern edge of the Pierre Hills Division of the Great Plains [BHADM-5]. The Pierre Hills is characterized by gently to steeply sloping topography dissected by ephemeral streams [BHAD-96,115]. The geology of the area is characterized by a thick sequence of gently dipping Mesozoic and Paleozoic sedimentary rocks [BHAD-025,096,115].

Due to the ephemeral nature of streams in the area, groundwater is the primary source of water at the former BHAD. Small stock ponds and reservoirs provide limited water to livestock [BHADM-6,7]. Drinking water at the depot is provided by two deep wells (3,885 and 4,000 feet below the surface) which were installed at the BHAD in 1942. Both wells penetrate the Madison Aquifer [BHAD-1,21,25,19,120]. Other water-bearing units which provide water to the surrounding area include the Quaternary Deposits, Fall River Formation, Lakota Formation, and the Sundance Formation; however, the water is generally high in dissolved solids [BHAD-8,9,115,117].

Soil development at the BHAD is limited due to the semi-arid environment and the presence of shale at the surface. Soils consist primarily of clay, clay loam, and silty clay loam [BHAD-46]. Terrain features gently undulating hills to highly dissected hills with steep ravines. A prominent ridge is present on the southern edge of the BHAD. Elevations may differ as much as 500 feet from north to south across the depot [BHAD-6,7]. Vegetation at the site is characteristic of the prairie environment and includes wheat grass, yellow sweetclover, salt grass, and buffalo grass. In many areas, however, vegetation is naturally limited due to climate, terrain and the geology [BHAD-141].

### **1.2.2 Demographics**

The former BHAD is located in a very rural and sparsely populated area. Edgemont (population 906) is located 8 miles northeast and Provo (population 32) is located 1.5 miles southeast [BHAD-121]. Presently, six families reside within the confines of the former BHAD [BHAD-128].

### **1.3 Site Ownership and Land Use**

#### **1.3.1 Prior to Government Lease**

The site for the former Black Hills Army Depot was selected in 1941 [BHAD-14]. Property at the former BHAD was acquired through purchase and/or condemnation proceedings [BHAD-65]. Prior to government acquisition, land use consisted entirely of ranching and homesteading [BHAD-46,122]. A total of 29 parcels were obtained from private owners, the Department of Agriculture, the State of South Dakota, and Fall River County [BHADM-003,65].

#### **1.3.2 Depot Operation**

The facility was constructed as a reserve depot in 1942 and designated the Black Hills Ordnance Depot [BHAD-91]. The depot was owned and operated by the U.S. Ordnance Department and provided for the maintenance, storage, renovation and demilitarization of ordnance, ordnance components and bulk explosives containing high explosive, incendiary or chemical fillers [BHAD-6,34,46,65]. In 1962, the Black Hills Ordnance Depot was renamed the Black Hills Army Depot [BHAD-091]. The facility continued to operate until its closure in 1967.

#### **1.3.3 Post Depot Land Use**

In 1967, the 21,095 acres comprising the former BHAD were transferred to the General Services Administration (GSA) [BHAD-12]. Acreage (approximately 15,000 acres) within the fenced perimeter was sold to the City of Edgemont, South Dakota in 1968 and the remaining 6,000 acres were transferred to the U.S. Forestry Service [BHAD-12]. Land use restrictions were attached to parcels containing the burning grounds and the Chemical Area [BHADM-001, BHAD-001,042].

#### **1.3.4 Current Ownership Property**

Land within the former fenced perimeter of the BHAD is currently owned by FHT, Inc., Fall River Properties, Burton Hutton, Eugene Erickson and six families residing within the Igloo subdivision [BHADM-010,012]. The U.S. Forestry Services owns the remainder of the property located outside the fenced area [BHADM-011]. Grazing is the primary land use [BHAD-119,141].

Fall River Properties is investigating the potential use of some of its property as a landfill for incinerator ash and the State of South Dakota is contemplating development of the reservoir at the former BHAD and extension of water lines in the area [BHAD-014,115].

## 1.4 Site Operations

### 1.4.1 Facility Operations

The former BHAD was constructed as a reserve depot whose primary objective was to receive, store, maintain, demilitarize, and issue conventional and chemical ordnance [BHAD-001,050,065,075]. In addition to ordnance facilities, the depot also consisted of numerous support facilities including: administrative area, residential areas, school and hospital facilities, mobilization area, utilities area, vehicle classification area, general storage area, and an airfield [BHADM-001].

Water was obtained from two deep wells located in the northeastern part of the depot [BHAD-001,065]. A sewage treatment plant and sanitary landfill were located near the wells north of the residential area [BHAD-001,065, BHADM-001]. An additional landfill for nonsalvageable items was located near the Combat Equipment Storage Area [BHAD-114]. \*

### 1.4.2 Ordnance Operations

1.4.2.1 Types and Quantities of Ordnance - The purpose of the BHAD was to store renovate, destroy and ship varying types of ordnance, bulk explosives and ordnance components [BHAD-001,065]. During the 22 years of the facilities operation, the depot handled considerable types and amounts of ordnance including small arms, conventional ammunition, bombs, grenades, mines, rockets, ammunition components, bulk explosives and chemical toxics. Ordnance contained high explosive, incendiary, chemical or nerve agent (storage only) filler. Millions of tons of ordnance and bulk explosives passed through the depot during its existence [BHAD-036,040,042,043,071,073,074,075,076,081,082,083].

1.4.2.2 Storage, Renovation, and Destruction of Ammunition - Ordnance activities were conducted at 10 separate locations identified by specific numbers or letters. Areas associated with the storage of ammunition included Igloo Blocks A-H and J, the Combat Material Area (1800 and 2000 Area), the outdoor storage pads (X Area), and the Chemical Warfare Area (6000 Area). Facilities designed for the renovation, repacking and demilitarization of ordnance included the Disassembly Plant (4000 Area), Ammunition Work Shop (3000 Area), Ammunition Bundle Packing Area (4000 Area), and the Ammunition Normal Maintenance Area (8000 Area) [BHADM-008, BHAD-001]. Burning Grounds 1, 2 (5000 Area), and 3 (X Area), and the deactivation furnace provided for the detonation or burn-out of surplus, old or off-specification ordnance, ordnance components or bulk explosives [BHAD-001,125,126]. The Chemical Plant and Chemical Burning Pit (6000 Area) were designed for the disassembly and disposal of chemicals and/or chemical weapons [BHAD-001,053,137].

## 1.5 Accidents

Accidents involving fires, explosions, or spills of UXO or OEW were infrequent at the BHAD [BHAD-125,126,135]. However, several explosions did occur involving white phosphorous, grenades, and ordnance components [BHAD-046,114,125,136]. One spill of bulk explosives occurred as a result of a traffic accidents [BHAD-114].

## 1.6 Closure and Decontamination

Decontamination was conducted in 1966 according to Standard Operating Procedures developed by the facility. In general, the grounds and structures were inspected, tested, washed, and rinsed. Passible areas within burning grounds were surface cleared. Burning pits, demolition trenches, and leaching pits were flashed and covered over with earthen materials [BHAD-001,053].

All areas were decontaminated to the "most reasonable degree" with consideration of the applicable land restrictions. The 1967 Statement of Clearance designated six restricted areas which included: Burning Ground 1 (non-use); Burning Ground 2 (non-use); Burning Ground 3 (surface use only); Tracer Test Range (non-use); Chemical Plant (non-use); and the Chemical Burning Pit (non-use) [BHAD-001].

## 1.7 Potential Presence of UXO

Since closure of the facility, no accidents involving UXO have been reported at the BHAD. However, a number of UXO have been recovered from the site by local residents collecting memorabilia [BHAD-119,127,128,129]. Items have included a practice rocket, 155 mm smoke shell, 75 mm anti-personnel rounds, incendiary bomb shell, and miscellaneous small arms ammunition. Some of the items were destroyed by an ordnance detachment shortly after TCT-St. Louis' site visit [BHAD-142].

Due to a number of complaints from a local resident pertaining to buried mustard gas bombs, a team of experts from Edgewood Arsenal visited the site twice in 1971. Air, soil, and shell fragments at Burning Ground 2 were sampled for the presence of mustard. Results were negative for all media sampled [BHAD-001,031,054]. Decontamination documents do, however, indicate the possible presence of a mustard-filled drain line in the subsurface near the former Chemical Plant [BHAD-053].

With the exception of the presence of large denuded areas, no surface evidence of UXO was encountered by TCT-St. Louis at the Chemical Area. The Chemical Burning Pit was fenced and posted as a non-use area; however, the remainder of the site was unfenced and used as grazeland.

During the site visit, UXO was encountered at Burning Grounds 1 and 2, the Tracer Test Range, and the Bundle Ammunition Packing Area. Items found and destroyed by the ordnance detachment included shells, fuzes, boosters, bursters, bomb casings (with incendiary residue), and small arms ammunition. In general, the majority of the UXO were found on the steep slopes of ravines located adjacent to Burning Grounds 1 and 2. Small arms ammunition were found at the surface of the target berm at the Tracer Test Range. Shrapnel, bomb fragments, and other debris were encountered throughout Burning Grounds 1 and 2.

Aerial photos of both burning grounds indicate the presence of numerous trenches [BHADM-014,015,016]. Reportedly, these trenches were used for the burnout of chemical weapons [BHAD-125,126]. Twelve large detonation craters were also present at Burning Ground 2 [BHAD-053]. Both areas were fenced and restricted from any land use; however, the sites are currently not completely fenced and cattle graze throughout the site [BHAD-001,006].

Shrapnel, fuzes, bursters, and bomb fragments were sporadically present at Burning Ground 3. Munitions containing high explosives, ordnance components, bulk explosives, and missile fuel were disposed of at Burning Ground 3 [BHAD-114]. The area was designated for surface use only. During 1984, Chem-Nuclear conducted an investigation to determine the suitability of the area for disposal of low level nuclear waste.

Items such as spent igniter tubes and primers were encountered south of the Ammunition Workshop; however, no surface evidence of UXO or OEW was encountered at the remaining areas. Reportedly, explosive leaching beds and washout facilities were present at the Ammunition Workshop and vacuum systems for explosives were located at the Ammunition Workshop and Ammunition Normal Maintenance Area [BHAD-001,053, BHADM-001,013]. Currently, an area south of the Ammunition Normal Maintenance Area is being studied as a potential site of an incinerator ash landfill [BHAD-115].



## SECTION 2

### 2.0 INTRODUCTION

The Department of the Army is responsible for administration of the DERP. The objective of this program is to identify and remediate environmental problems related to the presence of hazardous or toxic waste, OEW, and/or unsafe and unsightly debris at facilities formerly owned and/or operated by the DOD.

The U.S. Army Corps of Engineers (COE), Huntsville Division, contracted with TCT-St. Louis (TCT) in May 1991 to assess former DOD sites for presence of ordnance and explosives contamination under Contract DACA-87-91-D-0037. In April 1992, TCT was requested to perform archives checks and site visits for three former DOD sites, including the former BHAD, under Delivery Order No. 1 of the Contract.

The former BHAD (prior to 1962 called Black Hills Ordnance Depot) was constructed in 1942 [BHAD-001,046,065]. It included approximately 21,095 acres, which had consisted of homesteads and rangeland for cattle and sheep prior to DOD occupation. The former depot was located 8 miles southwest of Edgemont, South Dakota in Fall River County, South Dakota [BHAD-006,007]. A site location map is presented in Figure 2-1.

The former BHAD was operated by the U.S. Army Ordnance Department as a reserve depot whose primary mission was to store, renovate, demilitarize, and destroy munitions [BHAD-001,015,017]. The types and quantities of ordnance present at the facility varied considerably and included small arms, conventional ammunition, bombs, grenades, mines, ammunition components, bulk explosives, and chemicals [BHAD-019,035,036,040,046,053]. Munitions contained either high explosive, incendiary, or chemical fillers. A general site map is presented in Figure 2-2.

Areas associated with the storage of ammunition included Igloo blocks A-H, and J, the Outdoor Storage Pads and the Chemical Warfare Area. Facilities designed for the renovation, repacking, and demilitarization of ordnance included the disassembly plant, Ammunition Workshop, Ammunition Normal Maintenance Area, and the Bundle Packaging Area [BHADM-008, BHAD-001]. Burning Grounds 1 and 2 and the deactivation furnace provided for the detonation or "burn-out" of "unsafe, obsolete, and surplus ammunition, ammunition components, and chemical toxics" [BHAD-001]. In the late 1950's, Burning Ground 3 was constructed for the burning of bulk explosives, selected types of ammunition and ammunition components, and the disposal of corrosive and flammable missile fuel [BHAD-001,053,0114]. The Chemical Plant and Chemical Burning Pit were designed for the disassembly and disposal of chemicals and/or chemical weapons [BHAD-001,053,137].

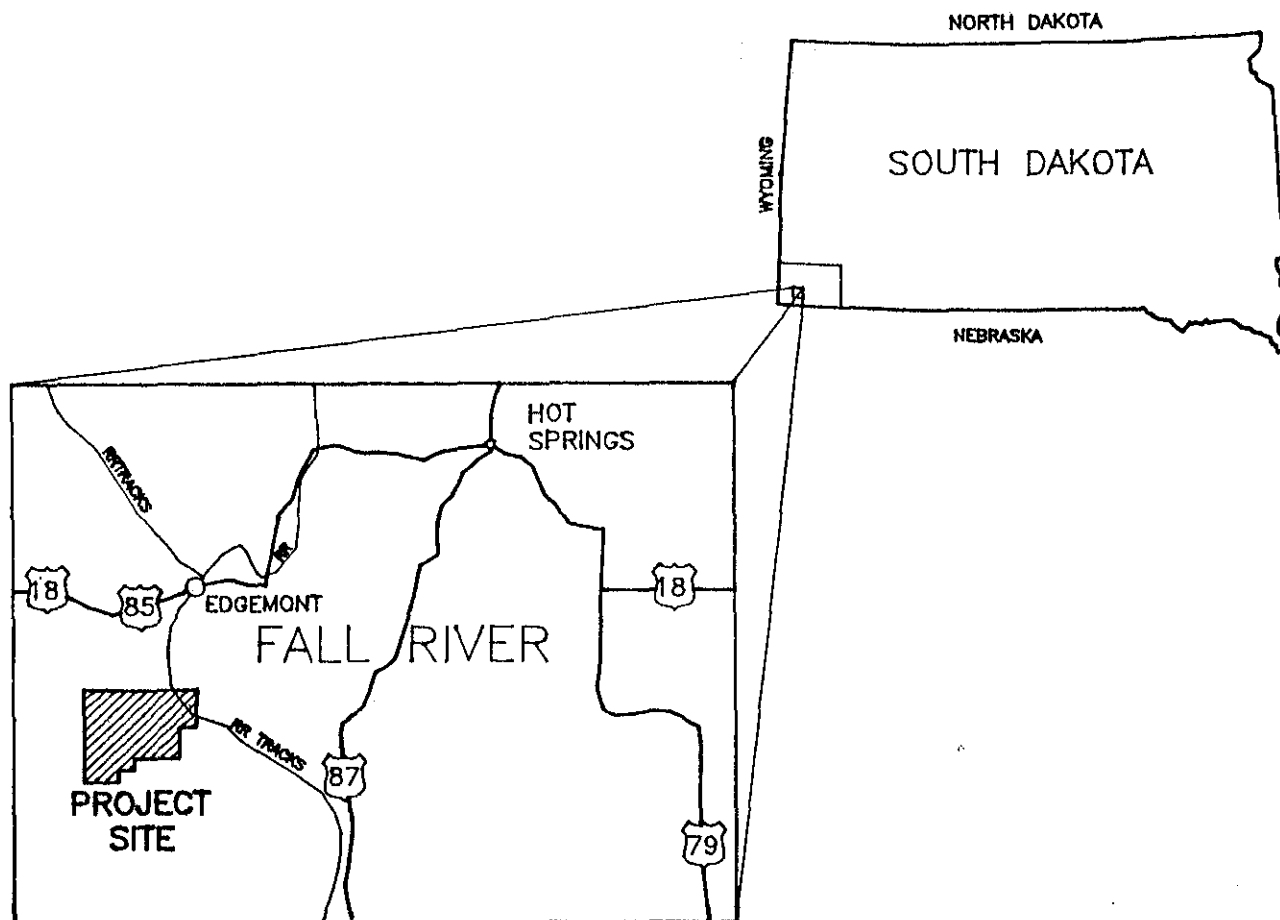


Figure 2-1

**TCT**

St. Louis

PROJECT LOCATION MAP  
FORMER BLACK HILLS ARMY DEPOT

Project No. 9222

By: *JS*

Chk'd By: *NMD*

Date: 8-11-92



The BHAD operated continuously as a depot from 1942 until its closure in June of 1967. [BHAD-046] During operation, portions of the property were leased for cattle and sheep grazing [BHAD-133]. In 1968, all land within the fenced area was sold to the City of Edgemont, South Dakota and land outside the fence, which included Burning Grounds 1 and 2 and the Chemical Burning Pit and Chemical Warfare Area, was transferred to the U.S. Forestry Service [BHAD-091]. Land use restrictions were included in the deeds for several parcels [BHAD-091].

Since 1968, the City of Edgemont has resold the land. Former BHAD property is currently owned by FHT Inc., Fall River Properties, Burton Hutton, and Eugene Erickson. A small residential area is also present in the northeast corner of the former depot. Current land use includes cattle grazing and salvage activities [BHADM-010,011,012, BHAD-119,120]. Studies have been conducted at the former BHAD to investigate development of the area as disposal sites for low level radioactive wastes and incinerator ash [BHAD-007,115]. In addition, the State of South Dakota is considering expanding water lines within the area [BHAD-014].

## **2.1 Project Objectives, Scope, and Approach**

As required by the Scope of Work, a separate Archives Search Report is required for each of the three project sites. No master planning documents were found during the records search.

The objective of this Archives Search was to obtain, review, and evaluate historical records related to the potential presence of any OEW that may exist on the former Black Hills Army Depot property. The Archives Search also includes a description of the site-specific geology and demographics. In addition, the significance of a potential explosive accident at the former BHAD property was assessed. The RAC, presented under separate cover, contains the results of the evaluation of safety hazards at the site.

The Scope of this project was limited to a records search and site visit (for the purpose of completing the records review and interviewing the local populace). The Scope specifically excluded accessing or recovering any UXO which might be present. (TCT and its subcontractor, UXB International, voluntarily performed random metal detector searches of portions of the property to supplement the records search and site visit). In order to achieve the objectives of the scope, TCT performed a records review which included visiting several repositories of information, telephone and in-person interviews, and the site visit.

## **2.2 Information Sources**

Numerous information sources, thought to have knowledge about the former BHAD, were contacted by telephone, written correspondence, or personal visit. These information sources and results of information requests are summarized in Table 2-1.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

Organization	Contact Date(s)	Contact Name	Results	Status
U.S. Department of Agriculture ASCS 2222 W. 2300 S. Salt Lake City, Utah 84130 (801) 524-5856	Tele. - 5/4/92 Written - 5/4/92 (Fed. Ex.) 5/20 request additional coverage, Fed. Ex. Tele. 5/22/92, 6/2/92	Customer Service	Requested availability and cost of aerial photos of all three sites. Our order number is D-1 82692 (in Linda McDonald's office).	Received aerial photo 6/24/92.
U.S. Army Corps Post Office Box 1600 Huntsville, Alabama (205) 955-5482	Tele. - 4/21/92 Tele. - 5/26/92	Mr. Bob Britton	Requested project materials. Additional sources provided to CEHND by Susan Henderson.	Materials received 4/27/92. Sent back originals 5/7/92.
Kansas City District Corps 700 Federal Building CEMRK-ED-D 601 East 12th Street Kansas City, Missouri 64106-2891 (816) 426-3010	Letter 5/5/92 Tele. 5/5/92 Tele. 5/7/92 Tele. 5/18/92 Tele. 6/5/92	Mr. Dan Ahern	Send letter requesting information on Ft. Crowder.  He suggested additional contacts (Gamma and Holmes).	Sent letter. On 5/7 he called and said he was sending information. Received information on 5/11/92.  Ahern attended site visit on 6/23/92. He stated he was not aware of basis for suspecting OEW contamination at 20-acre site.
Defense Explosive Safety Board 2461 Eisenhower Alexandria, Virginia (703) 325-0969	Tele. 5/5/92	Gene Clark	May have information on Black Hills.	Letter 5/6/92. No information provided to us.
Army Material Center (702) 325-0891	Tele. 5/5/92	Kim Holein	Referred to Regional Archives Center and National Archives and Reports	No further contact needed.
Central Plains Regional Archives (816) 926-6272	Tele. 5/5/92	Myrna Geselbracht	Referred to National Archives and Records	No further contact needed.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

Organization	Contact Date(s)	Contact Name	Results	Status
St. Louis District Corps of Engineers CE-LMS-PM-M 1222 Spruce St. Louis, Missouri 63101-2833 (314) 331-8036	Tele. 5/6/92 Letter 5/6/92  Tele. 5/18/92	Mike Dace/Sharon Cotner  Mike Dace	May have some information - will revise files. Send letter with information request. He researched files.	TCT received letter stating no information is available.
Omaha District Corps of Engineers CEMRO-ED-EC 215 N. 17th Street Omaha, Nebraska 68102-4978 (402) 221-7851	Tele. 5/6/92 Letter 5/6/92 Tele. 5/21/92 Tele. 5/26/92 Tele. 6/3/92	Linda Wagner	Sent letter. She will send all available reports, photos, e.g., Fred C. Hart report, Chem Nuclear report, real estate reports. Suggest call Jerry Smith (402) 221-4395 for further real estate information.	We received reports and photos. Visited District Office 6/24/92.
Savannah Army Depot Activity SDSLE-VA Savannah, Illinois 61074-9636 (815) 273-8827 (815) 273-6025 Fax	Tele. 5/6/92 Fax 5/6/92 Tele. 5/7/92	John Clarke Environmental Coordinator	Faxed letter requesting information. Clarke stated 75 and 155 mm projectiles containing mustard gas were shipped from Savanna Ordnance Depot to BHAD some time after WW II.	He will check for written documentation concerning mustard gas shipment. No response received.
Department of the Army Freedom of Information Office USA/SC-P (ASQNS-OP-F) Crystal Square #2 Suite 201 1725 Jefferson Davis Highway Arlington, Virginia 22202	Tele. 5/5/92 Tele. 5/12/92 Tele. 5/26/92	Edie Miley Norman Howard Steve Elldredge	Request permission to review records. Had received letter. Letter for WNRC will be sent out one week before due at WNRC. Date set as 6/15/92.	Letter sent 5/5/92. Fax sent 5/12/92. Letter for NRC received 5/18/92.
U.S. Army Defense Ammunition Center & School Attn: SMCAC-DO Savanna, Illinois 61074-9639 (815) 273-8901 (Byrd) (815) 273-8801 (Colberg)	Tele/ 5/6/92 Letter 5/6/92  Letter 5/14/92  Tele. 5/19/92 Tele. 6/18/92	J. L. Byrd, Jr., Director Mel Colberg, Program Manager  Mel Colbert  Mel Colberg	Send letter requesting information. They have responded to many similar requests and have access to records related to ordnance. 5/14/92 letter requests prioritization of archives searches with Huntsville. We explained TCT can do literature review at Savanna.	Savanna has not provided any information.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

<b>Organization</b>	<b>Contact Date(s)</b>	<b>Contact Name</b>	<b>Results</b>	<b>Status</b>
U.S. Army Corps of Engineers Omaha District Omaha, Nebraska 68102-4978 (402) 221-4395	Tele. 5/6/92	Jerry Smith	They have real estate files. Will send site map.	Conducted a visit June 24, 1992.
GSA - FOIA Attn: Dick Stinson 18th and F Street Washington, DC 20405 (202) 501-2520 Fax (202) 501-2069 Phone	Tele. 5/5/92 Letter 5/6/92 Tele. 5/18/92 Tele. 5/20/92 Tele. 5/26/92 Tele. 6/1/92 Tele. 6/8/92	Gloria McDonald Dick Stinson Leslie Carrington (202) 208-0619	Send letter requesting information. Will prepare letter. Will send information on location of records. Does not have all information.  Leslie is locating access numbers for K.C. and Denver record centers	TCT conducted records reviews at K.C., Fort Worth, and Denver records repositories.
USATHAMA (301) 679-3338	Tele. 5/5/92	Rich Binns	Computer search while on phone - only documents #55 Igloo - BHAD #3270 Crowder - Ambient Air Quality	Request through Conrad Swann.
U.S. Army Military History Institute Carlisle Barracks, PA 17010 (717) 245-3152 (717) 245-4370 (Fax)	Tele. 5/5/92	Louise Arnold	Request for information. Can fax request.	Letter and fax sent 5/6/92. Received some information 5/20/92.
National Records Center 9700 Page Avenue St. Louis 63132 (314) 538-4216	Tele. 5/6/92 Tele. 5/21/92 Tele. 6/1/92	Bill Siebert	Request information. Need permission. Will interview records at NRC 6/9/92. Received letter from Grace Rowe.	Letter 5/6/92. Visit conducted June 9-10, 1992.
National Archives & Records Room 11 Washington, DC 20404 (202) 501-5395	Tele. 5/6/92 Tele. 5/26/92	Tab Lewis	Request information. Will call his office week of 6/15/92.	Letter and Fax 5/6/92. Visited office week of June 15, 1992.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

<b>Organization</b>	<b>Contact Date(s)</b>	<b>Contact Name</b>	<b>Results</b>	<b>Status</b>
Archives, Suitland (301) 763-7411	Tele. 5/6/92	Richard Boylan	Request information.	Letter 5/6/92. Letter received 6/1/92. Visited week of June 15, 1992.
AMCCOM Rock Island, IL (309) 782-1451	Tele. 5/6/92	Ralph Krippner	Request information - none - gave DESCOM and USADACS sources.	No further contact needed.
Huntsville COE (205) 922-5482	Tele. 5/6/92 Tele. 5/20/92	Jim Ferris	Ordnance Control Center information. OEW assessments based on current records, not site visit.	Contact as needed. Received information on M1 and M1A1 training kits.
543rd Ordnance (EODCT) Ft. Leonard Wood, MO 65473 (314) 596-6145	Tele. 5/6/92	Capt. Perez	Requested information.	Letter 5/7/92. Called 5/11/92.
548th Ordnance (EODCT) Presidio, CA 94129 (415) 561-4203	Tele. 5/6/92	Sgt. Slabodian	Request information. Told to call 53rd EOD.	Letter and Fax 5/7/92.
The Center of Military History SE Federal Center, Bldg. 159, Room 537 Washington, DC 20374-5088 (202) 475-2562	Tele. 5/6/92	Hannah Zeidlik	Received limited information 5/19/92.	No further contact needed.
Picatinney Arsenal U.S. Army ARDAC Building 1 (SMCAR-IND) Picatinny Arsenal, NJ 07806-5000 (201) 724-6365	Tele. 5/6/92	Peter Rowland Mr. Owens (Historian)	All records sent to National Archives.	Letter 5/7/92. Called TCT 5/15/92.  No further contact needed.
Ordnance Field Safety Office 11454 Highway 62 Charleston, IN 17111-9669 (812) 284-7915	Tele. 5/6/92	John Campbell	Request information.	Sent fax and letter 5/7/92. No information provided.



TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

Organization	Contact Date(s)	Contact Name	Results	Status
DESCOMM AMSDS-PA Chambersberg, PA 17201-4170 (717) 267-8655	Tele. 5/6/92		May have information on Black Hills.	Fax and letter 5/7/92. Response received 5/15/92. DESCOMM has no information on BHAD. Recommended Suitland, MD or Army Material Command.
Cartographic Branch (NNSC) National Archives Washington, DC 20408 (703) 756-6700	Tele. 5/7/92	Linda Cullember	Needs maps of locations and years of coverage desired. No coverage for BHAD.	No further contact required.
USATHAMA CETHA-IR-P Aberdeen Proving Ground, MD 21010-5401 (301) 671-1534	Tele. 5/7/92 (Conrad Swan)	Will get us microfiche 55.		Letter and Fax sent 5/7/92. No information provided.
South Dakota Department of Environment and Natural Resources Department of Water (605) 773-3754	Tele. 5/7/92	Garland Erbele		Returned call 5/8/92. Will send us quarterly sampling results.
South Dakota Department of Environment and Natural Resources CRCLA 523 E. Capital Pierre, SD 57501 (605) 773-4217	Tele. 5/7/92. Tele. 6/23/92	Leanne Smith	She will check and see what information is available. Well on site high in nitrates. Call geological surveyor for information on who is doing work.	Letter and Fax sent 5/8/92. Called 5/8/92. Said best information in USEPA report. May have an old list of land owners. No other information.
Edgemont Police Department (605) 662-7732	Tele. 5/7/92	Dispatcher	No information. BHAD just came under their jurisdiction.	No further contact needed.
Edgemont City Hall (605) 662-7422	Tele. 5/7/92 Tele. 5/26/92	Linda	Several contact names. Additional contacts.	No further contact needed.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

<b>Organization</b>	<b>Contact Date(s)</b>	<b>Contact Name</b>	<b>Results</b>	<b>Status</b>
South Dakota Department of Environment and Natural Resources Solid Waste (605) 773-3153	Tele. 5/7/92	Vonnie Callnemy	May have some old reports, will check and see what is available. May need to visit.	No information.
Former Mayor, Edgemont, SD Matt Brown Box 629 Edgemont, South Dakota 57735 (605) 662-7720	Tele. 5/7/92 Tele. 5/26/92 Tele. 6/1/92 Tele. 6/4/92	Matt Brown	Has a lot of information on BHAD from 1968 on. Will need to visit. Will set up for our visit week of 6/29/92. Has all keys. Merle Holloway from property owners will accompany us.	Interviewed 6/29/92-6/30/92.
Chem Nuclear 140 Stonridge Drive Columbia, South Carolina 29210 (803) 256-0450	Tele. 5/7/92	Regulatory Affairs	May be able to get report and additional information. Will not provide their report or additional information. Considered confidential.	Letter sent 5/7/92. Letter received 6/1/92.
U.S. Army Materiel Command Alexandria, Virginia (703) 274-9475	Tele. 5/8/92	Mr. McCargle	No information. Call Gary Abrisz, U.S. Army Tech Center, Savanna, Illinois.	No further contact required.
U.S. Army Armament, Munitions and Chemical Command (309) 782-2024	Tele. 5/8/92	Russ Hartwig	Not available. Will return call.	Waiting for call.
Local Engineer Edgemont, South Dakota (605) 662-7136	Tele. 5/11/92	Keith Anderson	For best geological information, call South Dakota School of Mines. Dr. Perry Rahn.	No further contact required.
Fireman (Chief) Edgemont, South Dakota (605) 662-7313	Tele. 5/11/92 Tele. 6/4/92 Tele. 6/5/92	Dave Henderson	Has maps etc.	Waiting for return call. Interviewed 6/29/92-7/2/92.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

Organization	Contact Date(s)	Contact Name	Results	Status
U.S. Forestry Service 201 North River Hot Springs, South Dakota 47747 (605) 745-4107	Tele. 5/11/92 Tele. 5/26/92	Bob Childress Bob Hodorf	May have information. Visit office 6/29/92. contact is Bob Hodorf.	Visited office 6/29/92.
U.S. Army Armament, Munitions and Chemical Command (309) 782-2024	Tele. 5/11/92	Russ Hartwig	No information.	Called and suggested source of information in surety office.
South Dakota Geological Survey (605) 677-5227	Tele. 5/12/92	Receptionist	Will send 1992 Publication List referred to Western Field Office	Call if need to order publications. Received publication list 5/14/92.
South Dakota Geological Survey and South Dakota Dept. of Environmental and Natural Resources Western Field Office (605) 394-2229	Tele. 5/12/92	Jim Martin	Will call back.	Foster Sawyer called 5/13/92. Has some geological and water resources information. Received information 5/92.
Fall River County Soil Conservation Service Hot Springs, South Dakota (605) 745-4113	Tele. 5/12/92 Tele. 5/26/92	Charlene Hillgrin	Will send out soil survey and see if anyone else has any information. Visit office 6/29/92.	Visited office 6/29/92.
Edgemont Herald Edgemont, South Dakota (605) 662-7201	Tele. 5/12/92 Tele. 5/26/92 Tele. 6/1/92	Barb Bryan	Has all old newspapers. Will visit her office 7/2/92.	Visit office while in town.
Fall River County Assessors Office Edgemont, South Dakota (605) 394-2229	Tele. 5/13/92 Tele. 5/26/92	Erma Welch	Has a 3' x 5' plot map. Cannot copy. Visit office 6/29/92.	Visited office 6/29/92.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

Organization	Contact Date(s)	Contact Name	Results	Status
Commander U.S. Army Environmental Hygiene Agency AHN HSHB-CI-I/Ms. Anders Building E 1570 Aberdeen Proving Grounds, Maryland 21010-5422 Tel. (410) 671-4408 Fax (410) 671-3665	Tele. 5/14/92 Tele. 5/18/92	Ms. Anders	She will see what information is available.	Letter faxed and sent 5/14/92. Information received 5/29/92.
Commander Pueblo Depot Activity SDSTE-PA/Darlene Dowd Pueblo, Colorado 81001-5000 (719) 549-4111 Public Information Office Fax (719) 549-4617	Tele. 5/14/92 Tele. 5/18/92 Tele. 6/1/92	Darlene Dowd	She will see what information or sources on BHAD she can find. No records at Pueblo. All transferred to Center for Military History, Washington. Military history should know where information is.	Letter faxed and sent 5/14/92. Call if can't find information. Letter received 5/29/92.
Center for Military History 3rd + M Street, SE Building 159 Washington, DC (202) 287-9000	Tele. 5/18/92	Terry Dougherty	They only have 3-D objects. Contact center for military history for unit histories. (202) 475-2514	If we furnish unit numbers, they can supply unit histories.
Hot Springs Star Edgemont Library (605) 662-7712 Fax (605) 662-6666	Call to our office 6/3/92. Tele. 6/4/92	Dave Nelson Patty Drellick	Wants interview. May have information.	Referenced to CEHND who were interviewed on 6/30/92. Visited 7/2/92.
Property Owner BHAD (605) 343-2475	Tele. 6/8/92 Tele. 6/12/92	Gene Erikson	Call. May have some information.	No further contact.
Area Rancher	Interviewed 6/29/92.	Bill Chaney	Limited information.	No further contact.
Salvager BHAD	Interviewed 6/30/92.	Merle Holloway Russ Anderson	Recorded pertinent information.	Call as needed.

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

<b>Organization</b>	<b>Contact Date(s)</b>	<b>Contact Name</b>	<b>Results</b>	<b>Status</b>
TSP and Property Owner (Consolidated Management) 600 Kansas Street Rapid City, SD (605) 343-6102	Tele. 6/23/92	Cheryl Kandaras (TSP) Bill Mitchell (Consolidated Management)	Geologic and water quality information.	Received information 6/29/92.
Hot Springs Historical Society (605) 745-4815	Tele. 7/2/92	Marshall Truax	Has igloo book.	Order if needed.
BHAD, Former Worker Provo, SD	Interviewed 7/1/92	Leonora Pedersen	More contacts.	Interviewed 7/1/92.
Former Worker BHAD Edgemont, SD	Interviewed 7/2/92	Woodie Markey	Information on demolition and nerve agent.	No further contact required.
Rancher at BHAD, Mayor, Edgemont, SD	Interviewed 7/2/92	Frank Manke	Information on BG #3	Interviewed 7/2/92.
Worked near Old Facility Don Jacobs Edgemont, SD 662-7994	Tele. 7/1/92	Don Jacobs	No information	Interviewed
Former Worker Provo, SD 662-7048	Tele. 7/1/92	Edward Heiser	No information	Interview 7/1/92
Former Demo Worker Igloo, SD	Interviewed 7/1/92	Frances Finkell	Pertinent information	Visited 7/2/92
Former BHAD Fireman Hot Springs, SD	Interviewed 7/2/92	Louis Rickard	Pertinent information	Visited 7/2/92
Former BHAD Army Ordnance (605) 574-2617	Tele. 7/4/92	James Rickard	Pertinent information	Call as needed

TABLE 2-1

**SUMMARY OF RECORD SEARCH INQUIRIES  
BLACK HILLS ARMY DEPOT**

<b>Organization</b>	<b>Contact Date(s)</b>	<b>Contact Name</b>	<b>Results</b>	<b>Status</b>
94th Ordnance Detachment Ft. Carson, CO (719) 579-4242	Tele. 7/17/92	Sgt. James Van Huss	Information about on-site detonation	Received information on 7/27/92.
EOD Detachment Ellsworth AFB Rapid City, SD (605) 685-2873	Tele. 7/20/92	Mr. Prosperi	Possible information on UXO at BHAD	No information on BHAD.
Hot Springs General Hospital Hot Springs, SD (605) 745-3159	Tele. 7/20/92		Would need specific names to determine if they have pertinent information available.	No further contact required.
Local Rancher Edgemont, South Dakota	Tele. 8/3/92	Dwight Lackey	Obtained information on salvage activities in the mid-70's.	No further contact required.
Local Rancher/Former Banker Rapid City, South Dakota	Tele. 8/3/92	Eugene Erickson	Obtained information about past and current owners.	Further contact may be needed.
Local Hunter/Former Worker Hot Springs, South Dakota	Tele. 7/30/92	William Bruce	Obtained information about chemical plant operation.	Further contact may be needed.

As a result of telephone or written inquiries and/or site visits, records, documents, or other information were obtained from the following records repositories, organizations, and individuals:

U.S. Army Corps of Engineers, Huntsville Division; and Kansas City and Omaha Districts; General Services Administration, Washington, DC, Kansas City, Denver, and Ft. Worth Records Center; U.S. Army National Personnel Records Center, St. Louis, MO; National Archives and Records Centers, Washington, DC, and Suitland, MD; United States Army Environmental Hygiene Agency, Aberdeen Proving Ground, MD; United States Army Toxic and Hazardous Material Agency (USATHAMA); Fall River County Agricultural Stabilization and Conservation Service; South Dakota Department of Natural Resources, Department of Water, and RCRA; Matt Brown; South Dakota School of Mines and Technology (Dr. Perry Rahn); Edgemont Fire Chief, Dave Henderson; U.S. Forestry Service; South Dakota Geological Survey, Western Field Office, (Foster Sawyer); Fall River County Soil Conservation Service; Edgemont Herald; Fall River County Assessors Office (Erma Welch); Merle Holloway; Russ Anderson; Marshall Truax; Leonora Pedersen; Woodie Markey; Frank Manke; Frances Finkel; Louis Rickard; James Rickard; Susan Henderson; 94th Ordnance Detachment, Ft. Carson, CO; EOD Detachment, Ellsworth, AFB, Rapid City, South Dakota; Bill Mitchell; Cheryl Kandevas; Eugene Erickson, and Dwight Lackey.

In addition to the surveys described above, TCT communicated in person or in writing with the following organizations or individuals who could provide no substantial information concerning presence of OEW or related subjects concerning Black Hills Army Depot:

Defense Explosive Safety Board, Alexandria VA; Corps of Engineers, St. Louis District; Savanna Army Depot Activity, IL; U.S. Army Defense Ammunition Center and School, Savanna, IL; U.S. Army AMCCOM, Rock Island, IL; 543rd and 63rd EODCT, Ft. Leonard Wood, MO; Office of Public Affairs, Pine Bluff Arsenal; Picatinney Arsenal, NJ; U.S. Army DESCOMM, Chambersberg, PA; U.S. Army Material Command, Alexandria, VA; Center for Military History, Washington, DC; Edgemont Police Department; Edgemont City Hall; Chem-Nuclear; Don Jacobs; Edward Heiser; Bill Chaney; Hot Springs General Hospital.

Topographic maps were ordered from the U.S. Geological Survey Mid-Continent Mapping Center in Rolla, Missouri. Aerial photos were ordered from the U.S. Department of Agriculture - ASCS in Salt Lake City, Utah and the National Archives Cartographic Branch in Alexandria, Virginia.

A list of references documenting information sources for the Archives Search is presented at the conclusion of this report.

TCT-St. Louis reviewed documents, files, publications, maps, and aerial photographs (1954, 1957, 1965, and 1971), and conducted interviews to assess former and current land ownership and use, and obtain information concerning OEW or UXO. If requested by the contracting

officer, copies of the documents will be provided and sent under separate cover. Copies of aerial photos and photographs are presented in a separate document entitled Photo Documentation.

A site visit of the former BHAD was conducted June 29 through July 3, 1992. The purpose of the visit was to gather additional information and observe current conditions at the site. The site visit was performed by Nancy Dickens and Kevin Klipsch of TCT-St. Louis who were accompanied in part by Bob Mentzer of UXB International and Huntsville Division Corps of Engineers personnel Bob Britton (Project Manager), Ken Crawford (Public Relations), and Randy King (Safety Office).



## SECTION 3

### **3.0 SITE CHARACTERIZATION**

#### **3.1 Project Location**

The former BHAD, owned and operated by the U.S. Ordnance Department from 1942 until 1967, is located approximately 8 miles southwest of Edgemont, South Dakota (Figure 2-1). As shown in Figure 2-2, the facility consists of 21,095.85 acres which occupy the western 5/6 of T10S, R2E and the eastern 1/6 of T10S, R1E of southwestern Fall River County, South Dakota [BHADM-006,007].

#### **3.2 Physiography**

The former Depot lies on the northern edge of the Pierre Hills Division of the Great Plains [BHADM-5]. The Cheyenne River, eight miles to the north, separates the Black Hills Division from the Pierre Hills Division. The Pierre Hills are characterized by gently sloping to steeply sloping topography dissected by ephemeral streams and channels. In the study area, erosional forces have created steep ravines, cutbanks, and outwashes [BHADM-004,006,007, BHAD-025,096,115].

#### **3.3 Geology**

Subsurface information, summarized in this section, is based primarily upon investigations conducted by the South Dakota Geological Survey, Johnson Environmental Concepts [BHAD-115] and researchers from the South Dakota School of Mines and Technology [BHAD-096,118].

The subsurface at the former BHAD consists of a sequence of folded Paleozoic and Mesozoic sedimentary rocks deposited prior to uplift of the Black Hills and structurally affected by the subsequent mountain-building episode. A series of anticlines extend in a southwesterly direction from the southern edge of the Black Hills. The Cottonwood Anticline cuts across the western portion of the project site. Strata dip gently (generally  $<1^{\circ}$ ) to the south and southeast throughout the majority of the site; however, in the extreme western portion of the site, the strata may dip to the west, southwest, and/or northwest along the western limb of the Cottonwood Anticline. Faulting is not common within the area, however, jointing patterns have been identified in some of the formations present in the subsurface [BHAD-025,115,117,118].

A generalized geologic map is presented in Figure 3-1. Beneath the project site, Paleozoic and Mesozoic shale, limestone, and sandstone approximately 4,000 feet thick overly a Precambrian basement consisting of igneous and metamorphic rocks [BHAD-008,025].



## LEGEND





-  Niobrara Fm.
-  Alluvium
-  Carlile Fm.
-  Pierre Shale

Figure 3-1

**TCT**  
St. Louis

GENERALIZED GEOLOGIC MAP  
FORMER BLACK HILLS ARMY DEPOT

Project No. 9222

By: *OPH*Chk'd By: *TL*

Date: 8-11-92

Surface deposits of windblown loess, alluvium, and terrace deposits consisting of sands, silts, and clays of Quaternary Age may be sporadically present in lowlands and drainageways present within the area. Average thickness varies considerably ranging from 1 to 30 feet thick [BHAD-096,115,117,118].

Three formations of Cretaceous Age are exposed at the surface at the project site. These include, from youngest to oldest, the Pierre Shale, the Niobrara Formation, and the Carlile Shale [BHAD-024,025,096,115,117].

The youngest Cretaceous unit exposed at the former BHAD is the Sharon Springs Member of the Pierre Shale (Cretaceous). This formation is present only on the southern periphery of the project site and consists of black fissile organic shale which weathers to chips. Beds of bentonite and zones containing concretions are commonly present throughout. Thickness of the unit ranges from 172 to 200 feet [BHAD-096,115,117].

The Niobrara Formation (Cretaceous) underlies the Pierre Shale. Surface exposures of this unit form the lowland throughout the central portion of the former Depot between the ridges of the Pierre Shale to the south and the Carlile Shale to the north. The Niobrara is composed of a gray calcareous and occasionally fossiliferous shale and/or chalk approximately 225 feet thick [BHAD-096,115,117].

The oldest Cretaceous unit exposed at the surface in the northern portion of the site is the Carlile Shale. The unit consists of a gray shale with concretions and thin sandstone lenses. In the area, thickness of the unit varies from 520 to 540 feet. Two sandy members of the Carlile Shale, the Turner Sand and the Wall Creek Sand, occur in the middle of the formation [BHAD-096,115,117,118].

Below the Carlile Shale are additional Cretaceous units, including from top to bottom, the Greenhorn Formation, Graneros Group, Fall River Formation, Lakota Formation, and Morrison Formation. The Greenhorn Formation is composed of thin bedded fossiliferous limestone approximately 50 feet thick. Underlying the Greenhorn is a sequence of gray shales and claystones which comprise the Graneros Group. Sandstone, limestone, and bentonite beds are occasionally present within the 860 foot thick unit. The sandy member within the Graneros, the New Castle Sand, is composed of thin sandstone 20 feet in thickness. The Fall River Formation underlies the Graneros Group, and consists of 30 to 165 feet of interbedded sandstone and carbonaceous shale. Below the Fall River is the Lakota Formation which consists of 100 feet of cross-bedded sandstone with sporadic coal beds at the base. The underlying Morrison Formation is composed of 150 feet of shale and thinly bedded limestone [BHAD-096,115,117].

Jurassic and Triassic units present below the Cretaceous formations include the Sundance (Jurassic) and Spearfish (Triassic) Formations. Estimated thicknesses of the units described below were obtained from a 1959 South Dakota Geologic Survey report which recorded the thickness of each unit based on the Igloo well borehole logs [BHAD-025]. Beneath the Cretaceous Morrison Formation is a 437 foot sequence of interbedded sandstones and shales comprising the Sundance Formation (Jurassic) [BHAD-025]. The underlying Spearfish

Formation of Triassic Age consists of 337 feet of shale, limestone, and evaporite (anhydrite and gypsum) [BHAD-025,117].

A Paleozoic series of sedimentary rocks are present beneath the above described units. The series ranges from Permian to Mississippian in age and consists, in descending order, of the Minnekahta Limestone (Permian), Opeche Formation (Permian-Pennsylvanian), Minnelusa Formation (Pennsylvanian), and Pahasapa Formation (Mississippian). The Minnekahta Limestone consists of crystalline limestone approximately 54 feet thick. Below the limestone, the Opeche Formation is comprised of approximately 137 feet of interbedded sandstones and purple shales. Underlying the Opeche, is a very thick sequence of sandstones, thin beds of limestone, shales, and evaporite deposits of the Minnelusa Formation which varies in thickness from 755 to 1,040 feet. The basal sedimentary unit present at the former BHAD is the Pahasapa Formation which consists of 310 feet of limestone and dolomite. The upper 100 feet of this unit is highly fractured and cavernous. Less than 20 feet of the Deadwood Formation may underlie the Pahasapa Formation at some locations of the project site [BHAD-025,096,115,117].

Beneath the above described sedimentary units, is a Precambrian crystalline basement consisting of granites, schists, and quartzite.

### 3.4 Surface Hydrology

Surface water at the project site is provided primarily by ephemeral creeks which flow northerly toward the Cheyenne River or easterly toward Coal Creek. A topographic map showing surface water features is shown in Figure 3-2. Cottonwood Creek drains the northwestern corner of the former BHAD and flows northerly to the Cheyenne River. Alum Creek and Buck Draw drain the southwestern portions of the site and flow toward Cottonwood Creek. The eastern half of the former depot is drained by Softwater Creek which flows toward Coal Creek. Hay Draw, a tributary of Coal Creek, is present on the southern perimeter of the project site and drains the area comprising Burning Ground 2 [BHADM-6,7].

A number of man-made water bodies shown in Figure 3-2 are present at the former depot and provide water to grazing livestock. Within the site boundaries, two man-made reservoirs are present along Soft Water Creek and one along Hay Draw. Additionally, a larger reservoir (17 acres) is located near the main entrance to the former facility. The State of South Dakota plans to develop one of the larger reservoirs and extend new water supply pipelines throughout the area [BHAD-014]. Numerous small stock ponds (less than 250 feet<sup>2</sup>) have been created in low areas of ephemeral drainageways. A number of these ponds and reservoirs were dry during the walkover survey [BHADM-006,007]. Surface water samples collected from the reservoir in the center of the BHAD in 1981 by USEPA did not indicate the presence of any contaminants [BHAD-009]. Analytical results for samples collected by Johnson Environmental Concepts in 1991 indicated poor water quality high in dissolved solids and deficient in oxygen [BHAD-115]. Nitroaromatics were not included in the analytical parameters.

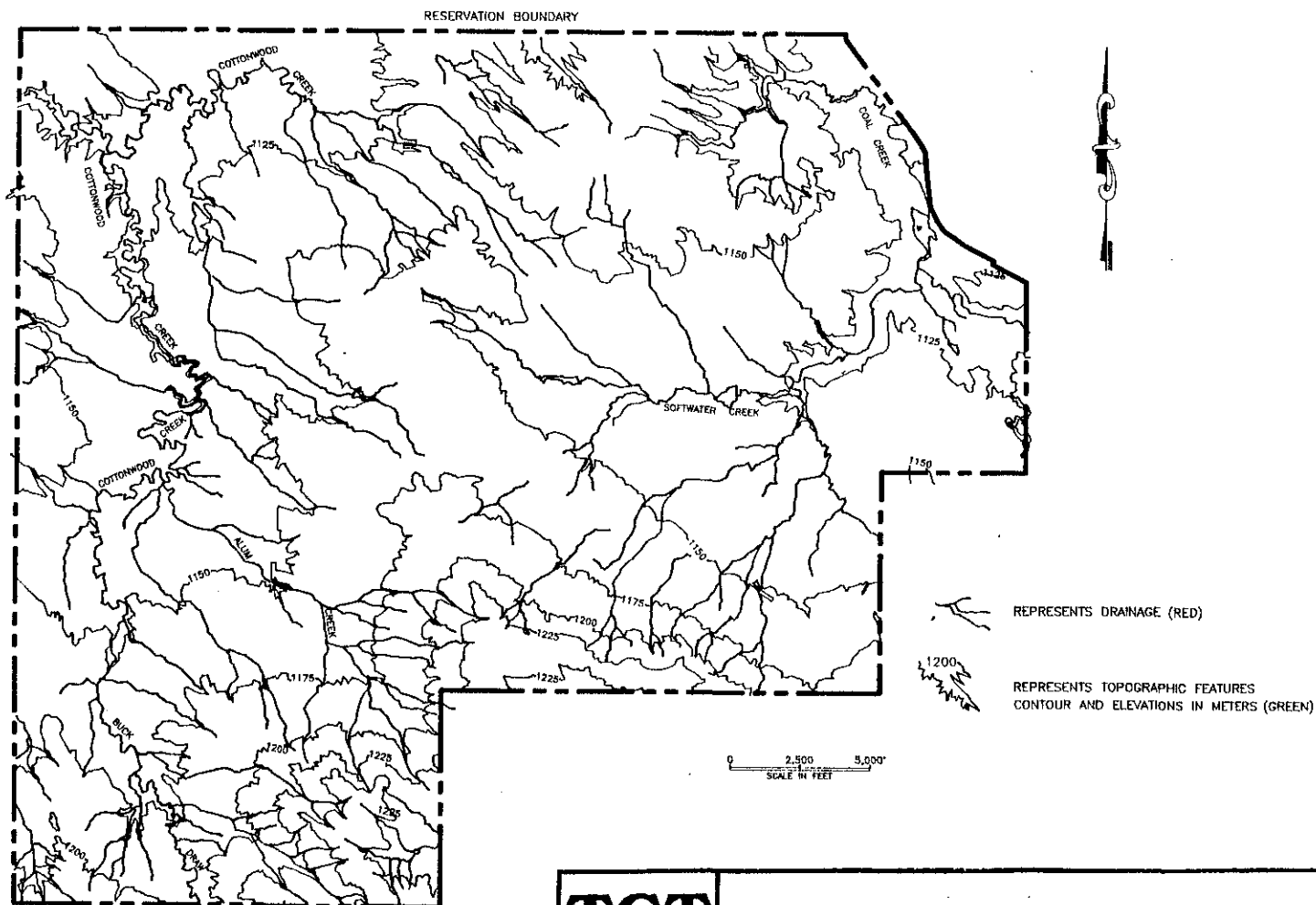


Figure 3-2

**TCT**  
St. Louis

TOPOGRAPHIC AND DRAINAGE FEATURES  
FORMER BLACK HILLS ARMY DEPOT

Project No. 9222

By: *[Signature]*

Chk'd By: *KC Kapsch*

Date: 10-9-92

### **3.5 Hydrogeology**

Water bearing units within the vicinity of the former BHAD which constitute usable aquifers include the Quaternary Deposits, Fall River Formation, Lakota Formation, Sundance Formation, and the Madison Formation of the Pahasapa Limestone [BHAD-008,009,006,115,117]. A table summarizing the water producing wells within a 55-mile radius of the site is presented in Appendix B [BHAD-117]. Wells which tap the above aquifers, with the exception of the Quaternary Deposits are generally artesian. Direction of flow within all but the Quaternary aquifer is down dip resulting in a south or southeasterly flow throughout most of the depot.

In the far western portion of the site where the western flank of the Cottonwood Anticline may be present in the subsurface, flow may vary from southwest to west to northwest. Flow within the Quaternary water bearing zones is governed by the local topography [BHAD-096,115,117].

Water bearing zones of the Quaternary Alluvial deposits are generally associated with the floodplains of the Cheyenne River and Cottonwood Creek. Depth to water varies from 8 to 59 feet below the surface. Reportedly, water obtained from this unit is high in dissolved solids (calcium, magnesium, and sulfate). Wells which penetrate this unit provide water for domestic and livestock uses [BHAD-096,115,117,118].

The majority of the wells in Fall River County tap the Fall River Formation. In the vicinity of the BHAD, depth to the aquifer is estimated to be 1,100 feet below the surface. Water provided is reported to be high in dissolved solids but is generally potable for human and livestock consumption [BHAD-008,096,115,117].

The Lakota Formation provides a highly productive aquifer. Depth to the water bearing unit is approximately 1,300 feet below the surface. Water quality, however, is similar to that observed for the Fall River Formation [BHAD-115,117].

Water producing wells near the Town of Provo penetrate the Sundance Formation. Water quality may be poor due to the presence of dissolved solids, iron, and sodium [BHAD-115].

The fractures and cavernous nature of the Madison Aquifer of the Pahasapa Limestone creates high porosity and permeability resulting in an extremely high water bearing capacity. Depth to the aquifer is approximately 3,500 feet and generally precludes extensive development for water production in the area [BHAD-008,025,096,115,117].

Water provided to residents of Edgemont and Igloo is obtained from wells which penetrate the Madison Aquifer. These wells are artesian and highly productive yielding from 150 to 250 gallons per minute (gpm). In general, water obtained from these wells has an average temperature of 125°F to 150°F and requires cooling prior to use [BHAD-001,021,119].

Two wells, installed at depths of 3,855 and 4,000 feet during construction of the BHAD, are currently in use. Records vary as to the precise depths of the wells [BHAD-001,

021,025,119,120]. The wells are owned by Fall River Properties and provide water to the residence of Igloo as well as grazers and owners of the former depot.

During the site visit, Well No. 2 was in use and actively pumping. Well No. 1 was not in use due to mechanical problems with the pump [BHAD-120]. Water quality is generally good but water from this aquifer often may contain elevated dissolved solids (sodium and bicarbonate). Analytical results from water samples collected from the Igloo wells during operation of the BHAD and results obtained recently from the South Dakota Department of Water and Natural Resources are presented in Appendix C [BHAD-021,052].

Recently, a well was installed south of Block H. Originally, the well was installed for oil exploration; however, due to associated problems local individuals planned to use the well for water supply. [BHAD-119] Analytical results, however, indicated the presence of gross alpha and beta above drinking water standards established by the USEPA. Uranium and other radioactive elements associated with uranium are naturally occurring in the area.[BHAD-127] Uranium deposits are located in the Edgemont Area. The depth and aquifer the well penetrates is unknown. Analytical results are presented in Appendix C [BHAD-044].

In addition to the primary aquifers described above, wells in the area also penetrate the Pierre Shale, Niobrara Formation, Carlile Shale (Turner Sand and Wall Creek Sand Members), and the Graneros Group (Newcastle Sand) [BHAD-025,096,115]. In general, these water bearing units produce limited and/or alkaline or sulfur rich water. Use is primarily limited to consumption by livestock and wells frequently run dry [BHAD-096,117].

Previous investigations conducted in the vicinity of the BHAD indicate the presence of semi-confined perched groundwater within the weathered shale and residuum of the Carlile Shale and Niobrara Formation [BHAD-008,015,096,]. These studies did not indicate the presence of water in the unweathered shale. Reportedly, weathered shale may extend to a depth of 100 feet [BHAD-008,096,115]. Direction of flow within the perched system follows local topography. Results of an investigation conducted in 1981 by Johnson Environmental Concepts, indicates that the shallow, perched groundwater contains high levels of dissolved solids (sulfate, chloride) [BHAD-115].

During the site visit, seeps or springs were not evident within the Carlile; however, seeps were observed in the Pierre Shale on the sides of ravines north of Burning Ground 2. A white flocculent was found in association with the seeps and may indicate the presence of dissolved solids or bacteria. Perched water within the Pierre Shale is most likely governed by the presence of unweathered shale similar to conditions reported above for the Carlile and Niobrara.

### **3.6 Topography**

Topographic and drainage features are shown in Figure 3-2. Elevations are presented in metric units which were derived from a 1982 USGS topographic map. The USGS map was the sole source available detailing the topography of the site. Units throughout the remainder of the report are presented in English units [BHADM-006,007].

Elevations within the former BHAD vary from 3,639 feet (1109m) above mean sea level (AMSL) on the eastern edge of the facility near the main gate to 4,190 feet AMSL (1277m) in the southwestern corner near Burning Ground 2. Higher elevations occur in southern portions of the site on the ridge formed by the Pierre Shale [BHAD-006,007].

### **3.7 Vegetation**

Based on observations during the walkover survey, the majority of the site is vegetated with grasses and herbaceous plants typical of the prairie environment such as wheat grass, yellow sweetclover, salt grass, buffalo grass, prickly pear, switchgrass, etc. [BHAD-141]. In some areas vegetation is naturally limited or absent due to lack of water, steep slopes, and/or the presence of shale or bentonite. Trees were not abundant and with the exception of one lone tree near Burning Ground 3, trees were only present near the former residential area in the northeastern portion of the site.

### **3.8 Soils**

Soils found at the former BHAD vary considerably. In general, soil development is somewhat limited (less than 60 inches) due to the semi-arid environment, lack of organic material and presence of shale at the surface. Mappable units are prone to desiccation and consist of friable calcareous clays and clay loams. Gypsum may be a frequent constituent of the soil profile. A soils map is presented in Figure 3-3 [BHAD-046].

Soils at the site consist primarily of the Minnequa, Manzanola, Kyle, and Pierre Series. Clays and clay loams belonging to the Arvada, Broadhurst, Lohmiller, and Steller Series are present in drainageways throughout the former depot, however, their aerial extent is extremely small. Additional soil types are sporadically present in upland areas as shown in Figure 3-3 [BHAD-046].

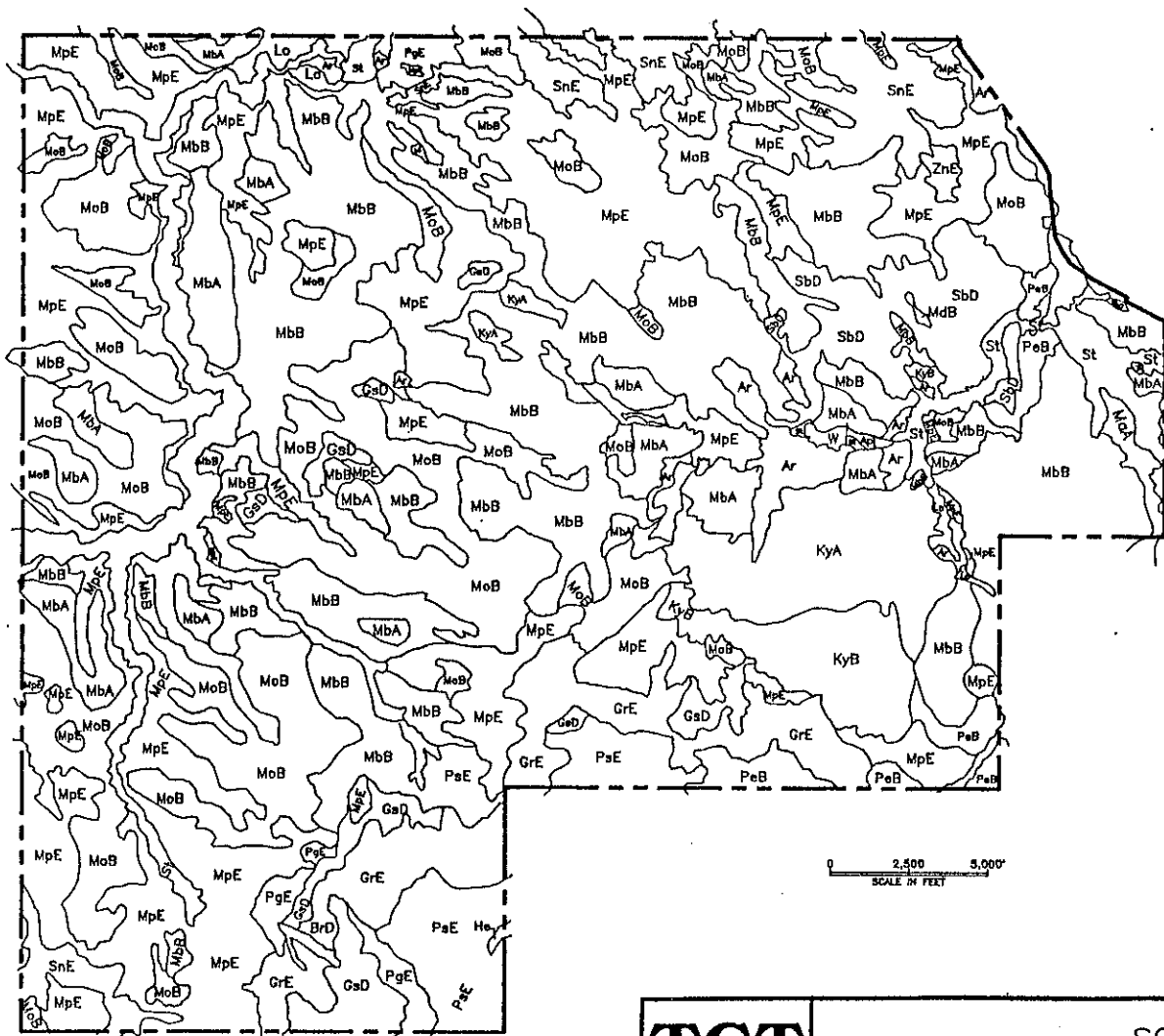
The Kyle Series, which is present primarily in the east central portion of the site, consists of a well drained calcareous clay approximately 50 to 60 inches deep. This soil type is prone to formation of desiccation cracks and has slow permeability. Slopes range from 0 to 6 percent [BHAD-046].

The Manzanola Series is found throughout the former BHAD and consists of a well drained silty clay or silty clay loam 25 to 60 inches deep. Permeability is moderately slow and slopes range from 0 to 6 percent [BHAD-046].

The Minnequa Series is also present throughout the site and consists of a well drained calcareous silty clay loam 24 to 60 inches deep. Permeability is moderate and slopes range from 0 to 6 percent [BHAD-046].



3-9



Legend

- Ap Aqualls Series
- Ar Arvada Series (Clay loam)
- BrD Broadhurst Series (Clay)
- GrE Grummit Series (Clay)
- GaD Grummit Series (Clay)
- He Hisle Series (Clay)
- Ho Haven Series (Silt loam)
- KyA Kyle Series (Clay)
- KyB Kyle Series (Clay)
- MbA Manzanola Series (Silty clay and Clay loam)
- MbB Manzanola Series (Silty clay)
- MoB Minnequa Series (Silty clay loam)
- MpE Minnequa Series (Silty clay loam)
- PeB Pierre Series (Clay)
- PgE Pierre Series (Clay)
- PaE Pierre Series (Clay)
- SbD Samsil (Clay)
- SnE Shingle (Loam)
- St Stetter Series (Clay)
- ZnE Zigweid Series (Clay loam)

Figure 3-3

**TCT**  
St. Louis

SOILS MAP  
FORMER BLACK HILLS ARMY DEPOT

Project No. 9222

By: *OK*

Chk'd By: TL

Date: 8-11-92

The Pierre Series is present primarily in the southern portions of the site and consists of a well drained clay 34 to 60 inches deep. The soil is prone to formation of desiccation cracks. Permeability is very slow and slopes range from 2 to 25 percent [BHAD-046].

### **3.9 Demographics**

Fall River County has a population of 7,353. The nearest towns include: Edgemont (population 906) which is located eight miles northeast and Provo (population 32) which is located 1.5 miles southeast [BHAD-121]. The residential area of Igloo is located within the confines of the former BHAD. During operation of the depot this area housed officers assigned to the facility. Six families reside in the Igloo subdivision which is located in the northeast corner of the former facility [BHAD-128]. The subdivision is less than 1 mile (4,000 ft.) from Burning Ground 3.

## SECTION 4

### 4.0 SITE OWNERSHIP AND LAND USE

#### 4.1 Prior to Government Possession

The site for the former Black Hills Depot was selected late in 1941 [BHAD-034]. Prior to government acquisition of the land, the area was primarily used for grazing cattle and sheep [BHAD-130,129,125,133]. The land surface was poorly suited for agricultural activities due to the semi-arid conditions and the poor quality of the water. Homesteaders were sparse. The nearest village, Provo, was located approximately one mile to the east and had a population of only 20 people. This site was selected for the BHAD because of its remoteness from human habitation [BHAD-001,006,046].

The land obtained for the depot was acquired through the purchase of 29 parcels. The largest parcels were obtained from the Department of Agriculture (7,630.14 acres), and the Department of the Interior (1,095.32 acres). Additional public lands were purchased from the State of South Dakota (1,280 acres) and Fall River County (817.82 acres). The largest amount of acreage purchased from an individual land owner was obtained from Albert C. Soske (1,420.74 acres) [BHADM-003]. Table 4-1 lists the land owners prior to the existence of the depot. Figure 4-1 shows the location of the parcels. Numbers and letters displayed in Figure 4-1 correspond to the tract and parcel numbers shown in Table 4-1.

#### 4.2 Depot Operation

The facility was officially designated the Black Hills Ordnance Depot by General Orders No. 9, dated February 5, 1942 [BHAD-091]. The depot covered 21,095.85 acres of land consisting of the following:

- a. 12,370.05 acres of land acquired by the United States from private owners, primarily in fee, in 1942 and 1943 by direct purchase and/or condemnation proceedings.
- b. 1,095.32 acres of public domain lands reserved for military use by Executive Order 9526, dated February 28, 1945.
- c. 7,630.14 acres of land originally acquired by the Department of Agriculture under the Bankhead-Jones Farm Tenant Act which was transferred to the War Department by Executive Order 9197, dated July 9, 1942.
- d. 0.34 acre of lesser interests were acquired at no cost.

Construction began in the spring of 1942 and was completed in October of 1942; however, facility improvements were made throughout the depot's existence [BHADM-001, 008].

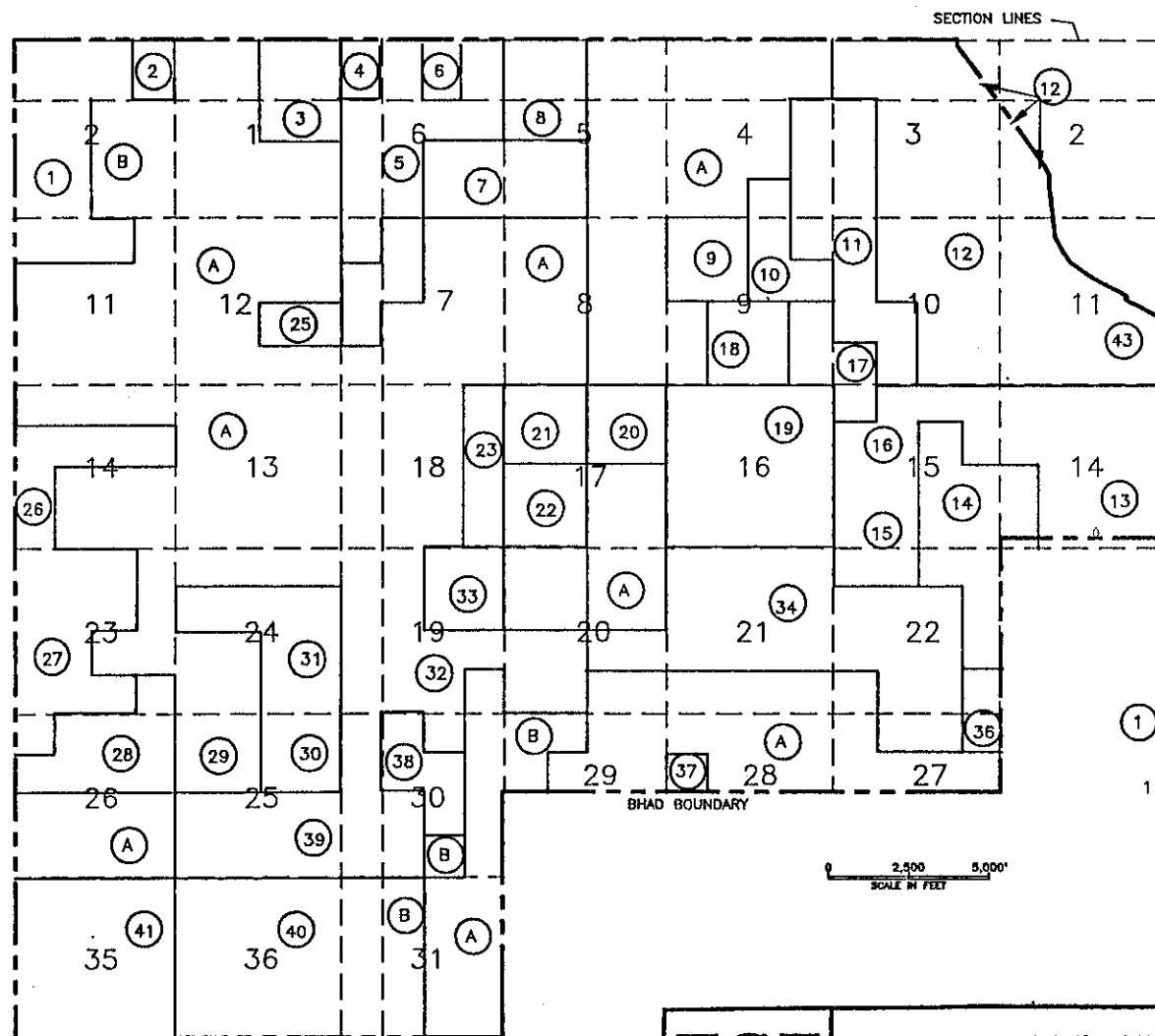
TABLE 4-1 PRIOR LAND OWNERSHIP				
Tract/Parcel No.	Land Owner	Acreage (Fee)	Acreage (Transferred)	Acreage (License)
A	Department of Agriculture		7630.14 <sup>1</sup>	
B	Department of Interior		1095.32 <sup>2</sup>	
1, 3	Preston L. Ellis	520.06		
2	Emma Ellis, Heirs	40.14		
4, 10, 24, 31, 38	Fall River County	817.82		
5, 21	Lucinda Johnson, Heirs	570.49		
6, 22	Arthur S. Johnson, Heirs	200.15		
7, 20	Jesse M. Johnson	480.00		
8, 23	Charles Johnson	320.37		
9	Emily McConkey Baldwin	160.00		
11	John W. Coates	480.00		
12, 37, 43	Albert C. Soske	1420.74		
13	Parkin Land & Livestock Co.	640.00		
14	Clarence K. Calland	360.00		
15, 16, 18	Fred Coates	640.00		
17	George L. Bales	160.00		
19, 40	State of South Dakota	1280.00		
25	Daniel J. Dierks, Heirs	80.00		
26	Grace Walters	320.00		
27	Katherine Nieman	400.00		
28, 41	Richard Pfister	960.00		
29	William Erschen	160.00		
30	Clifford A. & Joyce Wilson	160.00		
32	Federal Farm Mort. Co. (Philip J. Erschen)	499.72		
33	Edward F. Gainor	160.00		
34	Arthur D. Gow	960.00		
36	George Leslie Coates	80.00		

TABLE 4-1 PRIOR LAND OWNERSHIP				
Tract/Parcel No.	Land Owner	Acreage (Fee)	Acreage (Transferred)	Acreage (License)
39	Fred Kuntz, Estate	500.56		
44.L	Chicago, Burlington & Quincy Railroad			0.34 <sup>3</sup>
Totals		12,370.05	8,725.46	0.34

<sup>1</sup>Use permit dated 1-31-42, Executive Order 9197 dated 7-9-42.

<sup>2</sup>Public Land Order No. 10 dated 7-8-42.

<sup>3</sup>License for fence dated 3-24-43.



1 REFER TO TABLE 4-1 FOR  
CORRESPONDING PROPERTY  
OWNERS

1 SECTION NUMBERS

Figure 4-1

**TCT**  
St. Louis

OWNERSHIP PRIOR TO 1942  
FORMER BLACK HILLS ARMY DEPOT

Project No. 9222

By: *TL*

Chk'd By: *TL*

Date: 8-13-92

As constructed, the facility was to provide 1,500,000 square feet of space for long-term reserve storage of ammunition including storage of ammunition containing high explosive, chemical or nerve agent fillers [BHAD-034]. In addition to storage, the depot provided for the receipt, maintenance, inspection, testing, restoration, issuance, and shipment of ammunition, propellants, components of guided missile fuel, and chemical toxics; unpacking and functional packing of small arms ammunition; and the demilitarization of unsafe, obsolete and surplus ammunition, chemical ammunition, ammunition components, chemical toxics, general supplies [BHAD-006], and General Services Administration supplies [BHAD-035]. Workers inspected and tested the ordnance or packed, repacked, and inventoried ammunition, and disposed of any ammunition deemed unsafe or obsolete [BHAD-46].

Ammunition was stored in 802 igloo-type magazines, open storage sites between igloos, 12 standard magazines and miscellaneous outdoor storage areas. These storage facilities were located on 19,000 acres within the restricted portions of the depot [BHAD-034]. Access to the restricted areas was limited by security guards, fencing, gates, and lighting [BHAD-123]. The remaining 2,000 acres were set aside for administrative, residential, and general operational requirements.

Structures and buildings within the depot were either numbered, lettered, or alpha numerically labelled. Particular labeling was assigned to groups of buildings with a specific function and location. These included: Igloo Storage Magazines (Block A-H and J); the Combat Material Area (Area 1800 and 2000); Ammunition Workshop Area (Area 3000); Bundle Ammunition Packing Area (Area 4000); Burning Ground 2 (Area 5000); Chemical Plant and Chemical Warfare Area (Area 6000); bridges (Area 7000); Ammunition Normal Maintenance Area (Area 8000); Tracer Test Range (Area 9000); Outdoor Storage Area and Burning Ground 3 (X Area); and Burning Ground 1. Structures numbered 1700 and below identified administrative, residential, and general operational buildings [BHADM-001].

From 1948 until the 1960s, in addition to normal facility operations, grazing of cattle and sheep was permitted by lease on 14,615 acres of depot property. Livestock were not permitted within the burning grounds or the chemical area, but grazed throughout the remainder of the depot in order to limit potential grassland fires [BHAD-123]. Prior to 1958, ranchers grazing cattle and/or sheep at the depot included Porter, Hepner, Hudson, Barkley, and Trotter. After 1958, the Manke family grazed cattle and sheep on the east side of the depot and the Bones family leased grazing rights on the west side [BHAD-132,133].

In 1962, the Black Hills Ordnance Depot was renamed Black Hills Army Depot (BHAD) by General Orders No. 51, dated August 21, 1962 [BHAD-091]. By 1964 the depot stored more than 250,000 tons of ammunition in the 802 igloos. The facility included 504 buildings [BHAD-046].

In the early 1960s, DOD officials conducted a study of ammunition storage depots with the objective of reducing excess storage by consolidating facilities. As a part of this study, an inspection team visited the BHAD [BHAD-046]. On April 24, 1964 the Secretary of Defense announced the future closure of the BHAD to be phased out over a period of three years and closed by June 1967 [BHAD-123,114]. At 4:00 pm on June 30, 1967, the facility

was permanently closed and was transferred to the GSA. Twenty people remained as caretakers for a 15-month period [BHAD-046].

#### 4.3 Post Depot Ownership and Land Use

Shortly after the announcement of the depot's closing, the citizens of Edgemont, South Dakota considered purchasing the depot for development as an industrial park. Federal officials assisted with pertinent plans and publicity. They also arranged for a water study because they suspected that some of the reluctance of businesses to locate in the area was due to the poor water quality at the site [BHAD-053]. In 1967, the "Morrison Group", which consisted of five businessmen from Nebraska, Utah, South Dakota, Colorado, and Wyoming began investigating the possibility of developing the depot area. The group proposed to lease the site from the city with an option to buy within five years [BHAD-012]. At this same time, the U.S. Forestry Service requested all 21,000 acres of the depot for a grazing district [BHAD-123]. The Forestry Service stated it had held title to a portion of the area prior to the establishment of the depot, and as such, had an obligation to manage the land. According to the Forestry Service, regulations prohibited the use of land managed by the Department of Agriculture for industrial purposes [BHAD-123].

In 1968, GSA transferred a total of 5,700 acres to the Department of Agriculture (U.S. Forestry Service).

In November of 1968, GSA sold 15,355.51 acres to the City of Edgemont, South Dakota. GSA retained the title to the depot property until the city made its last payment in 1988. In the contract between GSA and the City, special provisions were included as follows:

- o 145 frame buildings were transferred to the Bureau of Indian Affairs.
- o GSA would hold the rights to the contents of Building X-115 and right-of-way for ingress and egress.
- o Edgemont would maintain the chapel and provide interdenominational services.
- o Edgemont would provide water to the town of Provo at reasonable rates through the depot water system [BHAD-123,091].

In addition, certain restrictions stated below were included:

*Purchaser specifically acknowledges that portions of the property are contaminated or may be contaminated from residual explosives and are restricted, fenced, and placarded. "Contaminated Area, surface use only, no digging." The purchaser for itself and assigns expressly acknowledges that these areas have been identified to it and that any use there of will be consistent with the restrictions imposed by the United States Army and that the use of these areas will be at its own risk. The Purchaser agrees that any successors in interest shall be required*



*to save harmless and indemnify the United States of and from any claims or demands of any type whatsoever arising out of use of the contaminated areas will be at its own risk. This indemnity shall extend to all costs, counsel fees, expenses and liabilities incurred in connection with the defense of any such claim, action of proceeding brought against the United States arising from, directly or indirectly, and in any manner incident to use of the contaminated area [BHAD-012-13].*

In 1968, the City of Edgemont, South Dakota, leased 11,362.00 acres to FHT, Inc. in the southern half of the depot. FHT, Inc. was a company based in Towner, Nebraska, owned by Hayden Thompson, Jerry Feverhelm and Burton Hutton. FHT, Inc., in turn, subleased the property to local ranchers for grazing privileges [BHAD-012,013].

In April, 1969, the 0.34 acre licensed to GSA from Quincy, Chicago, and Burlington Railroad Co. transferred back to the railroad [BHAD-012]. The following year GSA conveyed 2,995.5 acres in the eastern portion of the site to the City of Edgemont, South Dakota. The city in turn sold the property to Black Hills Industrial Freeport, Inc. (BHIF). BHIF was known to the local populace as "the Morrison Group". BHIF then sub-leased the same 2,995.5 acres to Texas Calf Palace for cattle operations [BHAD-012,013].

From 1971 until 1973, Perry Lackey operated a salvage operation at the former BHAD. The location of his operation is unknown. Brass igniter tubes and other metal ordnance items obtained from Burning Grounds 1 and 2 and the Surveillance Area were the primary source of salvageable items [BHAD-143].

Texas Calf Palace, known also as Beef Palace, operated a feed lot for cattle and sheep. It closed down in 1974. Marshall Caters purchased the 2,995.5 acres in the eastern portion of the former BHAD and attempted to run the feed lot known as Cheyenne Feeders. In 1988, Caters sold the land to Consolidated Management Corporation (CMC). CMC changed its name to Fall River Properties in 1992 and is the current owner of the property [BHAD-144].

In January of 1975, BHIF merged with a company known as Salt Flats Development Corporation [BHAD-012,013]. Later in 1975, the city leased to BHIF the three parcels of land purchased previously from Edgemont.

During this same time frame, GSA transferred to the Bureau of Indian Affairs 145 buildings [BHAD-012]. In the spring of 1978, the U.S. Forestry Service aerial seeded their property at the depot to help stimulate vegetation, growth, and control erosion [BHAD-119,130]. During this same period, BHIF (Salt Flats Development Corp.) sold six parcels totalling 1,202 acres in the northeastern portion of the site to Securities Industries, Inc. (SII) [BHAD-012,013]. One parcel consisted of the Normal Maintenance Area (the 8,000 Area) and the surrounding land [BHAD-012, BHADM-001].

In December 1978 and 1979, SII leased 95 acres in the eastern portion of the site to Unitram Corp. Unitram intended to operate an ash plant and ash burial site on the leased property. Unitram installed equipment, but failed to begin operation. Shortly thereafter, Unitram Corporation folded due to financial instability. SII retained title to the land [BHAD-130].

In December of 1983, the city sold to FHT, Inc., four separate tracts of land in the western half of the former BHAD which included 11,327 acres [BHAD-012,013]. In May of 1983, FHT, Inc. signed a contract with Chem-Nuclear, Inc. to lease (with the option to buy) 7,211.59 acres. Chem-Nuclear, Inc. planned to build a low-level radioactive waste disposal facility. A feasibility study was conducted at Burning Ground 3 by Chem-Nuclear in 1984. Following Chem-Nuclear's preliminary investigation of the use of the former depot, the State of South Dakota passed a law prohibiting any nuclear activities within the boundaries of the state. FHT, Inc. leased the remaining acres (former Burning Ground 3) to a hog operation and to ranchers for sheep and cattle grazing [BHAD-130].

In February of 1984, FHT, Inc. (Thompson as sole owner) won a lawsuit against Feuerhelm and Hutton and obtained the title to a total of 7,853 acres in the southern half of the site. At the same time, Hutton won in a lawsuit against Feuerhelm and Thompson and obtained title to 3,456 acres located in the northern half of the former BHAD [BHAD-012, 013].

With the death of Jerry Feuerhelm, the land purchased by FHT, Inc. was divided between Hutton and Thompson [BHAD-130]. Currently, both lease the land to ranchers for cattle grazing. Between 1988 to 1990, FHT, Inc. had leased igloos to the Federal Government to store wheat [BHAD-130].

In June of 1984, the Southern Hills Bank Corporation sold to Robert Valley 6.48 acres. Currently, Cora Height owns the 6.48 acres in the northeastern corner of the former BHAD and uses the land for residential purposes [BHAD-012,013,130]. In September of 1984, SII sold approximately 247.10 acres in Igloo Block J to Circle P Ranch. Circle P Ranch used the property, including igloos, for a hog operation. Circle P Ranch folded and Eugene Erickson, the owner, retained the property. Between 1984 and 1987, Erickson leased five igloos (Block J) to Space Ordnance Systems for the storage of munitions [BHAD-144]. The quantity and types of ordnance stored are unknown. Currently, the igloos and the land are not being utilized.

#### **4.4 Current Ownership and Land Use**

As shown in Figure 4-2, a number of businesses and/or individuals (with the exception of the Igloo subdivision) currently own property at the former BHAD. The acreage owned by each is listed below [BHADM-018].

Cora Height	6.48
Eugene Erickson	248.18
Consolidated Management Corp.	3,763.87
FHT, Inc.	7,853.17
Burton Hutton	347.52
Igloo Subdivision	8.60
Subtotal	15,355.51
Department of Agriculture	5,740.00
Quincy, Chicago, and Burlington Railroad	0.34
<b>Total</b>	<b>21,095.85</b>

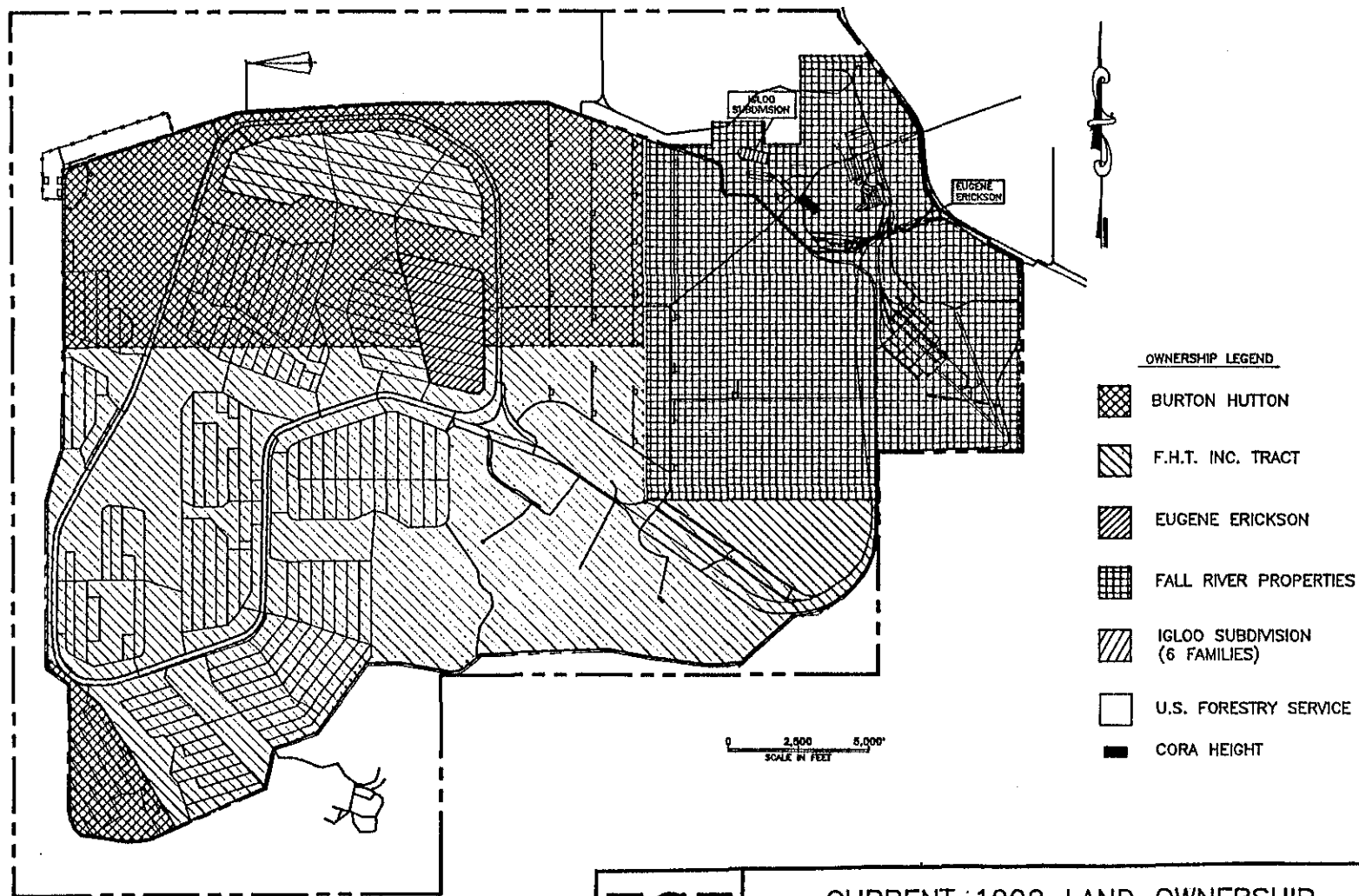


Figure 4-2

**TCT**  
St. Louis

CURRENT 1992 LAND OWNERSHIP  
FORMER BLACK HILLS ARMY DEPOT

Project No.	9222
By	<i>OK</i>
Chk'd By:	TL
Date:	8-13-92

The Igloo subdivision consists of 19 lots on Hanney Road. The lots are approximately 0.25 to 0.50 acres in size. During depot operations, these homes were the officers quarters [BHADM-001,128,125].

Currently, a single salvage operation exists as the only industrial operation at the former depot. Merle Holloway started the salvage operation in the spring of 1989. The primary land use at the former BHAD is cattle grazing [BHAD-130,129,128,133]. One rancher, LaVerne Buskohl, has Texas longhorns grazing alongside Rushmore Road near the water tanks [TCT,134]. Ranchers have leasing rights to graze cattle throughout most of the igloos and the eastern half of the former depot. No grazing was observed at Burning Ground-2; however, the U.S. Forestry Service has leased the area for grazing [BHAD-141].

## SECTION 5

### 5.0 SITE OPERATIONS

#### 5.1 Introduction

Information pertaining to operation of the former Black Hills Army Depot (BHAD) provided in this section is based upon information gathered during the extensive literature review and site visit, which included: aerial photos, interviews with landowners and former employees, site maps and drawings, and historical documents pertaining to the operation and use of ordnance at the BHAD.

A site visit of the former depot was conducted June 29 through July 3, 1992. The purpose of the visit was to gather additional information by obtaining documents and maps, conducting interviews and observing current conditions at the site. Selected photographs taken during the site visit which depict current conditions and copies of aerial photos are presented in a separate document entitled Photo Documentation. An archives search conducted by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA) is presented in Appendix D and a transcript of the interview with the former Demolition Foreman and BHAD Fire Chief is presented in Appendix E.

The site visit was performed by Nancy Dickens and Kevin Klipsch of TCT-St. Louis who were accompanied by Bob Mentzer of UXB International. Huntsville Division, Corps of Engineers representatives present during a portion of the visit included Bob Britton (Project Manager), Ken Crawford (Public Relations), and Randy King (Safety Office). A metal detector was used during the site visit to help define conditions at the site.

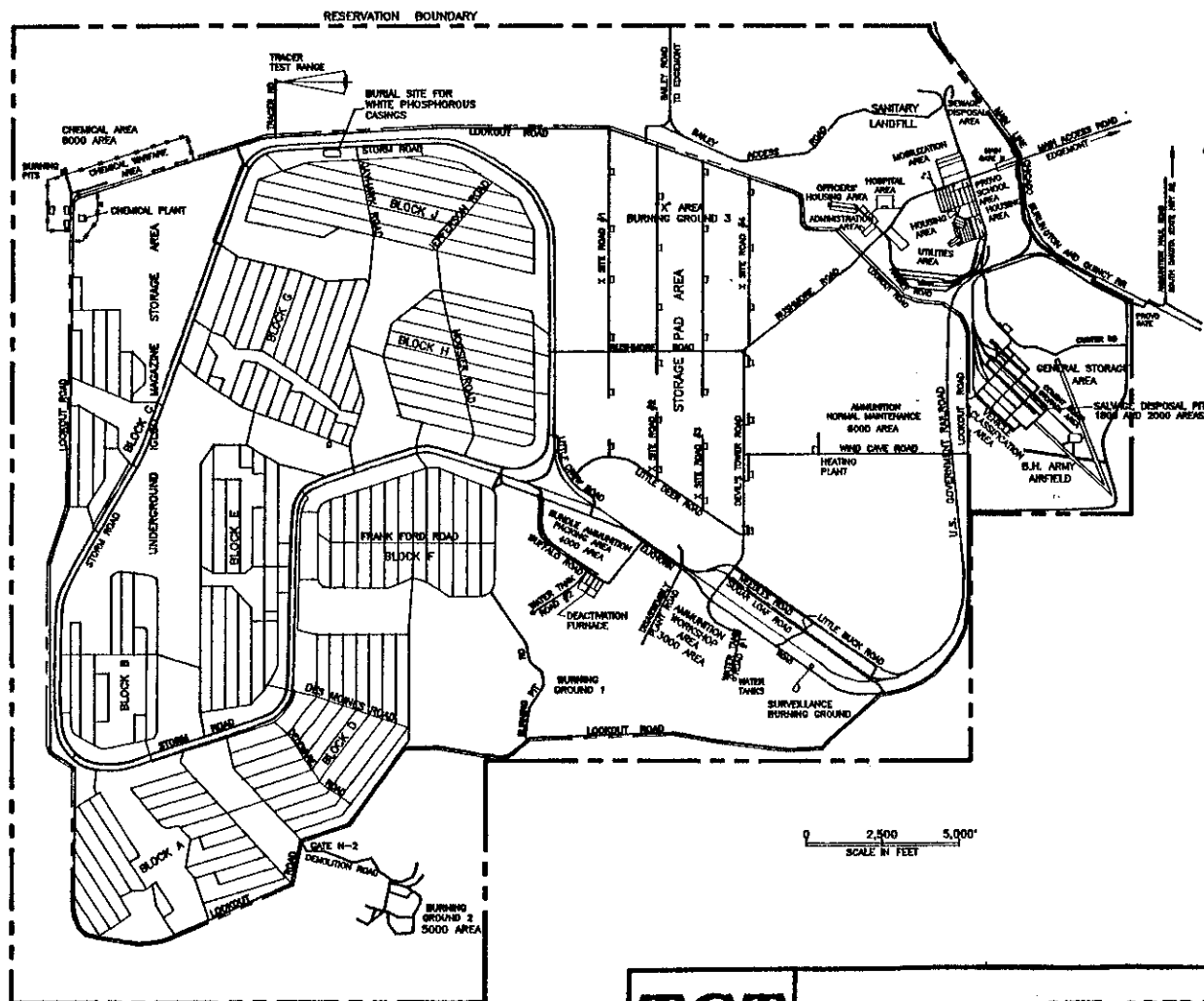
#### 5.2 Facility Operations

##### 5.2.1 General Facility Operation

The former BHAD, shown in Figure 5-1, was constructed in 1942 as a reserve depot whose primary objective was to receive, store, maintain, demilitarize, and issue conventional and chemical ordnance. The depot received its first shipment on October 30, 1942 from Wolf Creek Ordnance Plant [BHAD-001,050,065,075].

The remote location of the facility in southwestern South Dakota required the construction of an extensive residential area, school, hospital, and airfield [BHAD-065].

Water was supplied by two wells located in the northeastern corner of the facility. As described in Section 3.5, water obtained from the wells has a temperature of approximately 150°F. The water distribution system consisted of a hot water storage tank, two zeolite softeners, evaporative coolers, chlorination room, and a cold water storage tank. During the 50's, Well 3 was installed in the northwestern corner of the facility at a depth of 1,930 feet below ground level in order to provide water to a shower system and leaching field located at the Chemical Plant [BHAD-001,065].



Prior to 1961, wastewater treatment consisted of a number of septic tanks and overflow lagoons located throughout the facility. In 1961, a wastewater treatment system was constructed in the northeast corner of the BHAD (Figure 5-1). The facility consisted of a grit chamber, two clarifiers, trickling filter, primary and secondary digester, final clarifier and two sludge drying beds [BHAD-001,065]. According to Dave Henderson, Edgemont Fire Chief, an apparatus associated with one of the clarifiers broke while two children were playing. The incident occurred a number of years ago and a substance believed to be elemental mercury poured out from the apparatus onto the ground and into the clarifier. The amount of the spillage was undetermined [BHAD-127].

One sanitary landfill was present at the BHAD. Information supplied by Matt Brown and analyses of aerial photos, indicates solid waste generated from normal operational activities at the BHAD was placed into a sanitary landfill located near the wastewater treatment plant (Figure 5-1). All collection and disposal activities were "performed by an unidentified civilian contractor" [BHAD-001]. Solid waste generally included refuse, garbage and ashes [BHAD-001,119, BHADM-014,015,016,017]. According to Matt Brown, the landfill may have been used subsequent to closure of the facility [BHAD-119].

In addition to the sanitary landfill, an industrial salvage disposal and burn pit area were located in the combat area. References to this area were encountered in the Daily Duty Logs from the Fire Department [BHAD-114]. From the analysis of aerial photos, the Salvage Disposal Area is most likely located directly north of the Combat Equipment Storage Area and south of Building 1818. TCT-St. Louis suspects items such as scrap lumber, non-salvageable metals, boxes, etc. were buried or disposed of at this location; however, no reference to this area was encountered in the historical reports. Due to the close proximity of this area to other buildings, storage areas and the airfield, TCT-St. Louis does not believe this location was used for the disposal of ordnance or ordnance components.

The remaining depot support facilities consisted of an administrative area, mobilization area, utilities area, residential areas, hospital and school facilities, vehicle classification area, general storage area, and airfield [BHADM-001]. A number of underground gasoline and fuel oil storage tanks were located throughout the facility and according to Mr. Matt Brown, many of them still contain product from the former BHAD operational period and visual evidence suggest some may have leaked or ruptured [BHAD-119]. Facilities and operations associated with ordnance activities at the former BHAD are described in Sections 5.2.2.

### **5.2.2 Ordnance Operations**

The primary objective of the BHAD was to serve as a reserve depot for the receipt, storage, maintenance, inspection, testing, restoration, issuance, and shipping of ammunition, propellants, components of guided missile fuel, and chemical toxics; unpacking and functional packing of small arms ammunition; and the demilitarization of unsafe, obsolete and surplus ammunition, chemical ammunition, ammunition components, chemical toxics, general supplies [BHAD-006], and General Services Administration supplies [BHAD-035]. The mission of the former depot remained the same throughout the years.

At certain times through the years, different functions of the mission would intensify more than others. During wartime, the work effort at the depot was directed toward testing, issuing, and shipping ordnance to the armed services and allies. In the interim years, emphasis was placed primarily on receiving, renovating, and storing munitions.

**5.2.2.1 Types and Amounts of Ordnance** - During the 25 years of the facilities operation, the depot handled considerable amounts and types of ordnance including small arms, conventional ammunition, bombs, grenades, mines, rockets, ammunition components, bulk explosives and chemical toxics. Ordnance contained high explosive, incendiary, chemical, or nerve agent filler. The amount and types of ordnance stored, renovated, and destroyed at the facility varied from year to year. Millions of tons of ordnance and bulk explosives passed through the depot during its existence. Table 5-1 lists the types of ordnance that were reportedly present at the former BHAD at one time or another.

During the first 13 months of operation (November, 1942 - January, 1944), 140,676.89 tons of munitions were received and 22,811.97 tons of munitions were shipped from the depot [BHAD-073]. From 1943 through 1945, the depot received individual shipments for storage of ammonium nitrate, and trinitrotoluene (TNT) in excess of 2 million and 15 million pounds, respectively [BHAD-063]. During 1946, approximately 85,000 tons of ammunition were received and 2400 tons were shipped. During the last 3 months of 1946, over 50,000 rounds and components were destroyed, 50,000 pounds of cyanogen chloride were recovered from leaking chemical gas bombs, 670,000 rounds of small arms ammunition were disassembled and salvaged, and 125,000 shells were renovated [BHAD-064]. During the last 6 months of 1959, more than 11,000 tons of ordnance were destroyed and 6,000 tons were renovated [BHAD-107].

Chemical weapons were also stored, tested, renovated, and destroyed throughout the BHAD's operational period. From 1949 to 1950, over 300,000 mustard gas bombs [BHAD-001,070,143] were stored at the depot. All of the bombs were believed to be potential leakers [BHAD-001]. During one 3-month period in 1955, 211,000 mustard gas shells (105 mm) were renovated and approximately 2,000 were destroyed [BHAD-102].

Testing of all munitions was conducted by the facility's Surveillance Office who determined the final disposition of off-specification items. In general, deteriorating or leaking items were renovated if possible; however, extensively damaged ordnance as well as old or obsolete munitions were generally destroyed at the burning ground.[BHAD-001] According to the former Demilitarization Foreman, items received from other depots were scheduled for destruction rather than modification or renovation [BHAD-125].

During the final years of operation, the majority of ordnance present at the BHAD was either shipped to other facilities or destroyed [BHAD-135].

**5.2.2.2 Storage, Renovation, and Destruction of Munitions** - At the former BHAD, ordnance activities were conducted at ten separate locations identified by specific numbers and/or letters. Table 5-2 lists the types of ordnance operations and the corresponding building designations.



TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 1 of 7)

Reference #	Specific Ordnance
BHAD-002	Lewisite
BHAD-005	Captured German Chemicals
BHAD-006	M-55 Rockets filled with GB or VX
BHAD-039	1,000 lb, AN-M59 Series (S1REA, S1RAA)
BHAD-039	Bomb, Frag, Comp B, 90 lb, M82 (S1ENA)
BHAD-040	Cluster, Frag Bomb, M8, 8" Shell
BHAD-040	Cartridge HE, T50E2, Suppl charge without fuze for 75 mm gun
BHAD-040	M26, Frag Bomb, 500 lb
BHAD-040	105 mm Propelling Charges
BHAD-040	Cartridge, 90 mm, HE, M71, flashless with fuze, PD M48A2, 0.05 second delay for guns M1, M2, and M3
BHAD-040	Shell, S/F, HE, M1 with fuze, M48A2, 0.15 second delay for 105 mm How, M2, M2A1, and M4
BHAD-040	Charge propelling M9 for 8" gun M1
BHAD-040	Charge propelling M10 for 8" gun M1
BHAD-040	500 lb, GP bomb, Amatol loaded
BHAD-040	500 lb, GP bomb, TNT loaded
BHAD-040	500 lb, GP bomb, Comp B loaded
BHAD-040, 102	M22 boosters
BHAD-040	M57 head assemblies
BHAD-040	M1B1A2 Primers M58
BHAD-040, 102	Boosters M110A1, M111, M110, M111A2
BHAD-040, 103	Fuze, M57, M51A1, M110, M111
BHAD-040, 103, 105	20 lb Frag Bomb, M40, and M41
BHAD-040	M102 Adaptor Boosters
BHAD-040	M Fuze M51A5
BHAD-040	Fuze M51A1
BHAD-053	CN, AC
BHAD-054	Smoke Bombs (WWII) 10 lb to 100 lb, M67 (WP) Bomb, or M74 or M77

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 2 of 7)

Reference #	Specific Ordnance
BHAD-054	(HC) Hexachloroethane
BHAD-054	100 lb M47A2 (WP) Bomb
BHAD-054	Cluster Bomb M67 and M77, Black Powder
BHAD-063	White Phosphorous (WP)
BHAD-063	Ammonium Nitrate
BHAD-063	TNT (trinitrotoluene)
BHAD-063	Amonit(e)
BHAD-063	Kolloxilene
BHAD-067	Strontium Nitrate
BHAD-067	Magnesium Grade A Ferro Enamel and Grade B
BHAD-067	Asphaltum
BHAD-067	Calomel
BHAD-067	Barium Peroxide
BHAD-067	Tetryl
BHAD-067	Grade A5, Black Powder
BHAD-067	Barium Stearate
BHAD-067	Graphite
BHAD-067	Explosive D (ammonium 2,4,6-trinitrophenolate)
BHAD-073	Dibutylphthalate
BHAD-073	Diphenylamine
BHAD-073	Dimethylaniline
BHAD-073	115 lb bomb, Gas, Persistent (L) M70
BHAD-074	M78 and M79 Chemical Bomb
BHAD-077	Sodium Hydroxide for the Destruction of Lead Azide
BHAD-077	Sodium Sulphide for the Destruction of TNT
BHAD-080, 107, 137	Bomb, Gas, CK, 500 lb, AN-M78
BHAD-080, 137	Bomb, Gas, CK, 500 lb, AN-M79
BHAD-080	Bomb, Gas, CG, 500 lb, AN-M78

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 3 of 7)

Reference #	Specific Ordnance
BHAD-080	Bomb, Gas, CG, 500 lb, AN-M79
BHAD-080	S2ADA Adaptor Booster, M11521
BHAD-080	S2NRA Fuze Bomb, Nose, AN-M103A1
BHAD-086, 105	Grenade, Hand, Frag, MK2A1, with M10 Series Fuze to MK2 with Fuze, M204A1
BHAD-086	Shell, Fixed, HE, M48, Reduced Charge with Fuze, Pd, M51A5
BHAD-086	Shell, HE, M49A2, with Fuze, Pd, M52A1
BHAD-086	Shell, Fixed, HE, M48, Super Charged with Fuze, Pd, M51A5
BHAD-086	Shell, Semi-fixed, HE, M48 with Fuze
BHAD-086	Shell, Fixed, HE, M48 with Supplemental Charge with Fuze
BHAD-086	Shell, Fixed, HE, M48, Normal Charge with Fuze
BHAD-090	M6 Mines
BHAD-102	Scrap Pentolite
BHAD-102	HE, AT, M67 with Fuze, BDM62A1 for 105 mm Howitzer
BHAD-102	Gas Persistent, H, M60 for 105 mm Howitzer
BHAD-102	Cluster, Fragmentation Bomb, M28
BHAD-102	90 mm Gunshell
BHAD-102	90 lb Frag Bombs
BHAD-102	105 mm H Gas Shell
BHAD-102	155 mm H Gas Shell
BHAD-102	Projectile, 105 mm, M67
BHAD-102	Projectile, 76 mm
BHAD-102	Projectile, M64, WP Smoke
BHAD-102	Primers, 76 mm
BHAD-102	Booster, 75 mm
BHAD-102	Fuze, MK BD10
BHAD-102	Primers, M22A2
BHAD-102	Fuze, M54

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 4 of 7)

Reference #	Specific Ordnance
BHAD-102	Booster, M20A1
BHAD-102	Scrap TNT
BHAD-102	Bomb, AP, 1,600 lb
BHAD-102	Bomb, HE, 4,000 lb
BHAD-102, 105	Bomb, 500 lb
BHAD-102	Cluster Frag, M4, M140, M41
BHAD-102	Cluster Frag, M126
BHAD-102	Fuze, M120
BHAD-102	Fuze, M62A1
BHAD-102	Fuze, Flare, Mech Time M111
BHAD-102	Fuze, M120A1
BHAD-102	Fuze, M48
BHAD-102	Fuze, M111, M110, and M111A2
BHAD-102	Adapters, 250 lb Bomb
BHAD-102	Boosters, 250 lb Bomb
BHAD-102	Boosters, M26 Frag
BHAD-102	Primers, R1RVA
BHAD-102	Projectile, 75 mm, M48
BHAD-102	Projectile, 75 mm, M66
BHAD-103	M28 Rifle Grenade
BHAD-103	M9A1 Rifle Grenade
BHAD-103	100 lb, GP, Tritonal Bomb
BHAD-105	Parachute and Cont., Bomb, M4
BHAD-105	Cluster Frag Bomb, AN-M1A2, 100 lb
BHAD-105	Bomb, GP, 500 lb, Comp, AN-M64A1
BHAD-105	Projectile, 8" HE, M103 with Fuze, Pd, M51
BHAD-105	Charge, Prop, M23 F/240 mm
BHAD-105	Assy, Head, Fuze, Pd, M51A4

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 5 of 7)

Reference #	Specific Ordnance
BHAD-105	Bomb Prac, 250 lb, M124
BHAD-105	Cart, 90 mm, AP-T M318
BHAD-105	Cart, 106 mm, HE-T, M346A1
BHAD-107	Fuze, M103A1
BHAD-107	Bomb, GP, 500 lb, Comp B, AN-M64A1
BHAD-107	Flare, Surface, Trip
BHAD-107	Powder, Prop.
BHAD-107	Cart, 76 mm, HE, M42A1
BHAD-107	Proj. HE, M114, F/240 mm
BHAD-107	Case, Cart, M5A1, 76 mm
BHAD-107	CML, Mustard-H-5516, Container
BHAD-107	Case, Cart
BHAD-107	Cart, 57 mm, HE, M306, A1
BHAD-107	TNT, Flake
BHAD-107, 137	Bomb, Gas, CG, AN-M79, 1,000 lb
BHAD-107, 137	Bomb, Gas, CK, AN-M79, 1,000 lb
BHAD-107	Projectile, 8" HE, M106
BHAD-108	Mustard Gas Bomb, M70
BHAD-108	10,000 lb Tritonal GP Bomb
BHAD-108	30 Caliber Ball Ammunition
BHAD-109	Cluster Frag Bomb, MLA2
BHAD-112	260 lb Frag Bomb
BHAD-114	U.D.M.H., Nitric Acid, M-3 Fuel, Jet Fuel
BHAD-127	Mines
BHAD-127	40 mm
BHAD-127	76 mm
BHAD-127	81 mm Mortar
BHAD-127	4.2" Mortar

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1\*

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)**  
(Page 6 of 7)

Reference #	Specific Ordnance
BHAD-127	3.5" Rocket
BHAD-127	120 mm HE
BHAD-127	105 mm RR
BHAD-127	155 mm HE G
BHAD-127	750 lb
BHAD-127	57 mm Smoke
BHAD-127	60 mm WP
EOD	M61 Pract Chem Rocket
EOD	M83 Frag Bomb (Butterfly)
EOD	M47A4 US Bomb Incendiary
EOD	M103 Bomb Fuze
EOD	155 mm, Smoke Filled with Red Phosphorous
PHOTOS	37 MM Shells

## Supporting References:

009, 030, 031, 039, 042, 047, 053, 064, 069, 071, 075, 078, 079, 081, 082, 085, 086, 090, 103, 110, 111

Captured German Chemicals: Could include phosgene, G-Series nerve agent, blood agents and blister agents.

\*For explanation of abbreviation see page 7 of Table 5-1.

TABLE 5-1

(Page 7 of 7)

**LIST OF ORDNANCE PRESENT DURING THE OPERATION OF THE BLACK HILLS ARMY DEPOT (BHAD)  
LIST OF ABBREVIATIONS**

Abbreviation	Definition
AC	Hydrocyanic acid - a blood and nerve poison, a gas.
AP	Anti-personnel or armor piercing, pending reference to ordnance.
CG	Phosgene - a choking gas.
CK	Cyanogen Chloride - a blood and nerve poison, a liquid until released into the atmosphere where it changes to a gas.
CN	Chloroacetophenone - a training and riot control gas, a common tear gas.
G	Gasoline, aviation gasoline used as a fuel with a liquid propellant.
GB	Sarin (methylisopropoxyfluorophosphine oxide) - a blood and nerve poison, a liquid.
GP	General Purpose - term used to describe dropped munition (bomb).
H	Mustard (2,2-dichlorodiethylsulfide) - a blister gas.
HC	HC Mixture - a smoke generator which is formed by the combustion of aluminum with hexachloroethane and zinc oxide or High Capacity.
HE	High Explosive - characterized by the extreme rapidity with which detonation occurs.
PD	Point Detonating Fuzes - an explosive train component that can be activated by impact.
RR	No reference found.
TNT	2,4,6-trinitrotoluene - a constituent of such explosives as amatol, pentolite, tetrytol, tritonal, pickatol and Composition B; or can be used by itself as an explosive as a bursting charge, demolition charge or blasting charge.
UDMH	Unsymmetrical Dimethylhydrazine - a liquid rocket fuel.
WP	White Phosphorous - a screening smoke and an incendiary agent, a liquid, ignites spontaneously on exposure to air and produces dense white smoke.

Sources: BHAD-066,055,157

TABLE 5-2		
FORMER BHAD ORDNANCE OPERATIONS		
Ordnance Operation	Area Designation	Function
Storage Igloos	Block A-H Block J	Munition storage
Combat Material Area	1800 and 2000 Area	Inert storage
Ammunition Workshop Area	3000 Area	Munition storage, depriming, debanding, and TNT washout of munitions, burnout of small arms and ammunition components
Bundle Ammunition Packing Area Disassembly Plant, Deactivation Furnace	4000 Area	Small arms and ammunition packing ammunition disassembly
Burning Ground 2	5000 Area	Destruction of ammunition
Chemical Plant Chemical Warfare Area Chemical Burning Pit	6000 Area	Renovation, disassembly, destruction of chemical weapons, and storage of leaking chemical weapons
Ammunition Normal Maintenance Area	8000 Area	Renovation of munitions
Tracer Test Range	9000 Area	Test range for 30 and 50 caliber ammunition
Outdoor Storage Area Burning Ground 3	X Area	Munition storage and destruction
Burning Ground 1	No number or letter designation	Destruction of ammunition



### Storage Igloos

The igloo storage area, shown in Figure 5-1, is situated in the western half of the former BHAD. The magazines were labelled by blocks A through H and Block J. The structures provided long term storage facilities for ordnance, ordnance components and bulk explosives. With the exception of chemical leakers, the majority of the ordnance listed in Table 5-1 was housed in the igloos. Burned white phosphorous casings were reportedly buried in two pits in an area north of Block J [BHAD-001,053, BHADM-001].

From 1958 until 1960, Ellsworth AFB stored missile fuel (M3), fuming nitric acid and unsymmetrical dimethylhydrazine in igloos A-504 and A-805. M55 rockets containing nerve agent VX and GB were stored in Block G during this same time frame [BHAD-001,0054,126,127,132,133].

According to several former workers, no maintenance, modification, renovation, or demilitarization were performed on the nerve agent-filled M55 rockets. Leakers and eventually all the nerve agent filled ordnance were shipped to Rocky Mountain Arsenal [BHAD-125,126,132,135]. During this period, rabbits were raised at the depot and all personnel working near Block G were required to keep the rabbits with them at all times. Rabbits were used to determine if a leak of the nerve agent-filled rockets had occurred. Training sessions were mandatory for all personnel, including ranchers who grazed cattle and sheep in the vicinity of Block G [BHAD-132,133]. No records, however, were encountered which documented the training or final fate of the rockets.

In 1950, an explosion occurred at Igloo F-1304 which killed three people and destroyed the igloo. Grenades were scattered and the area was fenced off [BHAD-114]. No documents were found indicating the final disposition of the area.

Quantity distance tests were conducted in Igloo Block D in 1957. Approximately 4,000 M61 rockets containing nerve agent stimulant (ethylene glycol) were placed in the igloos and detonated [BHAD-054]. According to information supplied by former depot personnel, the rockets within the igloos were difficult to detonate. As a result, additional explosives were added. Both igloos were destroyed, however, the structures collapsed. Debris was not scattered throughout the area [BHAD-125,126,135].

### 1800 and 2000 Area - Combat Materials Area

In the Combat Materials Area (1800 and 2000), shown in Figure 5-1, small arms ammunition ranging in size from 22 caliber to 50 caliber was either stored or unpacked and reassembled into functional packs by either linking, belting, clipping, or recycling [BHAD-001, BHAD-M-001]. Additionally, inert materials and salvage items were stored at this location. A salvage yard landfill and burning pit for inert and nonsalvageable material was located within the area south of Building 1818 [BHAD-114].

### 3000 Area - Ammunition Workshop Area

The Ammunition Workshop Area (3000 Area) consisted of approximately 48 acres. As shown in Figures 5-1 and 5-2, the 3000 Area was located in the south-central portion of the BHAD. Maintenance, modification, renovation, and demilitarization of ordnance was conducted at this location [BHAD-053]. The types of ordnance handled at this facility included:

- conventional ammunition, 20 mm to 240 mm with high explosive (HE), white phosphorous (WP) and mustard (H) filler
- mines, antitank (AT) and antipersonnel (AP) with HE filler
- bombs, 250 lb. through 1,000 lb. with HE filler
- rockets, 2.75 - 4.75 inch with HE and WP (filler)
- hand and rifle grenades
- components including fuzes, primers, boosters, and propellants [BHAD-053]

Ordnance was disassembled and reassembled at specific locations throughout the Workshop Area. TNT was flaked and explosive fillers were removed from munition items at Building 3046 [BHADM-001, BHAD-001,053]. The types of munitions requiring washout included 75 and 76 mm shells, mines and 250-1000 pound bombs [BHAD-053]. The explosive filler, washed from ordnance items, was diverted into three leaching beds and allowed to settle into the ground [BHAD-053]. Records do not clearly indicate whether all three leaching beds were exclusively used for explosives or whether one or more of these structures were used for other chemicals such as acids. Numerous storage magazines were also present within the area. Plate 1 (Photo Documentation) shows the Ammunition Workshop Area.

### 4000 Area - Bundle Ammunition Packing Area

The 4000 Area, shown in Figures 5-1 and 5-3, contained the bundle ammunition packing buildings, maintenance/repair/equipment sheds, ammunition disassembly plant, and a deactivation furnace [BHADM-001]. The ammunition disassembly plant covered approximately 2 acres and housed television cameras and screens to aid in the disassembly of munitions ranging in size from 100 lb. through 4,000 lb. [BHAD-001,053].

The ammunition packing buildings were used to load and package munition into railroad cars for shipment to other installations both in the USA and abroad. The maintenance/repair/equipment sheds housed forklifts, tools, lumber and a carpenter shop [BHAD-001,053]. The deactivation furnace was located on an 11.2 acre site within the 4000 Area. All types of small arms, ammunition components, and tracers were destroyed in the furnace by burnout [BHAD-001,053]. The deactivation furnace and disassembly plant are shown in Plate 1 (Photo Documentation).

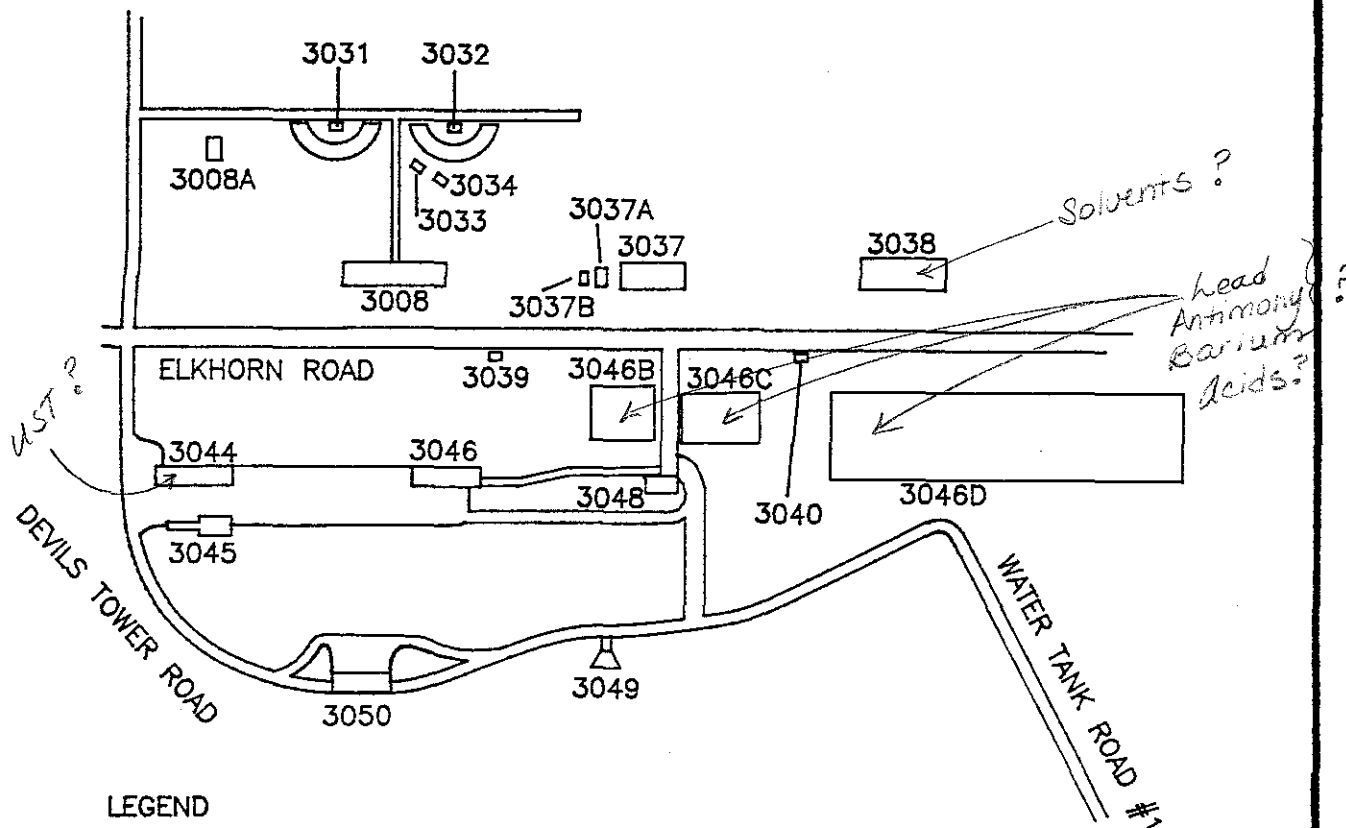
### 5000 Area - Burning Ground 2

Burning Ground 2 (BG-2), shown in Figures 5-1 and 5-4, was constructed in 1946 as a facility for heavy demolition and destruction of toxic gas filled ammunition. 1954 and 1971 aerial photos of the area have been reproduced and are presented in the separately bound Photo



0 400  
SCALE IN FEET

*UXO was in Bldg 3008.*



#### LEGEND

3008	AMMUNITION RENOVATION	3044	BOILER RM CHANGE HOUSE & OFFICE
3008A	POWDER PROPELLANT STORAGE	3045	MACHINE SHOP & TOOL HOUSE
3031	SMOKELESS POWDER MAGAZINE	3046	TNT WASHOUT & FLAKER BUILDING
3032	SMOKELESS POWDER MAGAZINE	3046B	LEACH BED
3033	VACUUM UNIT PUMP HOUSE	3046C	LEACH BED
3034	VACUUM UNIT BARRICADE	3046D	LEACH BED
3037	DEBOND & DEPRIME BUILDING	3048	TNT STORAGE
3037A	EARTH BARRICADE	3050	WORK SHED
3037B	SERVICE MAGAZINE	3049	DEBOOSTING BARRICADE
3038	CLEAN & PAINT BUILDING		
3039	SERVICE MAGAZINE		
3040	SERVICE MAGAZINE		

SOURCE: BHADM-001  
DATED 1959

Figure 5-2

**TCT**

St. Louis

## AMMUNITION WORKSHOP AREA FORMER BHAD

Project No. 9222

By: *DT*

Chk'd By: *NMD*

Date: 8-11-92

BUNDLE AMMUNITION  
PACKING AREA



0 400  
SCALE IN FEET

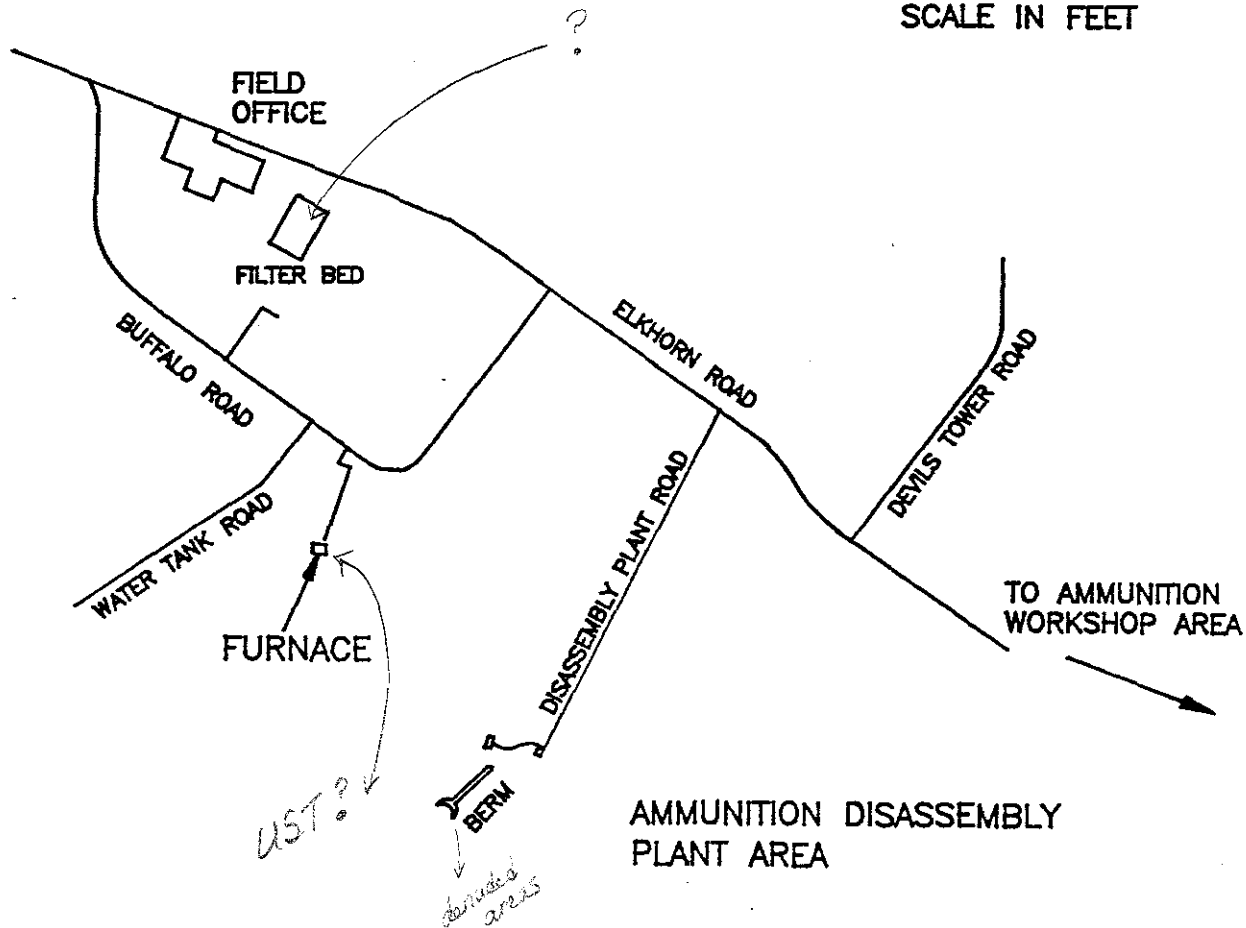


Figure 5-3

**TCT**

St. Louis

BUNDLE AMMUNITION PACKING AREA  
AND AMMUNITION DISASSEMBLY PLANT AREA  
FORMER BHAD

Project No. 9222

By: DJ

Chk'd By: TL

Date: 8-11-92

*all kind  
of metal in  
barrenes!*

*lots of  
metal  
present!*

0 1260  
SCALE  
IN FEET



LEGEND

- 5000 BASE OF SUPPLY BARRICADE
- 5001 TOOL STORAGE
- 5002 REMOTE CONTROL SHELTER
- 5003 ELECTRIC GENERATOR HOUSE
- 5004 STORAGE MAGAZINE
- 5005 DEMOLITION FURNACE AND WORK SHED

- - DETONATION PITS
- TRENCHES
- ◻ - BURN AREAS

DEMOLITION  
AREA

*UXO*

SOUTH LOOP ROAD

GATE N-2

LOOKOUT  
ROAD

LOOKOUT ROAD

*UST?*

*Trenches &  
Along road  
detritus -  
- phosphorus  
- white phosphorus  
- mustard gas  
- explosive gas (including  
- Lewisite gas  
- cyanogen chloride gas  
- hydrogen cyanide gas  
- heavy metals  
(Cd, Cu, Ni, Hg, Pb)  
56  
- 12 large pits  
- numerous  
trenches*

Figure 5-4

**TCT**  
St. Louis

BURNING GROUND #2  
FORMER BHAD

Project No. 9222	By: DJ	Chk'd By: TL	Date: 8-11-92
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Documentation as Plates 2 and 3. Prior to 1946, all demolition activities were conducted at Burning Ground 1 [BHAD-064]. The site was comprised of 965 acres and was located in the southwestern portion of the facility [BHAD-001,053, BHADM-001]. Facility maps indicate the presence of several structures at the burning ground including a barricade, tool storage building, the remote control shelter, electric generator house, storage magazine, workshed, and demolition furnace [BHAD-M-001].

BG-2 was used for the demolition/burning of ordnance containing explosive or chemical fillers. In addition, small arms containing tracers were tested at a range located within the burning ground. Munitions destroyed at Burning Ground 2 ranged from components such as igniters, primers and fuzes to 10,000 lb. bombs. During 1967, simulant filled rockets, M61, were detonated in open pits and incinerated [BHAD-054]. The following is a list of munitions reported to have been destroyed at BG-2:

- small arms, 30 caliber to 50 caliber, all types
- conventional ammunition ranging in size from 20 mm through 240 mm with high explosive (HE), incendiary and chemicals such as white phosphorous (WP), mustard (H) gas and chloracetophenone (CN) gas
- conventional bombs ranging in size from 4 lbs. through 12,000 lbs. with H.E., incendiary, pyrotechnics and chemicals (WP, H gas, Lewisite (L) gas, cyanogen chloride (CK) gas, phosgene (CG) gas and hydrocyanic acid (AC) gas)
- ammunition components (fuzes, primers, boosters, bursters, activators and propellant)
- rockets ranging in size from 2.75 inch to 4.5 inch with HE and WP filler
- mines, anti-tank (AT) and anti-personnel (AP) with HE filler
- grenades, hand and rifle with HE filler [BHAD-053]

The chemical bombs were placed in trenches or pits, the nose plugs were blown off and the leaking chemicals were then ignited and burned. The detonating wires were underground and were electrically connected to the remote control shelter and the electric generator house. According to the former Demolition Foreman, chemicals, including phosgene, cyanogen chloride, and mustard were poured into trenches 20-25 feet deep and were allowed to seep into the ground. Occasionally, chemical bombs were not placed in pits but were burned along the sides of the roads at BG-2 [BHAD-125,126].

Large bombs were detonated in 12 large pits, 20 to 40 feet deep. After the detonation charges were connected to the wires, the munitions were buried with earthen materials and detonated. All large detonations took place from behind the remote control shelter [BHAD-125]. Twelve large detonation pits or craters were in continual use at the burning ground [BHAD-053,054].

Smaller bombs were placed in open sites and detonated in place. When detonations were scheduled to occur, the fire department was called upon to watch for flying shrapnel and to put out any incidental grass fires [BHAD-114,125,126]. Small ammunition components such as primers, igniter tubes, etc. were burned in the popping furnace. Burned out components were then placed on the ground in the vicinity of the popping furnace [BHAD-125,126].

#### 6000 Area - Chemical Plant and Burning Pit

As shown in Figures 5-1 and 5-5, the 114 acre Chemical Area was located in the northwestern corner of the former BHAD. Copies of 1954, 1965, and 1971 aerial photos of the area have been reproduced and are presented in the separately bound Photo Documentation as Plates 4, 5, and 6. The area consisted of two separately fenced areas which included a chemical plant and storage area within the fenced area of the depot, and a chemical burning pit and outdoor storage facility outside of the fenced perimeter of the depot [BHADM-001]. According to documents, the 6000 Area was used for the disposal of mustard and cyanogen chloride and phosgene bombs ranging in size from 100 pounds to 1,000 pounds [BHAD-053].

An incinerator was constructed in the area in 1959 and was put into actual service in 1961 [BHAD-114]. Prior to 1961, the incinerator underwent extensive testing and modifications. The plant was located in the Demilitarization Building 6006 and was surrounded by additional fencing [BHADM-001]. The bombs were loaded onto a conveyor belt located within the storage building. The bombs were then punched, and the mustard was incinerated within a rotary kiln. Effluent and stack gases were treated with limestone and discharged to ponds located west of the plant [BHAD-030]. Information supplied by the Army Environmental Hygiene Agency described the operation of the incinerator shown in Figure 5-6 as follows:

*Bombs were loaded on the loading platform from the indicated storage area. The M-70, 129-pound mustard bombs were then loaded onto the conveyors and passed through the double door air-lock into the punch chamber. A hydraulic punch made two holes in the top of each bomb. The opened bomb was then conveyed through the conveyor tube into the kiln inlet head and then into the rotary kiln. The kiln is 4.0 feet in diameter and 30.0 feet long. The mustard was burned in the kiln using fuel oil as the auxiliary fuel. Combustion gases passed through a six-stage water scrubber and were discharged to the atmosphere from a 32-foot tile exhaust stack with an internal diameter of 30 inches, at an estimated rate of 12,000 cfm. The average rate of punching bombs and dumping them into the kiln was approximately 30 per hour, with a peak production rate of 46 bombs per hour. Daily production time was between 5.5 and 6.5 hours. After a 30-60 minute dwell time, empty bomb casings were discharged from the kiln discharge head through a water seal to a conveyor. The decontaminated bombs were then hauled away by truck for disposal as scrap metal [BHAD-030].*

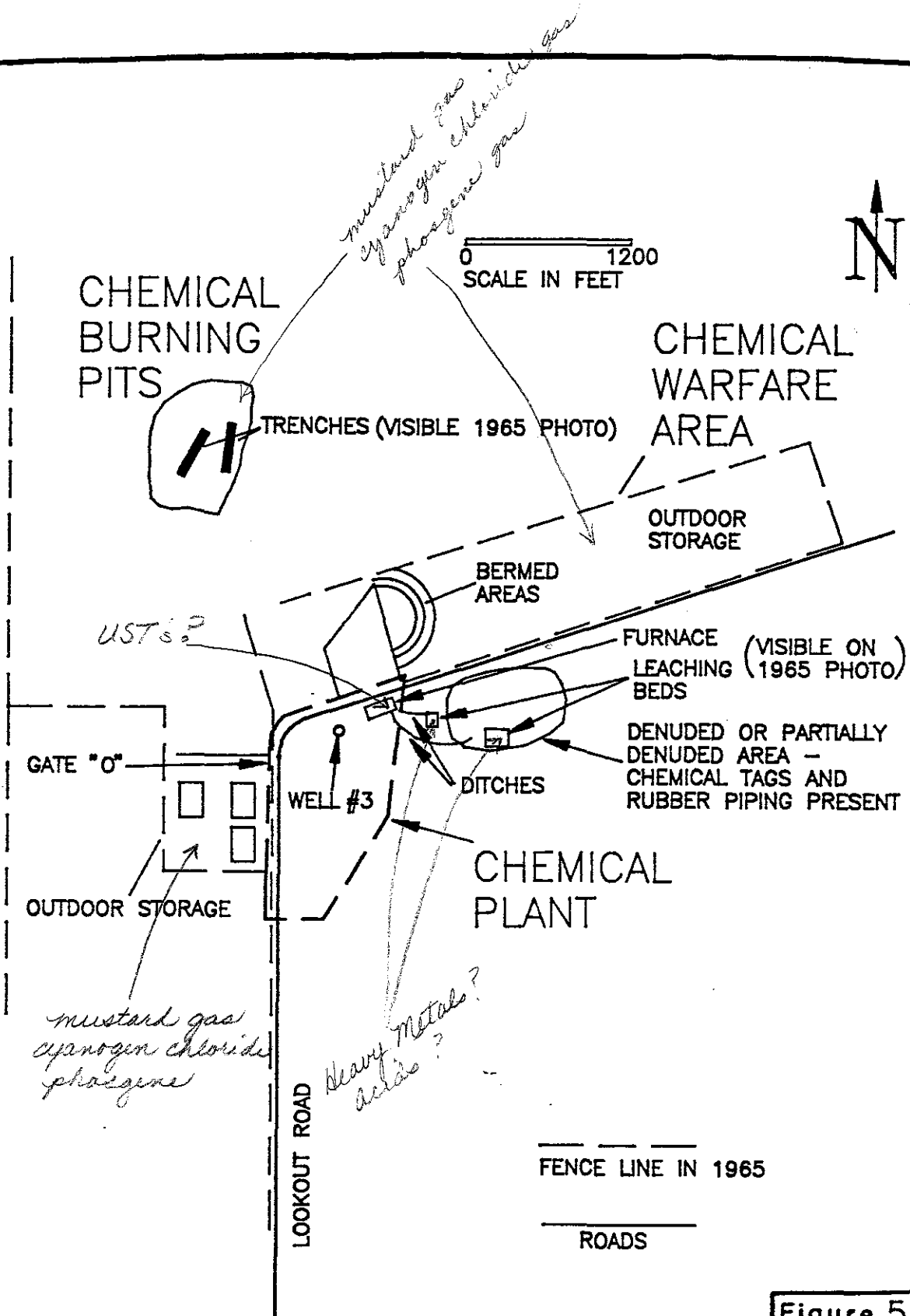


Figure 5-5

**TCT**

St. Louis

CHEMICAL AREA  
FORMER BHAD

Project No. 9222

By: DJ

Chk'd By: NMD

Date: 8-11-92



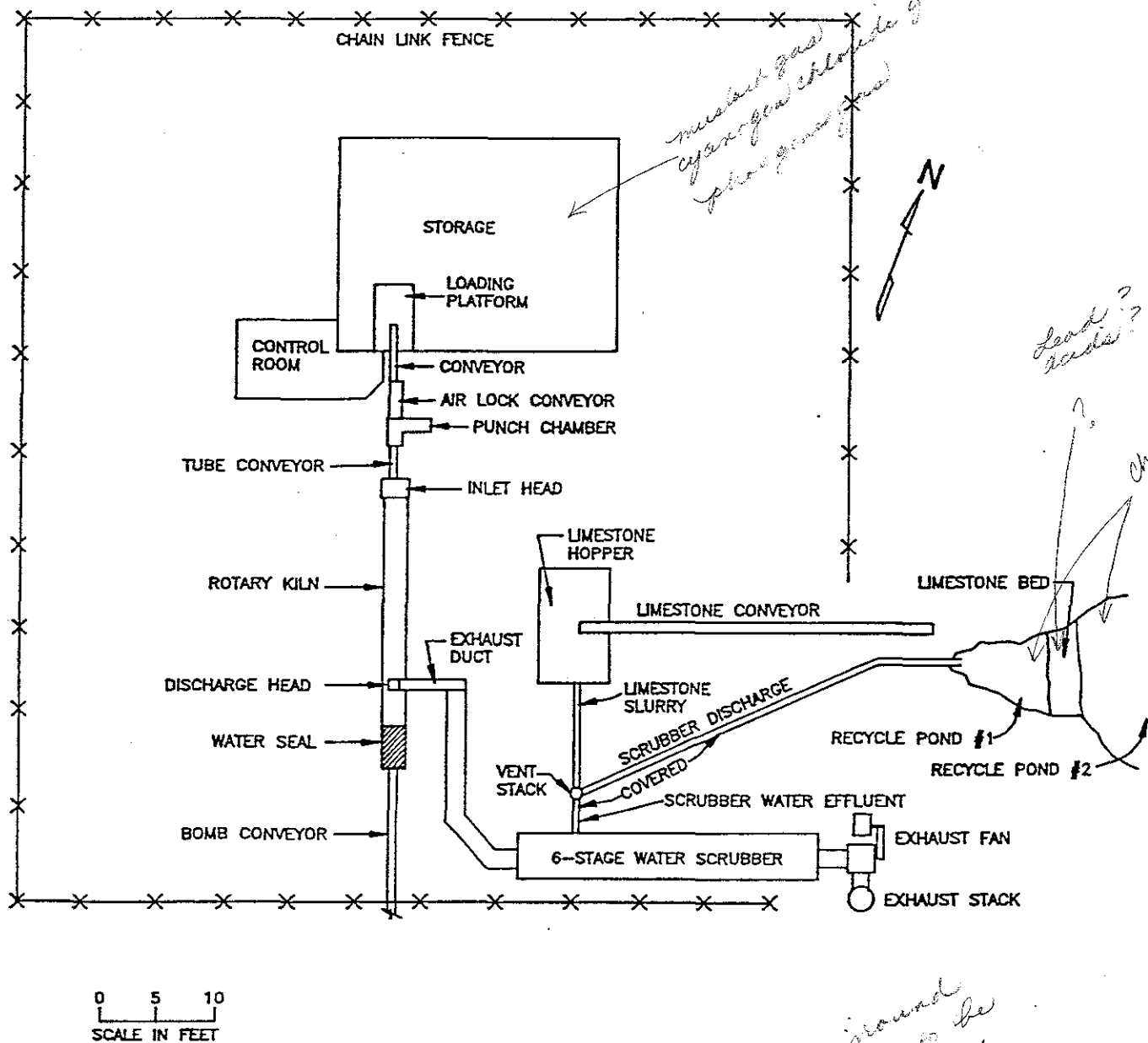


Figure 5-6

**TCT**

St. Louis

Mustard Incinator, Chemical Area  
Former Black Hills Army Depot

Project No. 9222

By: *[Signature]*

Chk'd By: TL

Date: 8-11-92

In 1961, the Army Environmental Hygiene Agency sent a team to the BHAD to sample stack emissions, water seals, pond effluent, and the nearby well. Results, included in Appendix F, indicated the presence of sulfuric and hydrochloric acid at nearly every sampling point and the presence of mustard gas in the water obtained from two of the water seals. The tests were conducted as a result of numerous injuries received by personnel working at the facility [BHAD-030].

In addition to mustard bombs, the plant also incinerated chemicals drained from cyanogen chloride bombs [BHAD-137]. According to a former worker, contents of cyanogen chloride and phosgene bombs were incinerated at the Chemical Plant as early as 1954 [BHAD-152]. A 1966 newspaper article described the process.

*The cyanogen chloride gas bombs were hoisted onto a 8-foot platform, the rupture disc was punctured, and the liquid was drained into a 500-gallon tank. The liquid was then pumped into a kiln and burned. Following draining, the casings were decontaminated with compressed air and shipped to other ordnance facilities for reuse. During 1966, 5,000 cyanogen chloride bombs (500-pound and 200-pound) were demilitarized [BHAD-137].*

Prior to 1959, the precise nature of the operations at the chemical area is not clearly defined in the records. Historical reports from the Chemical Branch, BHAD, indicate chemical ordnance was renovated at this location [BHAD-143,144,145,146,147,148,149,150,152]. Records indicate the leakers were transported from the storage igloos to a remote location believed to be the chemical area. Reportedly, all chemical ammunition was stored at the chemical area, however, interviews with former depot personnel indicate that unless the chemical munitions were leaking, chemical ordnance were stored in the storage igloos [BHAD-001,125,126,132]. Leakers were stored in the Chemical Area. In 1950, 310,000 potentially leaking mustard bombs were stored at the BHAD [BHAD-001,152].

In 1956, a shower system was installed within the Chemical Area at the change house (Building 6000), in order to protect workers from the effects of leaking munitions. The system consisted of four showers and a leaching field for the waste [BHAD-001].

The locations of the chemical area and burn pit are discernible on aerial photos (Plates 4, 5, and 6, Photo Documentation). TCT-St. Louis suspects that prior to 1959, the area was used to drain, renovate, decontaminate, and store leaking chemical weapons. Bulk chemicals retrieved from the munitions that were not of sufficient quality to transfer to other depots may have been disposed of at the chemical burn pit. According to documents, in 1951, a new mustard burning site was proposed to enable the facility to destroy 30,000 leaking mustard bombs per year [BHAD-001]. The proposed site was to be located in the northeast corner of the facility north of the mustard bomb storage pads. The northeastern corner of the facility consists of residential and administrative facilities. No storage pads are present in this area. TCT-St. Louis believes the records were actually referring to the northwestern corner of the former BHAD [BHAD-152]. The actual date of construction of the burning pit was not found during the Archives Search.

Historical reports from the Chemical Division, indicate that chemical bombs were drained of their contents (prior to destruction) in a bermed trench. DANC was frequently used as a decontaminating agent. Mustard gas was transferred from small containers to 1-ton containers at this location. Spilled chemicals were directed into a pit and away from the workers. Empty bomb casings were burned and decontaminated in open pits within the area [BHAD-149]. The majority of the empty casings were sold as scrap or sent to other facilities for reuse [BHAD-143].

In 1954 (Plate 4, Photo Documentation) and 1957 aerial photos, one trench is visible within the area designated as the burning pit. Chemicals and/or chemical weapons were most likely drained, destroyed, or decontaminated at this location; however, records indicate that during this time frame, chemical munitions were also destroyed at Burning Ground 2 [BHADM-014,015].

In the 1965 photo (Plate 5, Photo Documentation), two trenches are evident within the burning pit [BHADM-016]. According to interviews with former plant employees, the incinerator was dismantled during decontamination of the facility and was buried within the pit [BHAD-125,126,135].

#### 8000 Area - Normal Maintenance Area

The 8000 Area was called the Normal Maintenance Area. This area is discernible on a 1957 aerial photograph but not on the 1954 photo. As shown in Figure 5-1, the Normal Maintenance Area was located in the central portion of the former BHAD and consisted of 7.8 acres [BHADM-001, BHAD-053]. This area provided additional facilities for the maintenance, modification, renovation, and demilitarization of ordnance which included:

- conventional ammunition ranging in size from 20 mm through 240 mm with HE filler
- rockets ranging in size from 2.75 inch to 4.5 inch with HE and WP filler
- grenades, hand, and rifle with HE filler
- fuzes, primers, boosters, and propellants [BHAD-053]

*leach?  
bede?  
UST'S?*

The normal maintenance area (Plate 7, Photo Documentation) consisted of a maintenance building, flammable materials building, vacuum collector building, and four above-ground storage magazines [BHADM-001].

#### Area 9000 - Tracer Test Range

As shown in Figures 5-1 and 5-7, the Tracer Test Range was located north of Igloo Block J outside the perimeter fence (Plate 8, Photo Documentation). The site consisted of seven buildings and an impact and/or target barricade located approximately 2,400 feet from the buildings. Small arms ammunition, 30 to 50 caliber in size with tracer, were fired at this location [BHADM-001,013].



0 1200  
SCALE IN FEET

TRACER  
TEST  
RANGE

30 AND 50 CALIBER  
AMMUNITION

BERM

SITE OF BURIED  
WHITE PHOSPHOROUS CASINGS

GATE P-1

LOOKOUT ROAD

STORM ROAD

NORTH LOOP ROAD

IGLOO  
BLOCK "J"

WEST LOOP  
ROAD

JAYHAWK ROAD

FENCED AREAS

RR TRACKS

ROADS

Figure 5-7

**TCT**

St. Louis

TRACER TEST RANGE  
FORMER BHAD

Project No. 9222

By: DJ

Chk'd By: TL

Date: 8-11-92

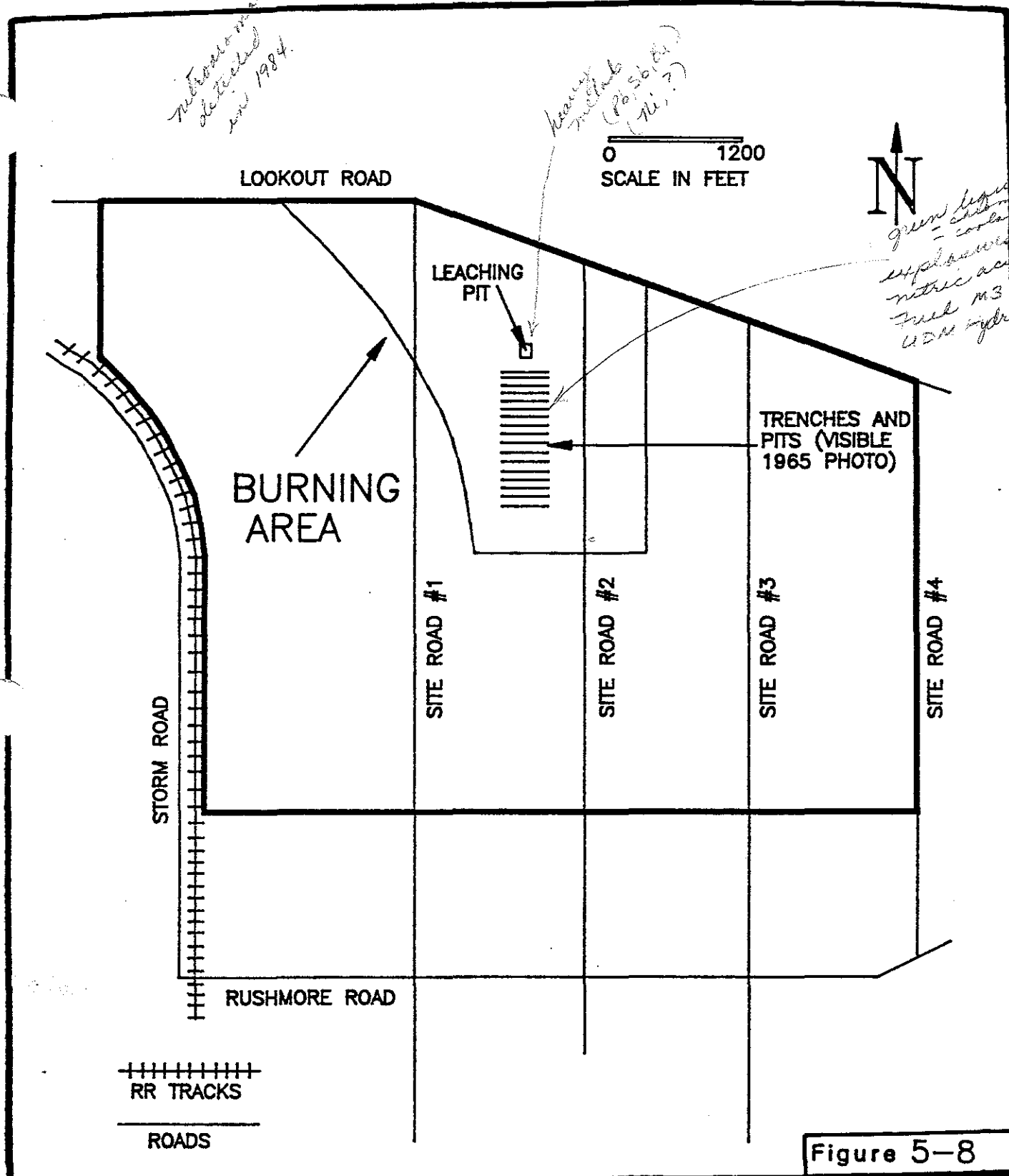


Figure 5-8

**TCT**

St. Louis

BURNING GROUND #3  
FORMER BHAD

Project No. 9222

By: DJ

Chk'd By: TL

Date: 8-11-92

Few references to this test range were encountered in the documents and those found consisted exclusively of facility maps dated 1959 or later. A 1965 facility map showing restricted areas labeled the Tracer Range as Restricted Area No. 4 and the Statement of Clearance described Area No. 4 as a non-use restricted area. The Test Range does not appear on aerial photographs until 1965 [BHADM-13]. Prior to the late 50's, records indicate that small caliber tracer ammunition was tested at Burning Ground 2 [BHAD-114,125,126].

### X Area - Burning Ground 3

Burning Ground 3, shown in Figure 5-8, consisted of approximately 675 acres and was located in the X Area in the north central portion of the BHAD (Plate 9, Photo Documentation). Prior to construction of the burning site, in approximately 1959, the X Area contained concrete pads for open storage [BHAD-103, 114]. Silica carbide was stored at Pad X-115 during and subsequent to the operation of the depot [BHAD-114]. In 1946, white phosphorous stored in the northwest corner of the X Area, ignited, and burned for several days [BHAD-064, 114]. The accident is further described in Section 5.3. Records indicate that the burned casings were buried north of Block J as shown in Figure 5-7 and Plate 8 (Photo Documentation) [BHAD-001,053, BHADM-001].

Burning Ground 3 was used for the burning of small arms (30 caliber ball with tracer), conventional ammunition ranging in size from 20 mm through 240 mm, fragmentation bombs ranging in size from 20 lb to 260 lb., ammunition components including fuzes, primers, boosters and propellants, bulk explosives, and guided missile fuel and oxidizers including fuming nitric acid, Fuel M3, and unsymmetrical dimethylhydrazine [BHAD-053, 103, 114]. All references to the burning of ammunition at Burning Ground 3 indicate the ordnance destroyed contained high explosives fillers rather than chemical fillers [BHAD-114,133,135].

A 1965 aerial photo (Plate 9, Photo Documentation) reveals the presence of 21 trenches. Six to 14 pits were present within each trench. Several denuded and disturbed areas most likely represent leaching beds for chemicals or bulk explosive [BHAD-M-016]. According to documents, personnel from Ellsworth AFB, South Dakota stored missile fuel and their component products at the depot. Burning Ground 3 was used for the disposal of these fuels. In general, the materials were poured into trenches and burned. All disposal activities were conducted by Air Force personnel rather than facility personnel [BHAD-114, 135]. Documents indicate the materials were stored in Igloos A-504 and A-805 beginning in 1958. Destruction of the materials took place from 1959-1960 [BHAD-114]. During the early 60's, Mr. Frank Manke, who herded sheep near Burning Ground 3, occasionally went into the restricted area to retrieve some of his flock. According to Mr. Manke, personnel would pour liquids, green in color and similar to anti-freeze, into the trenches. The material was not burned, but was allowed to soak into the ground [BHAD-133].

*Chromat? coolant?*

### Burning Ground 1

As shown in Figure 5-9, Burning Ground 1 (BG-1) was located outside the perimeter fence along the southern edge of the former BHAD [BHADM-001]. The area consisted of 438 acres and was used for the destruction of white phosphorous and mustard bombs and

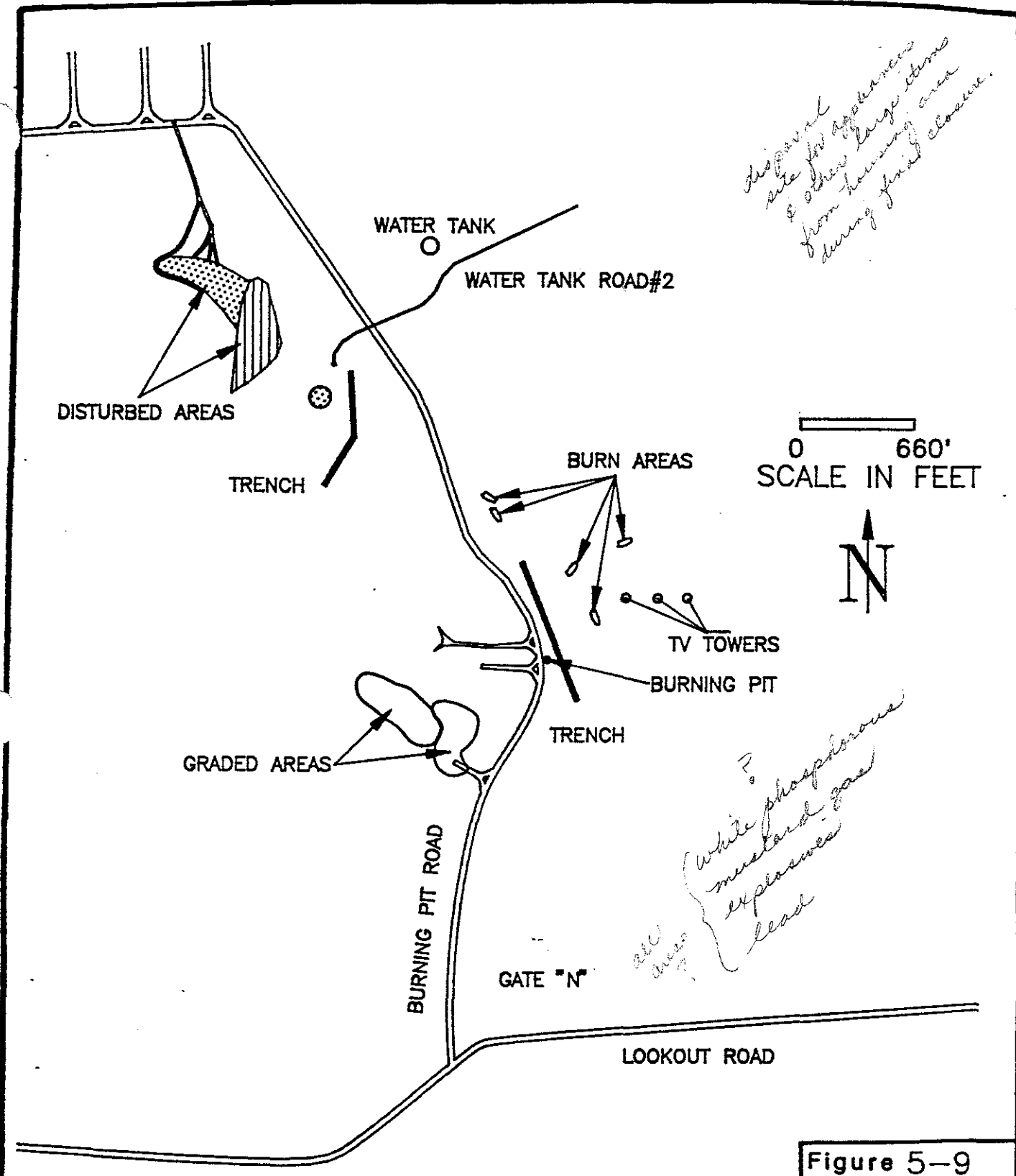


Figure 5-9

**TCT**  
St. Louis

BURNING GROUND #1  
FORMER BHAD

Project No. 9222	By: DJ	Chk'd By: TL	Date: 8-11-92
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conventional ammunition ranging in size from 20 mm to 240 mm, with explosive fillers [BHAD-053]. In the 1954 and 1957 aerial photos (Plate 10, Photo Documentation), two long trenches are present along the road in the center of the burning ground [BHADM-014]. TCT-St. Louis suspects these were burning trenches.

BG-1 was the ordnance disposal area for the depot prior to 1946. In 1946, Burning Ground 2 was constructed and activities increased at the Chemical Area [BHAD-064,125]. Records are unclear as to the use, if any, of Burning Ground 1 subsequent to 1946.

### 5.3 Accidents

Accidents involving fires, explosions, or spills of UXO or OEW did not occur frequently at the BHAD. The training and retraining of the surveillance and fire departments and depot personnel resulted in an excellent safety record at the depot. Several times throughout the depot's 25 year history, the fire department and the depot received awards for their safety practices [BHAD-125,126,135]. A number of accidents involving UXO and OEW did, however, occur.

In 1946, a large fire occurred when a forklift driver accidentally punctured a 100-lb. bomb containing white phosphorous which engulfed the entire stack of 38,500 bombs in flames [BHAD-125,136]. During the initial 20 hours following the incident, bombs exploded at random and white phosphorous and shrapnel were forced into the air. When the area was cleared, the burned white phosphorous casings were buried in two pits located north of Igloo Block J [BHAD-064]. The suspected burial location, based on documents and maps, is shown in Figure 5-7 and Plate 8, Photo Documentation.

On March 31, 1950, Joseph M. Murray, Douglas Armentrout, Jr., Harrison Bird, and Louis E. Sanford were working in an igloo magazine. At about 8:10 A.M., an explosion blew off the top of Igloo F-1304, shattering one wall, and scattering grenades throughout the area. The structure collapsed upon the men inside, trapping them under concrete and other debris. Three men died and the igloo was destroyed. Due to the presence of hand and rifle (M9A1) grenades scattered throughout the site, the area was fenced and barricaded [BHAD-114]. Records do not indicate the final disposition of the area, however, Igloo F-1304 is not mentioned in any decontamination documents found. uxo?

Two separate fatalities occurred at Burning Ground 2; however, the date of their occurrence is not known. While working on a "mustard shell" one man was killed when the shell exploded. It is not certain whether he died due to complications from the mustard gas burns or the shrapnel [BHAD-046,125]. The second fatality occurred at the popping furnace at Burning Ground 2. A worker tried to remove primers lodged in the flue of the popping furnace chimney. One or several of the burning primers exploded, killing the worker [BHAD-125].

In 1959, spillage of bulk explosives resulted from a collision between a truck and semi-trailer on Combat Perimeter Road near the airfield. One vehicle carried Composition B and the other diesel fuel. Following the accident, the explosive residue spilled on the ground was burned in place. It took over four hours to clean up the spillage of Composition B [BHAD-114].



#### 5.4 Closure and Decontamination

Following the U.S. Army Supply and Maintenance Command's decision to close the facility in 1964, the BHAD was decontaminated according to the "Preliminary Statement of Neutralization" and the "Standing Operating Procedures for Decontamination of the Black Hills Army Depot" by Depot personnel [BHAD-001, 053]. These documents are presented in Appendices G and H, respectively.

The methods and degree of decontamination were based upon War Department Supply Bulletin SB5-52 and War Department Technical Bulletin TB-Eng 57 [BHAD-123]. During the decontamination effort, a marking system was employed which would enable easy recognition of the method and degree of decontamination completed.

- X - Water flushed (partly decontaminated)
- XXX - Decontamination by boiling and/or steaming, but not considered toxically or entirely safe for open flame of high temperature
- XXXXX - Decontaminated by tear-down of the equipment and flashing with open flame where necessary or of such nature that decontamination was effective [BHAD-123]

Decontamination by flashing referred to the practice of subjecting the object to an open flame with a temperature above the flash point of the explosive compound.

The decontamination effort was completed in December of 1966 and was directed primarily towards reduction of the explosive hazards associated with ammunition storage facilities, renovation and washout facilities, leaching beds, burning grounds and the chemical area and chemical burning pit [BHAD-001,053]. Documents indicate that decontamination was performed to the "most reasonable degree" with consideration of the applicable land restrictions [BHAD-001]. Contaminated equipment or material and waste explosives were not to be disposed of by burying [BHAD-001]. The official Statement of Clearance dated January 31, 1967 is presented in Appendix I and states:

*Statement of Clearance (January 31, 1967) - All lands within the Black Hills Army Depot, Igloo, South Dakota, located approximately 8 miles southwest of Edgemont, South Dakota, have been given a careful search and have been cleared of all dangerous and/or explosive materials reasonably possible to detect. Six areas depicted on the enclosed drawing PE 1004-1, dated January 27, 1967, are designated as restricted. Area No's. 1, 2, 4, 5, and 6 are entirely restricted from any use. Area No. 3 is restricted to surface use only. All other tracts are recommended for any use for which the land is suited [BHAD-001].*

According to the 1966 SOPs, all area structures and equipment were decontaminated to the 3X level. Equipment was scheduled for inter-depot transfer [BHAD-001]. All structures associated with the storage igloos, 8000 Area, 3000 Area, 3046 Area, deactivation furnace, disassembly plant, 6000 Area, and Burning Ground 2 were to be thoroughly inspected and tested for explosives including floors, drains, sumps, pipes, and vacuum ventilation systems.

If explosives were found to be present, the inside structure was swabbed with either hot water (for black powder and explosive D), steam (for TNT and mixtures) or acetone (for tetryl). The structures were then rinsed and retested for the presence of explosives. All sweepings and wet vacuum water were containerized and sent to Burning Ground 2 for destruction [BHAD-001,053].

The perimeters surrounding all storage and operational structures were also inspected and tested for the presence of explosives. If explosive residues were present, scrap metal was brought to the site to create a high intensity burn. The area was then flashed. This procedure was repeated until the area tested negative for explosives [BHAD-001,053]

Explosive leaching beds were flashed with metal scrap and retested for explosives as above, then covered with soil. Acid leaching beds were covered with one inch of limestone then graded over with soil [BHAD-001].

All "exposed and passible" areas within the burning grounds and demolition areas (Burning Grounds 1, 2, 3) were cleared of explosive residues, ammunition and ammunition components. The demolition pits were covered over with soil and the areas were fenced. The chemical burning pit was filled with combustible burning materials and scrap and was then burned, covered over and enclosed in a barbed wire fence [BHAD-001].

According to the Preliminary Decontamination Report (1965), contamination within the Chemical Plant Area included:

*An underground drain, approximately 250 feet long, is known to be contaminated with mustard. This drain is located 5 to 8 feet underground and passes under a reinforced concrete slab [BHAD-053].*

Neither the Preliminary Decontamination Report, nor the decontamination SOPs recommended the excavation or removal of this drain [BHAD-001, 053]. The 1965 report did recommend the closure of the chemical burn pit, wash-down and removal of the Chemical Plant and fencing of both areas [BHAD-053].

According to the Statement of Clearance, six areas were restricted for use [BHAD-001]. These included: Area 1, Burning Ground 1 (non-use); Area 2, Burning Ground 2 (non-use); Area 3, Burning Ground 3 (surface use only); Area 4 - Tracer Test Range, (non-use) Area 5 - Chemical Plant (non-use), Area 6, Chemical Burning Pit (non-use). An undated map depicting restricted areas states the following [BHADM-013]:

*Areas restricted are fenced with 5-wire barbed fencing and posted at 1/4 mile intervals with Danger Signs.*

*Area 1, Area 2: Contaminated Areas, Live Ammo, Chemical Components or Shrapnel. Keep Out.*

*Area 3: Contaminated Area. Blister Chemicals, Acids, and Highly Flammable Materials at Depth.*

*TE: Restrictions  
Surface Use*

*Area 5, Area 6: Contaminated Areas, Blister Chemicals, Keep Out*

In September of 1965, the former BHAD was reported to the GSA as excess and neither decontamination document referred to the Tracer Test Range [BHAD-001,053].

On June 30, 1967, the facility was permanently closed [BHAD-091]. In 1968, all land within the fenced area was sold to the City of Edgemont and that outside was transferred to the U.S. Forestry Service as described in Section 4.3 [BHAD-012,013,091].

### **5.5 Potential Presence of UXO**

This section addresses the potential presence of UXO at the former BHAD. Information presented is based on historical and decontamination reports, maps, aerial photographs, interviews, and information obtained from TCT's site visit and previous investigations.

During TCT's site visit, a number of items were encountered that were believed to be UXO. Following their discovery, Corps of Engineers representatives present at the site, contacted the 94th Ordnance Detachment, Ft. Carson, Colorado. The Army unit destroyed the items listed in Table 5-3 [BHAD-142]. The majority of the UXO were encountered at Burning Ground 2 or were obtained from local individuals who found the items while on-site and collected them as war memorabilia. Included in the items was an M61 rocket which had been found at the BHAD and was stored in a warehouse at the site (Photo Documentation, Photos, p28). According to the former mayor of Edgemont, a metal crate of land mines was found at the BHAD and was removed by an ordnance unit from Ellsworth AFB [BHAD-119]. No dates or names were supplied. According to personnel from Ellsworth, no ordnance detachment had visited the former BHAD subsequent to 1980. Records were not kept on file prior to 1980 [BHAD-151]. Since closure of the facility, no accidents involving UXO have been reported.

A number of investigations have been conducted at the depot following its closure. Previous studies include investigations conducted by Edgewood Arsenal in 1971, U.S. Environmental Protection Agency (USEPA) in 1981, Chem-Nuclear in 1984, and Johnson Environmental Concepts in 1991 [BHAD-6, 9, 54, 115].

### **Storage Igloos**

During operation of the BHAD, the igloos were used for long term storage of ordnance and bulk explosive [BHAD-065]. The Magazine Area is located in the western half of the facility (Figure 5-1). Currently, the 797 igloos (originally 802 igloos) present at the former BHAD are either empty or contain animal waste from cattle present throughout the area. According to a local resident and salvage operator, no ordnance or bulk explosives are present in any of the igloos [BHAD-120]. The majority of the magazines are owned by FHT and Burton Hutton; however, Eugene Erickson owns 52 igloos in Block J [BHAD-M-010]. The area is used for cattle grazing.

TABLE 5-3	
UXO FROM BHAD DESTROYED BY 94TH ORDNANCE DETACHMENT	
Number	Item
1	M61 Practice chemical rocket
1	M83 Fragmentation bomb (Butterfly)
2	M47A4 Incendiary bomb
2	M103 Bomb fuze
1	155 mm Smoke filled with red phosphorous
8	75 mm AP shot rounds
1	M145 Bomb MT fuze (possible)
2	M61A1 Projectile fuze

AP = Antipersonnel

In 1950, an explosion occurred in Igloo F-1304, as described in Section 5.3, killing three men. Grenades were scattered around the area and the site was fenced. Records do not indicate the final disposition of the area [BHAD-114].

During 1967, two quantity distance tests were conducted in Igloo Block D, as described in Section 5.2.2. Approximately 4,000 M61 rockets containing ethylene glycol were placed in the igloos and detonated. Both igloos were completely destroyed. No records were encountered detailing the subsequent clearance of the detonation area [BHAD-054].

Several of the igloos were inspected during the site visit (Photo Documentation, Photos, p31). No evidence of UXO or OEW was encountered.

#### Burial Area - Empty White Phosphorous Casing

According to documents, burned and empty white phosphorous casings, resulting from a fire in the X-Area, were buried north of Igloo Block J. In 1946, following the fire, the casings were buried in two separate pits at the location shown in Figure 5-7 and Plate 8 (Photo Documentation). Aerial photographs and observations during the site visit do not indicate the presence of pits at this location. The area was surveyed with a metal detector, which did not indicate the presence of ferrous metal in the subsurface to a depth of 4'. Vegetation was present throughout the area; however, the grass was generally much shorter (<1/4 inch) at the suspected burial site than in the immediate vicinity (2-3 feet). The area is currently owned by Burton Hutton and is used for grazing (Photo Documentation, Photos, p27).

#### Combat Material Area - 1800 and 2000 Area

As shown in Figure 5-1, the Combat Material Area is located in the southeastern corner of the former BHAD. The area is owned by Fall River Properties and is used for cattle grazing [BHADM-010,012].

The Combat Area was used as a storage facility for inert materials and small arms [BHAD-001,065]. A salvage burning pit was located south of Building 1818 [BHAD-114]. The area was not observed during the site visit.

#### Ammunition Workshop Area - 3000 Area

The 48 acre Ammunition Workshop Area is located in the south central portion of the facility as shown in Figure 5-2. The site is currently owned by FHT and is used to graze cattle [BHADM-010,012].

During operation of the BHAD, this site was used for the renovation of munitions. A washout facility and leaching beds were used during renovation operations. Reportedly, the area was decontaminated by flashing and the beds were covered over with material [BHAD-001, 0053]. Explosive residue was not excavated and decontamination documents recommended the area for surface use only [BHAD-001,053]. The area is shown in Plate 1 (Photo Documentation). A 1971 aerial photo indicates the area had been graded over [BHADM-017].

Vegetation was sparse and, in places was absent; however, the area was extensively grazed which may limit vegetational development. During the site visit, explosive residues were not encountered at the surface, but UXO was encountered within the area. A 75 mm armor piercing shell with tracer was found on the floor at Building 3008. According to the Edgemont Fire Chief, a number of the shells were found in a crate. The crate was hung from the door of Building 3008 and was used to keep the door open (see photos, Appendix D, p28). The 94th Ordnance Detachment from Ft. Carson, disposed of the shell and seven others were found by local residents [BHAD-142].

No ordnance was encountered in Building 3038 and 3046.

#### Surveillance Area

During the site visit, a disturbed area was encountered south of the Ammunition Workshop. The roughly circular area was partially denuded and expended igniter tubes and primers were present on the surface. Signs of recent earth moving activities were visually evident. According to the former Demolition Foreman, this area may have been used by the Surveillance Office. The exact nature of their activities was not known [BHAD-125,126]. This area appears on 1957 and 1965 (Plate 11, Photo Documentation) aerial photos [BHAD-015,016].

#### Bundle Ammunition Packing Area - 4000 Area

As shown in Figure 5-3, the 4000 Area is located in the south central portion of the former BHAD. The site is currently owned by FHT and is used for cattle grazing [BHADM-010,012].

During operation of the former BHAD, the facility was used for the packing and repacking of ammunition. A disassembly plant and deactivation furnace (Plate 1, Photo Documentation) were located within the area [BHAD-001, BHADM-001].

No UXO were encountered by TCT within the 4000 Area. A sanitary filter bed system including an Imhoff tank was still present within the area (Photo Documentation, Photos, p31). All that remained of the deactivation furnace was a concrete structure. Small arms and ammunition components were destroyed in the furnace [BHAD-053].

The disassembly plant (Photo Documentation, Photos, p30) was an outdoor bermed area used to dismantle large bombs [BHAD-053]. The berm is still visible. At the southern end of Disassembly Plant Road, a crescent shaped berm containing large pieces of iron was encountered. At one end of the berm, small denuded areas were present. The material in the denuded areas had the appearance of thermite.

#### Burning Ground 2 - 5000 Area

Burning Ground 2 (Plates 2 and 3, Photo Documentation) is located in the southwestern portion of the facility (Figure 5-4) and consists of 964 acres. During operation of the BHAD, subsequent to 1946, this site was used for the demolition and burning of small arms,

conventional weapons, bombs (high explosive, chemical and incendiary), grenades, mines, rockets, and ordnance components as described in Section 5.2.2. Ordnance destroyed at this location contained high explosive, chemical or incendiary fillers [BHAD-114,125,126].

During decontamination, the area was surface cleared and all pits and trenches were covered. The former burning ground was fenced and restricted by the U.S. Government from all future land use [BHAD-001]. Currently, the property is owned by the U.S. Forestry Service and cattle graze throughout the site [BHAD-119]. The area is partially fenced; however, no "non-use" signs are posted. One locked gate limits access to the northern entrance to the burning ground. According to two local residents, fencing was removed and cattle grazed the area shortly after the property was transferred to the U.S. Forestry Service [BHAD-132,133].

During the site visit, three carcasses of cows were found in the northern portion of the site. Shrapnel was visible on the surface throughout the entire area. The metal detector was of little use due to the presence of large amounts of metal. Vegetation covered the majority of the site; however, many areas contained large patches that were denuded or sparsely covered (Photo Documentation, Photos p9). Areas adjacent to the northern roads were denuded and contained ash, metal fragments, fuzes, and boosters. Several trenches shown in Figure 5-4 were still visible. A number of structures, including the popping furnace were still present (Photo Documentation, Photos p10).

Ravines located along the northern roads at Burning Ground 2 contained numerous (>100) timing fuzes, teteryl-filled boosters, igniter tubes, miscellaneous fuzes, boosters, and bursters, possible thermite burn mounds, 55-gallon drums and metal wire and rings (Photo Documentation, Photos p11-13). Metal canisters were also present which may have contained gas kits, chemical grenades, or miscellaneous items. All the above items were scattered down the sides of the ravines. Additional items were partially exposed along the bottom and sides of the ravines. Information obtained from a number of local residents indicates that salvage operations took place at Burning Ground 2 following closure. The area was extensively cleared of salvageable brass [BHAD-127,128,129,130].

At the southern end of the burning ground, ten 155 mm shells were encountered near and within an alkaline stock pond (Photo Documentation, Photos p16). One of the shells contained a burster. An M83 fragmentation bomb (butterfly) was found near the shells. Adjacent to the pond, was a mounded area which appeared to have been a burning site for the 155 mm shells. Shell debris covered the location.

Approximately six steep sided, circular detonation craters were observed within the southeast-central portion of the burning ground (Photo Documentation, Photos, p15). Four of the craters contained water which smelled of sulfur and appeared stagnant. Vegetation was present in the bottom of the dry holes. One small ash pile (6 ft x 3 ft) was situated near one of the craters. In general, the area was highly vegetated, however, small areas devoid of vegetation were frequently encountered. No UXO were encountered near the detonation pits.

During 1971, a team from Edgewood Arsenal, Maryland, conducted an investigation within Burning Ground 2 in response to complaints from a local resident. Air, soil, and metal fragments were tested for the presence of mustard. All results were negative [BHAD-001]. Ten years later, in 1981, the USEPA conducted an additional study of the BHAD. Soil and water samples were collected from ash piles, dry craters, wet craters, a suspected mustard gas area, and the stock pond at the southern end of the burning ground.

Soil samples contained elevated levels of metals (cadmium, copper, nickel, mercury and lead) and nitrate. In addition to the above, the suspected mustard burning area contained polynuclear aromatic hydrocarbon compounds (flouranthene, chrysene, anthracene, phenanthrene, and benzo(a)anthracene. Water samples contained elevated levels of antimony. Samples were not analyzed for nitroaromatic compounds [BHAD-009].

#### Chemical Area - 6000 Area

The 114-acre Chemical Area, shown in Figure 5-5, includes the Chemical Burning Pit, Chemical Warfare Area and the Chemical Plant. The burning pit and Warfare Area are currently owned by the U.S. Forestry Service and the remainder of the Chemical Area is owned by Burton Hutton [BHADM-010,012]. With the exception of the burning pit, cattle graze throughout the site. The burning pit is fenced and is posted with a non-use sign.

During operation of the former BHAD, leaking chemical munitions were stored in the Chemical Warfare Area [BHAD-143,144,145,146,147,148,149,150,152]. The area, present on the north side of the perimeter fence, contained a large, slightly bermed depression (300 ft x 300 ft) and was surrounded on the eastern side by a series of three semi-circular trenches (Plate 5, Photo Documentation, Photos p22). Vegetation was present throughout and a magnetometer survey did not indicate the presence of metal in the subsurface within 4'. According to former depot personnel, the area was used exclusively for outdoor storage of chemical toxics and chemical filled ordnance [BHAD-125,126,132,135].

The former burning pit is located northwest of the storage area and measured approximately 75 ft by 150 ft. Documents do not clearly indicate the purpose of this area. One trench was present within the area in the 1954 and 1957 aerial photograph (Plate 4, Photo Documentation); however, two trenches (Plates 5 and 6, Photo Documentation) were present by 1965 [BHADM-014,015,016]. Chemical munitions were most likely drained and decontainerized in the pits. Chemical toxics may have been disposed of at this location [BHAD-149,152]. According to documents, during decontamination, the chemical incinerator was buried within the pit [BHAD-001,054].

The pit itself was flashed, covered over and fenced. The original sign which has fallen into the fenced area reads "Chemical Burning Pit, decontaminated and closed" (Photo Documentation, Photos p20). Vegetation was present throughout the fenced area; however, due to the actions of burrowing animals, denuded areas were present which exposed metal beneath the surface (Photo Documentation, Photos p21). A drainage area adjacent to the northwest corner of the fenced pit contained metal and rubble. This area was generally denuded.



Mustard, cyanogen chloride, and phosgene were incinerated within the Chemical Plant Area [BHAD-031-053,114,125,126,152]. An incinerator for cyanogen chloride and phosgene may have been present as early as 1954 [BHAD-137,152]. The entire area was fenced and a leaching bed was present east of the plant, outside the fenced area. Round red tags were found at the surface in a denuded area (Photo Documentation, Photos p23). Printing on both sides of the tags stated "Open valve for surveillance purposes only. Never apply more than 75-inch pounds in closing valve. Never remove this tag. Tampering with this valve may mean death". It is not known whether the tags were present on the chemical ordnance or the incinerator. The majority of the area east of the former incinerator was denuded (Photo Documentation, Photos p24-26).

According to decontamination documents, the incinerator was washed down and removed. A decontamination document presented in Appendix H indicates that a 250-foot buried pipe, 5-8 feet below the surface, contained mustard [BHAD-053]. No information pertaining to its removal was uncovered. The fence surrounding the chemical plant has been removed and very little remains of the fence which enclosed the incinerator (Photo Documentation, Photos p25).

#### Ammunition Normal Maintenance Area - 8000 Area

The 8000 Area, shown in Figure 5-1 and Plate 7 (Photo Documentation), consists of approximately 8 acres located in the central portion of the site. The area is owned by Fall River Properties and is currently used as grazeland.

Since 1991, a portion of the site has been investigated for its suitability as an ash disposal landfill. The study included the installation and excavation of monitoring wells, boreholes, and test pits. With the exception of nitrate, analytical results do not indicate the presence of any contaminants. One well contained extremely elevated levels of nitrate [BHAD-115].

During operation of the BHAD, the 8000 Area was used for the maintenance and renovation of ammunition. A vacuum collection building for the collection of explosives was present during operation of this site [BHADM-001, BHAD001,053].

Aerial photos indicate the presence of a circular disturbed area north of the 8000 Area (Plate 7, Photo Documentation). Its presence is believed to be associated with construction of the reservoir nearby [BHADM-014,015,016,017].

During the site visit, no UXO or OEW were encountered in the area. A covered sump, filter bed, and a series of vented pipes were present; however, the structure is believed to be an Imhoff tank for sanitary sewage (Photo Documentation, Photos p29).

#### Tracer Test Range - 9000 Area

As shown in Figure 5-7 and Plate 8 (Photo Documentation), the Tracer Test Range is located outside the perimeter fence north of Igloo Block J. The property currently belongs to the U.S. Forestry Service and is used as grazeland. the presence of this site does not appear on aerial photographs until 1965 [BHADM-016].

Two empty buildings and a target/impact berm are all that remain of the range. Thirty (30) and 50 caliber shells were found at the base of the berm. Many still contained tracer and the entire upper portion of the projectile was filled with a white powder which may be either an inert or incendiary filler [BHAD-153]. According to Dave Henderson, souvenir hunters frequent the area and after heavy rains additional shells are exposed at the surface [BHAD-127]. The area is not fenced and was designated as Restricted (non-use) Area No. 4 on a facility map [BHADM-013].

### X Area - Burning Ground 3

The X Area shown in Figure 5-1 consists of 675 acres and is located in the north central portion of the BHAD [BHADM-001]. From 1942 until 1959, the X Area was used for open storage of munitions [BHAD-103]. In 1946, a fire caused by the puncturing of deteriorating white phosphorous bombs occurred in the northwestern corner of the X Area [BHAD-064]. Documents do not delineate the clean-up of the area subsequent to the accident.

In 1959, Burning Ground 3, as shown in Figure 5-8, was constructed within the X Area. Ordnance, ordnance components bulk explosives and missile fuels were destroyed by burning at this location [BHAD-053,114,133]. Trenches and pits were visible in the 1965 aerial photo shown as Plate 9 in Photo Documentation [BHADM-016]. Leaching pits were present in the northern portions of the burning ground [BHAD-001,053, BHADM-001].

During decontamination, the burning pits and explosive leaching pits were flashed and covered over. Acid leaching pits were covered with limestone and earthen material. The area was to remain fenced and restricted to land use only [BHAD-001,053].

Currently, Burning Ground 3 is owned by Burton Hutton and is used as grazeland [BHADM-010,012]. The site is not completely surrounded by a fence and no signs were posted.

During the site visit, shrapnel, bomb fins, bursters, igniter tubes, and bomb fragments (260 lb fragmentation bomb) were sporadically present (Photo Documentation, Photos p18). No surface expressions of pits or trenches were observed. The majority of the site was well vegetated; however, sporadic denuded areas which contained shrapnel, fuzes and ash were present throughout the area (Photo Documentation, Photos p19). No visual evidence of the leaching bed was found.

In 1984, Chem-Nuclear selected Burning Ground 3 as a potential location for a disposal area for low level radioactive waste. A number of borings were drilled within the former burning ground. The presence of shrapnel, etc. was either not observed or not recorded. A metal detector was used during all drilling activities. Elevated levels of sulfates were found at all locations however, the soils within the area are generally high in sulfates. pH was low at two locations. Ultraviolet spectroscopy was used to detect the presence of nitroaromatics. One sample location exhibited potentially high levels and several others contained low to moderate levels. The site, however, was never developed as a disposal area [BHAD-008].

## Burning Ground 1

As shown in Figure 5-9 and Plate 10 (Photo Documentation), Burning Ground 1 is located along the south-central edge of the depot, outside the perimeter fence [BHADM-001]. The 438 acre site is currently owned by the U.S. Forestry Service and is used for grazing [BHADM-010,012].

During operation of the former BHAD, chemical incendiary and high explosive munitions were destroyed at this location by burning or detonation [BHAD-053]. Records indicate that this facility operated until at least 1946. In 1946, Burning Ground 2 was constructed and documents do not delineate what function, if any, Burning Ground 1 assumed [BHAD-064].

It is believed that this area was decontaminated in a manner similar to Burning Grounds 2 and 3. The area was fenced, placarded and designated as a non-use area [BHAD-001,053]. Currently the site is not completely fenced. No non-use placards were visible. According to the former mayor of Edgemont, this location was used as a disposal site (Photo Documentation, Photos p8) for appliances and other large items from facility housing during the final closure of the facility [BHAD-119].

During the site visit, numerous (>100) fuzes, 37 mm shells, 100 lb bomb casings (mustard or incendiary), bomb fragments and shells were encountered in the ravines on both sides of the burning ground. Photos of the items encountered are presented in Photo Documentation, Photos p2-7. Personnel from the 94th Ordnance Detachment destroyed two M103 bomb fuzes and one M47A4 incendiary bomb that was found at Burning Ground 1.

Vegetation on level areas at the site was generally sparse or absent (Photo Documentation, Photos p1). Trash, including appliances and ranching equipment was found in the southern portions of Burning Ground 1.

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BHADM-006	Topographic Map (7.5 Minute) Provo Quadrangle Fall River County, South Dakota 1982.
BHADM-007	Topographic Map (7.5 Minute), Phister Ranch Quadrangle, Fall River County, South Dakota, USGS, 1982.
BHADM-008	Hazardous and contaminated areas map, May 24, 1965. Office of the post Engineer.
BHADM-009	Late 40's early 50's Additions. 1940s Additions, Layout Plan, 1942.
BHADM-010	Soil Conservation Map, Ownership Map, 1992.
BHADM-011	U.S. Forestry Map, Forestry Ownership and Leases, 1992.
BHADM-012	Fall River County Tax Assessor's Office, Current Ownership Map, 1992.
BHADM-013	Restricted Areas Map, January 27, 1967, PE-1004-1.
BHADM-014	1954 aerial photographs, Department of Agriculture.

**REFERENCES**  
**BLACK HILLS ARMY DEPOT**  
**(Continued)**

BHADM-015	1957 aerial photographs, Department of Agriculture.
BHADM-016	1965 aerial photographs, Department of Agriculture.
BHADM-017	1971 aerial photographs, Department of Agriculture.
BHADM-018	Soil Horizon Map, Soil Conservation District, 1982.
BHADM-019	Hazardous & contaminated Area Map, BHAD, March 27, 1963.



**APPENDIX A**  
**RESPONSE TO COMMENTS**

## RESPONSE TO COMMENTS

### COMMENTS FROM MR. RUTHER - ARCHIVES SEARCH REPORT:

Comment 1: Page 5-18, GB-2, which starts the second paragraph should be changed to BG-2. Correct.

Response: Text revised.

Comment 2: Paragraph 2.5, the word "survey" should be added behind the parenthesis in the first sentence of the third paragraph. Correct.

Response: Text revised.

Comment 3: General - The figures use three types of shading for three types surveys interchangeably which can be confusing. The shaded symbols for each type of survey should be consistent.

Response: All figures revised. Each type of shading represents one type of geophysical survey.

Comment 4: Appendix A - The Risk Assessment Code draft letter attached as sheets 1 through 3 should not be included in any of the submittals for this project or any other projects (former Camp Crowder and Paine Airfield). Remove.

Response: Agree. Deleted pages 1-3 of Appendix A - Risk Assessment Code. Renumbered remaining pages accordingly.

Comment 5: General - Emergency measures consisting of fencing and placarding are recommended which encompasses a very large area. In lieu of such a large scale fencing operation, a fast surface clearance sweep may be desirable to remove all surface debris and the subsurface investigation could proceed at a more reasonable schedule.

Response: Disagree. A fast surface clearance of Burning Grounds 1 and 2 is not possible due to the size of the areas and the potential numbers of UXO present (hundreds to thousands of items spread out over a large area). In addition, the action of erosional forces at the site will continue to expose UXO at the surface and within the ravines after a surface clearance is completed. Limited fencing is a possibility; however, extensive fencing will still be required to enclose hazardous areas. The following has been added to paragraph 1, Sections 2.0, 2.5, 2.6, and 2.7 "The fenced area should include all trenches, pits, burn and demolition areas, and ravines containing UXO".

## RESPONSE TO COMMENTS

### COMMENTS FROM CHUCK TWING

Comment 1: General - Agree with TCT-St. Louis' recommendation that a remedial investigation be conducted at former Black Hills Ordnance Depot. As the RAC score assigned by TCT is IB or Imminent Hazard (RAC-1), further recommend a limited amount of fencing.

Response: Disagree. A fast surface clearance of Burning Grounds 1 and 2 is not possible due to the size of the areas and the potential numbers of UXO present (hundreds to thousands of items spread out over a large area). In addition, the action of erosional forces at the site will continue to expose UXO at the surface and within the ravines after a surface clearance is completed. Limited fencing is a possibility; however, extensive fencing will still be required to enclose hazardous areas. The following has been added to paragraph 1, Sections 2.0, 2.5, 2.6, and 2.7 "The fenced area should include all trenches, pits, burn and demolition areas, and ravines containing UXO".

Comment 2: General - As a more long-term approach, BHOD should be ranked in the priority list of Chemical Warfare Material (CWM) sites being developed by the St. Louis District. Once the priority reaches the action level, recommend we begin with subdivision and re RAC of smaller operable units. Each unit should be ranked within the BHOD and work begun to characterize the highest priority of these. Each operable unit should then have a remedial investigation/feasibility study to determine proper courses of action as regards both conventional OEW and CWM.

Response: No response required.

### In addition, TCT has reviewed the Draft Report and wishes to make the following changes:

1. Page 2-4, Section 2.1, Paragraph - Change "magnetometer" to "metal detection".
2. Page 2-13, Table 2-1 - Change - "Property (Owner Consolidate....." to "Property Owner (Consolidated....."
3. Page 3-1, Section 3.3, Paragraph 2 - Change "west, southwest, and northwest" to "west, southwest and/or northwest".
4. Page 3-6, Paragraph 8 - Change "Artesian" to "artesian".
5. Page 3-7, Paragraphs 3 and 4 - Combine these two paragraphs into one paragraph.
6. Page 4-8, Paragraph 3 - Delete "to be" from the first line.

## RESPONSE TO COMMENTS

In addition, TCT has reviewed the Draft Report and wishes to make the following changes:  
(Continued)

7. Page 4-8, Section 4.4, Line 2 - Change "own the property" to "own property".
8. Page 4-10, Paragraph 2 - Insert "a" between "Currently" and "single" and change second to last line to read "Burning Ground -2" instead of "BG-2".
9. Page 5-3, Paragraph 3 - Change ..... "burn pit was" to ..... "burn pit were..."
10. Page 5-13, Paragraph 3 - Change "...demilitarization was" to ".....demilitarization were".
11. Page 5-13, Last Sentence - Delete "(Figure 5-2)" and place Figure 5-2 following first mention of the 3000 Area.
12. Page 5-19, Paragraph 2, Line 4 - Change "primers or fuzes" to "primers and fuzes" and change "stimulant" to "simulant".
13. Page 5-28, Section 5.3, Paragraph 1 - Change "for its safety" to "for their safety".
14. Page 5-29 - Statement of Clearance - indent and italicize the Statement of Clearance.
15. Page 5-33, Paragraph 4 - Change "magnetometer" to "metal detector".
16. Page 5-35, Paragraph 2 - Change "magnetometer" to "metal detector".
17. Page 5-36 - Paragraph 1 - Change "stock panel" to "stock pond".
18. Page 5-36, Paragraph 2 - At the end of the paragraph, add "samples were not analyzed for nitroaromatic compounds."
19. Page 5-1, Paragraph 5.1 - Change "magnetometer" to "metal detector"
20. Page 5-34, Paragraph 1 - Change "armored piercing" to "armor piercing".
21. Page 5-36, Paragraph 1 - Change "Edgemont Arsenal" to "Edgewood Arsenal".

TCT wishes to make the following changes to the Conclusions and Recommendations:

22. Page 1-3, First Line - Change "inhabited locations" to "inhabited areas".

## RESPONSE TO COMMENTS

TCT wishes to make the following changes to the Conclusions and Recommendations:  
(Continued)

23. Page 2-1, Section 2.0, Paragraph 1 - At the end of the paragraph add "TCT-St. Louis recommends contacting the 94th Ordnance Detachment, Fort Carson, Colorado (719-279-4242) prior to initiating survey or excavation activities. Additional emergency response contacts are included in Appendix C." The contacts listed in Appendix C are attached.
24. Page 2-1, Section 2.1, Line 4 - Change "However, this training" to "However, due to the potential presence of chemical filled ordnance, this training."
25. Table 2-1 - A footnote has been added to indicate that "fencing should enclose all trenches, pits, burn areas and ravines".
26. Page 2-8, Section 2.8, Paragraphs 2 - Add the following after the first sentence "Fencing should surround both trenches at the burning pit, the former incinerator and the leaching bed area".
27. Page 2-11, Section 2.10, Line 4 - Changed to read "limited by fencing (of the bermed area only)".
28. Page 1-5, Paragraph 5 - Change "7 mm" to "75 mm".

**APPENDIX B**  
**WELLS LOCATED IN AREA**

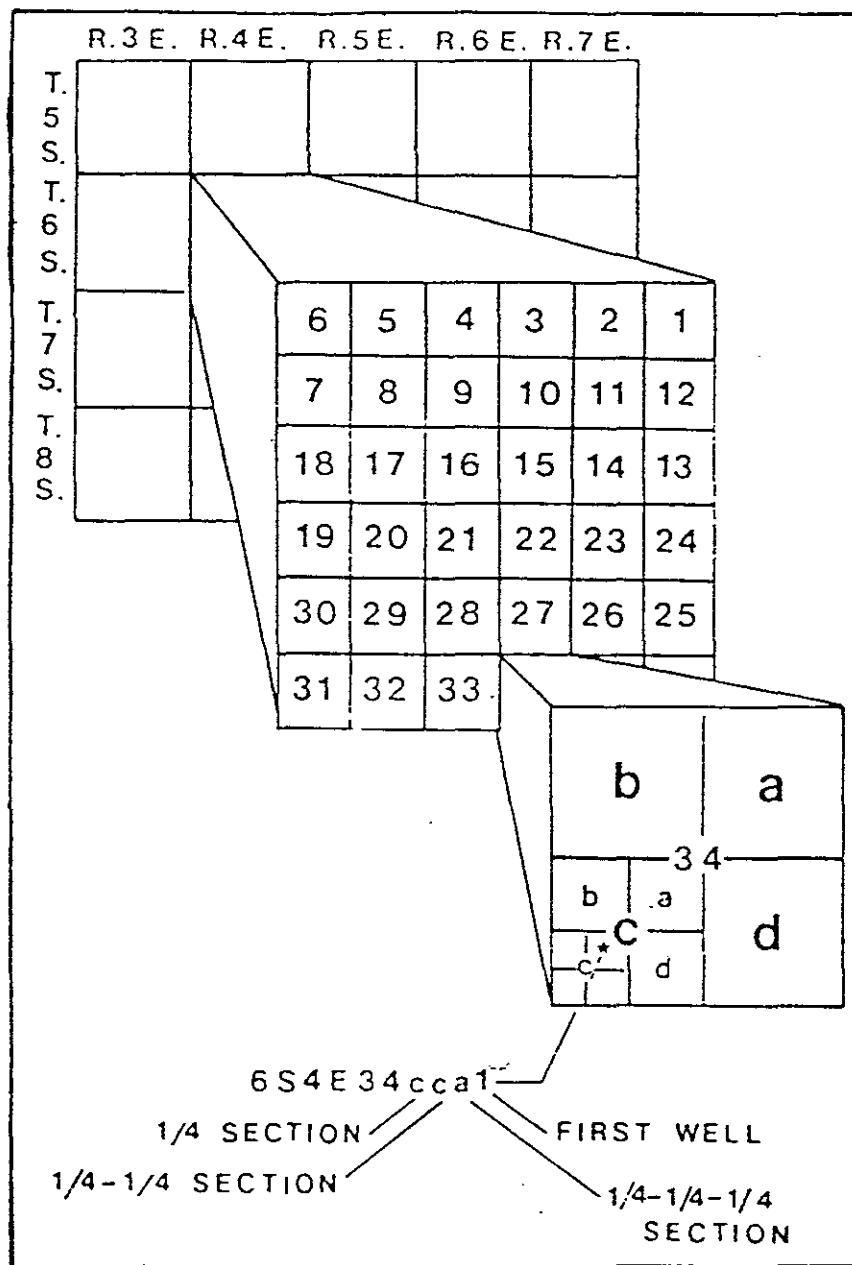


Figure 12 Well numbering system adopted by the U.S.G.S.  
(from Knirsch, 1980).

Table 2 Known water wells within a 13 km radius of the proposed low-level nuclear waste disposal site.

Well number: See Fig. 9. An 'a' after a number indicates the well is abandoned. Some numbers represent multiple wells.

Location: See Fig. 10.

Reference: K - Keene, J., 1973; U - Union Carbide, 1979, I - interview, personal inspection.

Aquifer: Qa - alluvium Qt - terrace Qw - wind blown deposit

Kp - Pierre Shale

Kn - Niobrara Formation

Kc - Carlile Formation

Kg - Graneros Group

Kf - Fall River Formation

Kl - Lakota Formation

Mp - Pahasapa Limestone



Table 2 continued

<u>Well number</u>	<u>Location</u>	<u>Reference</u>	<u>Owner</u>	<u>Depth (meters)</u>	<u>Aquifer</u>	<u>Remarks</u>
1	8S-2E-27dd	K	B. Childers	103	Kf	TDS-1376, trace H S
1a	28ac	K	C. Tubbs	18	Qa	abandoned
2	28bc1	K	C. Tubbs		Qa	
3	28bc2	K	C. Tubbs		Qa	Qa-Kg
3	28da1	K,N	M. Tubbs	126	Kf	SC-5100, H S, house/stock
4	28da2	K	C. Tubbs	6	Qa	2 wells, 0.063 l/s
5	34ac	K	B. Tubbs	27	Qa	trace H S
5a	35cb	K	B. Childers	198	Kl	dry, abandoned
6	35dd	K	M. Fritz	27	Qw	domestic, sand-Mowry contact
7	36aa	K	V. Childers		Qw	0.13 l/s
8	36ad1	K	V. Childers	98	Kl	0.13 l/s
	36ad2	K	G. Tupper	62	Kf	
9	9S-1E-20da	K	Pfister and Danks	613	Kf-Kl	sulfur
10	28ada	N		480	Kf	stock
11	9S-2E-1aall	K,I	Silver King Mines(TVA)	933	Mp	flows 28 l/s

Table 2 continued

12	1aa2	K	Burlington-Northern RR	343	Kl	
13	1aa3	K	Burlington-Northern RR	908	Mp	flows 63 l/s
14	1ac	K	Edgemont #2	908	Mp	flows 8.2 l/s, municipal
15	1bcd	K	D.W. Dutoit	168	Kl	
16	1bcd	K	Edgemont #3	970	Mp	flows 11 l/s, municipal
17	2da	K	Edgemont #4	1095	Mp	municipal
18	4cd1	K,N	J. Eberle	262	Kf	stock
19	4cd2	K	J. Eberle	9	Kg	below stock dam
19a	9ba	K	J. Eberle		Kg	shallow, abandoned
20	10dc	K	R. Miller		Qt	0.063 l/s, Qt-Kg contact
20a	15dd	K,I	R. Miller	5		abandoned.
21	21bb	K,N,I	R. Porter	368	Kl	shares with brother
22	9S-3E-8bd	K	G. Heppner		Qw	flows all year
23	19bca	N		315	Kf	domestic, stock
24	19ca	K,I	Ken Barker	6	Kg	domestic
25	20bdd	N	Robert Smith	360	Kf	domestic, stock
26	21cd	K,I	D. Stearns	9	Kg	stock

Table 2 continued

27	22bc	N, I	D. Stearns	360	Kf	domestic, stock
27a	26cc1	K	M. Helsel	67	Kf-K1	ranch abandoned
	26cc2	K	M. Helsel	8	Qa	abandoned
28	28dc	K, I	G. Heppner	5	Qt	
29	29cc	K, I	G. Heppner	48	Kg	
29a	33dd	K, I	G. Heppner	311	Kf	NaSO , abandoned
30	10S-1E-14ccc	N	John Tanner	7	Qa	stock
31	27n1/2	K	R.G. Pfister	11,6,12,12	Kp(Qa)	located along creek, 4 wells
31a	10S-2E-1bb	K, I	R. Soske	4	Kc	abandoned
32	3ac	K, I	BHOD#1	1175	Mp	privately owned, serves community
33	3dd	K, I	BHOD#2	1219	Mp	privately owned, serves community
34	12bc	K	C. Stearns	7	Kc	hard water
35	13cc	K	C. Stearns	9	Qa	hard water
36	14aac	N		8	Qa	stock
37	24cd	K, I	G. Labar, Wyo.		Qa	flows 0.32 l/s, shallow
38	25da	K, N, I	G. Labar, Wyo.	6	Kp-Kn	flows all year, TDS - 1370 ppm

Table 2 continued

39	28cc	K, I	R. Soske	3	Kp	
40	10S-3E-4	K, I	C. Heppner	2	Kc	improved spring
41	5db	K	E. Stearns	4	Kc	
42	1ldd	K	W. Martinson	6	Kc	below stock dam
42a	15ba	K, N, I	H. Henderson	369	Kf	gas from 90 m, NaSO , abandoned
43	19ac	K	G. Labar, Wyo.		Kn	
44	20aa	K, I	H. Henderson		Kn	runs dry
45	2lad	K, I	H. Henderson	4	Kn	0.32 l/s, hardness - 4760 ppm
46	2lcd	I	H. Henderson	4	Qa	Domestic/stock, serves 3 households
47	30cd	K	C. Crowe	8	Qa	
48	32	K, I	G. Heppner	6	Kp	improved spring
49	11S-2E-2ba	K, I	R. Soske	5	Kp(Qa)	
50	27ba	N	Caylor Bros.	730	Kf	multi-household

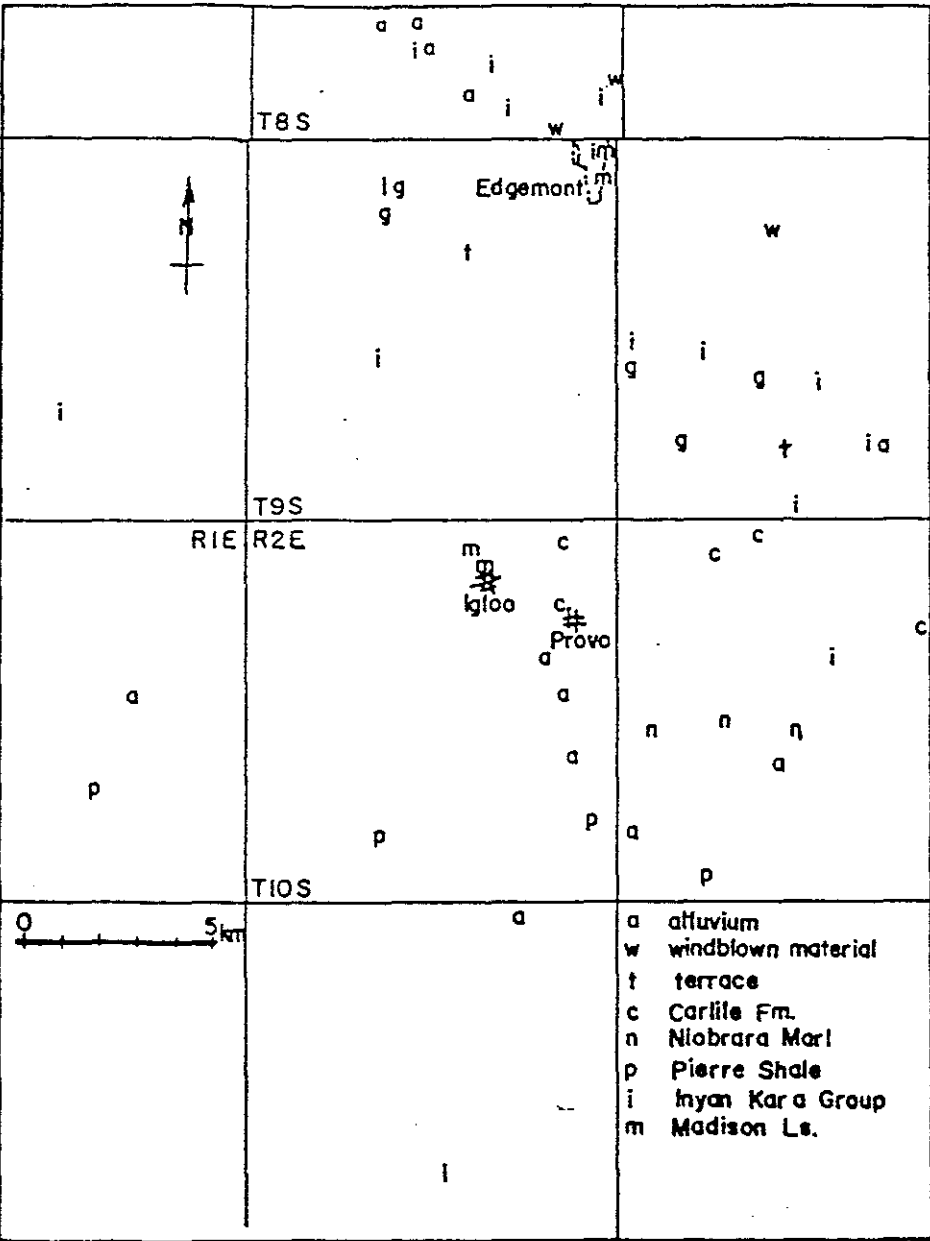


Figure 14 Well location map showing aquifers used by wells as described in Table 2.

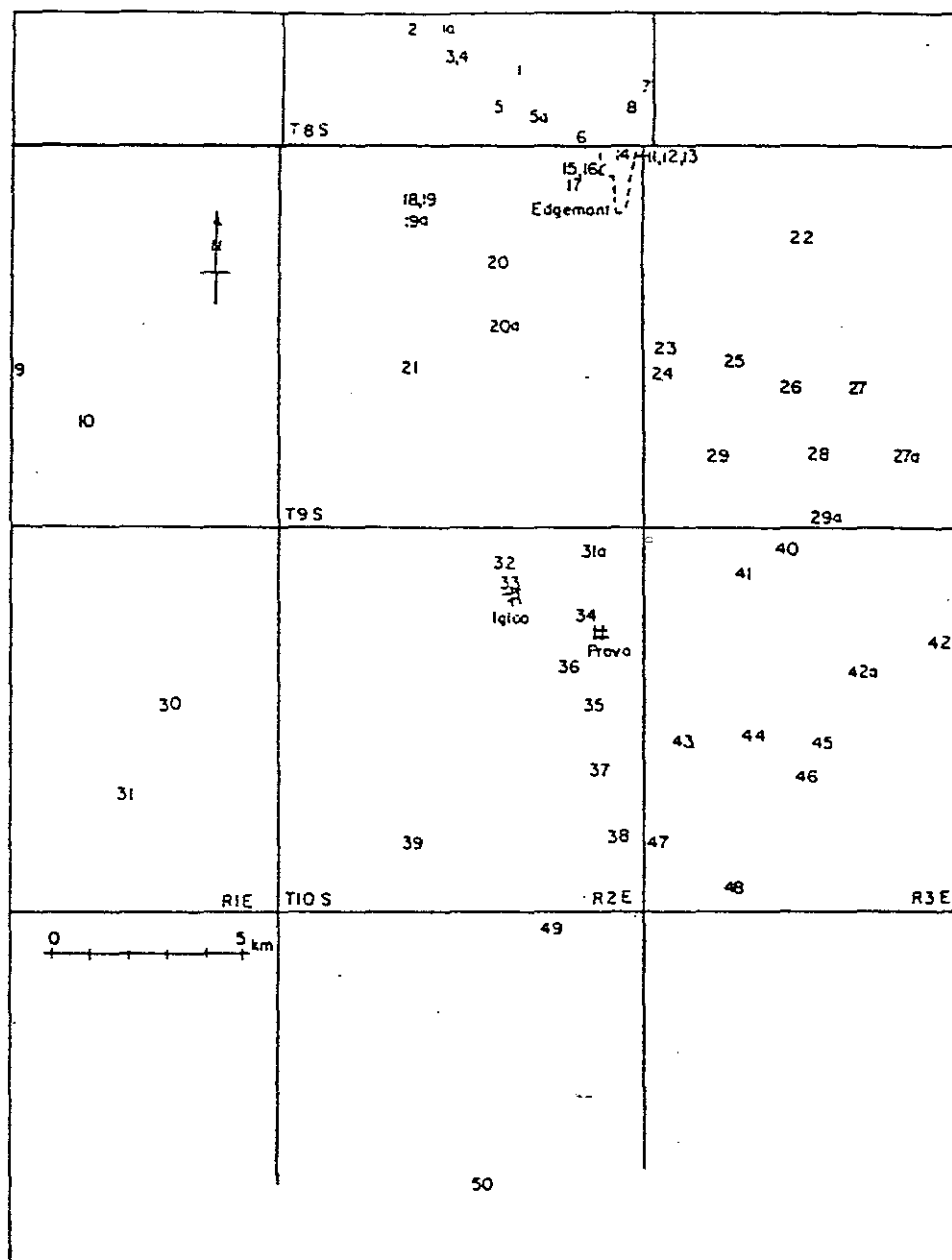


Figure 13 Well location map keyed to Table 2.

**APPENDIX C**  
**WATER QUALITY**

SOUTH DAKOTA STATE BOARD OF HEALTH

BHAD-0052

DIV. OF SANITARY ENGINEERING

PIERRE

MINERAL WATER ANALYSIS

Laboratory Number 13 Date 2-26-51  
 Town Edgemont Collected by C.C. Crumley On 2-22-51  
 Source City well #2 near reservoir, artesian free flowing  
 Report to Steve Mader, SHW-P.E. Russell, City Aud.-J.L. Sorbel, Distr. Engr.  
 Analysis made by R. W. Sheldon

CHEMICAL CONSTITUENTS	Parts Per Million	Grains Per Gallon
Total Solids	<u>1114</u>	<u>55.1</u>
Insoluble Matter	<u></u>	<u></u>
R <sub>2</sub> O <sub>3</sub> (Oxides of Iron and Aluminum)	<u></u>	<u></u>
Alkali as Na	<u>168.8</u>	<u>9.87</u>
Calcium as Ca	<u>117.9</u>	<u>6.89</u>
Magnesium as Mg	<u>34.4</u>	<u>2.01</u>
Nitrate as N	<u>0</u>	<u>0</u>
Fluoride as F	<u>1.1</u>	<u>0.064</u>
Chloride as Cl	<u>244</u>	<u>12.4</u>
Sulfate as SO <sub>4</sub>	<u>246</u>	<u>12.4</u>
Phenolphthalein Alkalinity	<u>0</u>	<u>0</u>
Methyl Orange Alkalinity	<u>189</u>	<u>11.5</u>
Bicarbonate as HCO <sub>3</sub>	<u></u>	<u></u>
Iron as Fe	<u>0</u>	<u>0</u>
Manganese as Mn	<u>0</u>	<u>0</u>
Hardness as CaCO <sub>3</sub>	<u>136</u>	<u>25.5</u>

pH

8.96

C.C. Crumley

C.C. Crumley

Chief of Water Section

PLATE

7A



BHAD-00-22  
BHAD-002

SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES  
Office of Drinking Water  
Chemical Analytical Data

Water Supply: Provo-Igloo

Date Collection: 5-18-91 Time: 3:30

EPA ID #: \_\_\_\_\_

Report to be Returned to: WPD

Source Sampled: 3800' Depth: \_\_\_\_\_

Date Built: \_\_\_\_\_

Type of Sample: Raw X Treated \_\_\_\_\_ Composite \_\_\_\_\_

Location of Sampling Tap: WELL (North)

Treatment Processes: NONE

Comments: \_\_\_\_\_

Received by Lab: 5-14-91 Time: 0800 AT

Report Sent by Lab: 10-17-91 ms

Parameter	Maximum Limit	Results	Parameter	Suggested Limit	Results
<input checked="" type="checkbox"/> Arsenic	50 ug/L	<u>&lt;1.0</u>	Chloride	250 mg/L	
<input checked="" type="checkbox"/> Barium	1000 ug/L	<u>79</u>	Iron	0.3 mg/L	
<input checked="" type="checkbox"/> Cadmium	10 ug/L	<u>&lt;1.0</u>	Manganese	0.05 mg/L	
<input checked="" type="checkbox"/> Chromium	50 ug/L	<u>&lt;1.0</u>	Sulfate	250 mg/L	
<input checked="" type="checkbox"/> Lead	50 ug/L	<u>1.9</u>	Tot. Diss. Solids (TDS)	500 mg/L	
<input checked="" type="checkbox"/> Mercury	2 ug/L	<u>&lt;0.2</u>	Lab pH	6.5-8.5	
<input checked="" type="checkbox"/> Nitrate (as N)	10 mg/L	<u>0.4</u>	Alkalinity - M (CaCO <sub>3</sub> )	mg/L	
<input type="checkbox"/> Nitrite (as N)	1 mg/L		Alkalinity - P (CaCO <sub>3</sub> )	mg/L	
<input checked="" type="checkbox"/> Selenium	10 ug/L	<u>&lt;1.0</u>	Bicarbonate	mg/L	
<input checked="" type="checkbox"/> Silver	50 ug/L	<u>1.4</u>	Carbonate	mg/L	
<input checked="" type="checkbox"/> Fluoride	4.0 mg/L	<u>1.32</u>	Spec Cond @ °C	umhos/cm	
<input checked="" type="checkbox"/> Gross alpha <u>Screen</u>	15 pCi/L		Calcium	mg/L	
Gross beta	pCi/L		Magnesium	mg/L	
Gross radium	pCi/L		Hardness (CaCO <sub>3</sub> ) gpg	mg/L	
Radium 226	pCi/L	<u>5.4 ± 0.7</u>	Langlier Index		
Radium 228	pCi/L	<u>0 ± 0.4</u>	Sodium	mg/L	
Uranium	pCi/L		Potassium	mg/L	
Radon	pCi/L		Field temperature	°F	°C
<input checked="" type="checkbox"/> VOCs		<u>*</u>	Field pH	6.5-8.5	
Unregulated organics					
SOCs					
THMs					

LAB COMMENTS: Pd FY91 Contract  
Drinking Water Compliance  
\* Lab Accident

mg/L = milligrams/Liter = parts/million (ppm)  
ug/L = micrograms/Liter = parts/billion (ppb)  
gpg = grains per gallon  
pCi/L = picocuries/Liter

STATE HEALTH LABORATORY

Percentage of Error: 500 E Capital  
PIERRE, SD 57501-5093

LAB NUMBER: 2910-0357

## SOUTH DAKOTA DEPARTMENT OF WATER AND NATURAL RESOURCES

## Office of Drinking Water

## Chemical Analytical Data

Water Supply: 1900-Phoxo-Water Dist. projectDate Collection: Feb 5-91 Time: 12:06 PEPA ID #: 0396

Report to be Returned to: \_\_\_\_\_

Source Sampled: #3 Depth: 4028Date Built: 1990Type of Sample: Raw X Treated \_\_\_\_\_ Composite \_\_\_\_\_Location of Sampling Tap: well headTreatment Processes: noneComments: Temp 126°FReceived by Lab: 2-10-91 Time: \_\_\_\_\_new well samplesReport Sent by Lab: 5-17-91 ms

Parameter	Maximum Limit	Results	Parameter	Suggested Limit	Results
Arsenic	50 ug/L		Chloride	250 mg/L	
Barium	1000 ug/L		Iron	0.3 mg/L	
Cadmium	10 ug/L		Manganese	0.05 mg/L	
Chromium	50 ug/L		Sulfate	250 mg/L	
Lead	50 ug/L		Tot. Diss. Solids (TDS)	500 mg/L	
Mercury	2 ug/L		Lab pH	6.5-8.5	
Nitrate (as N)	10 mg/L		Alkalinity - M (CaCO <sub>3</sub> )	mg/L	
Nitrite (as N)	1 mg/L		Alkalinity - P (CaCO <sub>3</sub> )	mg/L	
Selenium	10 ug/L		Bicarbonate	mg/L	
Silver	50 ug/L		Carbonate	mg/L	
Fluoride	4.0 mg/L		Spec Cond @ °C	umhos/cm	
<input checked="" type="checkbox"/> Gross alpha	15 pCi/L	<u>15.2 ± 8.6</u>	Calcium	mg/L	
Gross beta	pCi/L		Magnesium	mg/L	
Gross radium	pCi/L		Hardness (CaCO <sub>3</sub> ) gpg:	mg/L	
Radium 226	pCi/L	<u>4.8 ± 0.7</u>	Langlier Index		
Radium 228	pCi/L	<u>0.8 ± 0.4</u>	Sodium	mg/L	
Uranium	pCi/L	<u>13.3</u>	Potassium	mg/L	
<input checked="" type="checkbox"/> Radon	pCi/L	<u>160</u>	Field temperature	°F °C	
<input checked="" type="checkbox"/> VOCs			Field pH	6.5-8.5	
Unregulated organics					
SOCs					
THMs					

LAB COMMENTS: ODW

mg/L = milligrams/Liter = parts/million (ppm)

ug/L = micrograms/Liter = parts/billion (ppb)

STATE HEALTH LABORATORY

gpg = grains per gallon

500 E. Capital

pCi/L = picocuries/Liter

PIERRE, SD 57501-5093

201020188

Percentage of Error: \_\_\_\_\_

LAB NUMBER: \_\_\_\_\_

# ORES — ENVIRONMENTAL WATERS — FEEDS — SOILS

654 Lombardy Dr.  
Rapid City, South Dakota 57701

Job # 6110-91-18

JAMES H. TRAVIS  
Laboratory Manager

Water Supply: Igloo-Provo, Water Project District  
City, County: Igloo-Provo, Fall River  
Source Sampled: Well# 2 Depth           
Date drilled 1942 Other           
Type of Sample: Raw X Treated          Composite           
Treatment Process(s):         

Date Collected: 2/5/91  
Collected By: Gary Stephenson  
Report Mailed To:           
Rich Howe  
Box 1154  
Hot Springs, SD 57747  
Lat:          Long:           
Comments:         

Received By Lab: 2/5/91

Report Sent By Lab: 2/21/91 *J. Travis*

Parameter	Maximum Limit	Results	Parameter	Suggested Limit	Results
Arsenic (As)	50 ug/l		Chloride (Cl)	250 mg/l	253
Barium (Ba)	1000 ug/l		Iron (Fe)	0.3 mg/l	<0.05
Cadmium (Cd)	10 ug/l		Manganese (Mn)	0.05 mg/l	<0.03
Chromium (Cr)	50 ug/l		Sulfate (SO <sub>4</sub> )	250 mg/l	314
Lead (Pb)	50 ug/l		Tot. Diss. Solids (TDS)	500 mg/l	1,000
Mercury (Hg)	2 ug/l		pH	6.5-8.5	7.26
Nitrate (NO <sub>3</sub> ) (as N)	10 mg/l	0.58	Alkalinity-M (CaCO <sub>3</sub> )	mg/l	156
Selenium (Se)	10 ug/l		Alkalinity-P (CaCO <sub>3</sub> )	mg/l	
Silver (Ag)	50 ug/l		Bicarbonate (HCO <sub>3</sub> )	mg/l	190
Fluoride (F)	4.0 mg/l	1.16	Carbonate (CO <sub>3</sub> )	mg/l	
Gross alpha	15 pCi/l		Spec. Cond. @ °C	umhos/cm	1,640
Gross radium	pCi/l		Calcium (Ca)	mg/l	102
Radium 226	5 pCi/l		Magnesium (Mg)	mg/l	24
OTHER PARAMETERS			Hardness (CaCO <sub>3</sub> ) gpg:	22 mg/l	354
			Langelier Index		-0.39
			Sodium (Na)	mg/l	173
			Potassium (K)	mg/l	18
			Field temperature	°F	°C
			Nitrite (NO <sub>2</sub> ) (as N)	mg/l	

mg/l = milligrams/liter = parts/million (ppm)  
ug/l = micrograms/liter = parts/billion (ppb)  
gpg = grains per gallon  
pCi/l = picocuries per liter

Percentage of Error:

WNR - 606R - 6/82

LAB NUMBER: 5262

**Accu-Labs Research, Inc.**

4663 Table Mountain Drive Golden, Colorado 80403-1650  
(303) 277-9514 FAX (303) 277-9512

ADDITIONAL ANALYSIS**A N A L Y S I S   R E P O R T**

DATE: 06/16/92      PAGE 1

SUSAN R HENDERSON  
5141 INDIAN RIVER DR  
APT 265  
LAS VEGAS, NV 89103

Lab Job Number: 2196-42362-2  
Date Samples Received: 04/06/92  
Customer PO Number: (none)

These samples to be disposed of 30 days after the date of this report.

ALR Designation -	2196-42362-2-1	2196-42362-2-2
Sponsor Designation -	HENDERSON	IGLOO
Date Collected -	04/02/92	04/02/92

Determinations in pCi/L unless noted

Gross Alpha - total	16 ± 13 *	20 ± 11 *
Gross Beta - total	33 ± 14 *	25 ± 11 *
Uranium - total (mg/L)	0.008 [16]	0.008 [16]

\* Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

**Notes:**

[16] -- ADDITIONAL VALUE

By:

  
Bud Summers  
Radiochemistry Supervisor

BS/ep  


**Accu-Labs Research, Inc.**

4663 Table Mountain Drive Golden, Colorado 80403-1650  
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**A N A L Y S I S   R E P O R T**

DATE: 06/04/92      PAGE 1

SUSAN R HENDERSON  
5141 INDIAN RIVER DR  
APT 265  
LAS VEGAS, NV 89103

Lab Job Number: 2196-42362-2  
Date Samples Received: 04/06/92  
Customer PO Number: (none)

These samples to be disposed of 30 days after the date of this report.

ALR Designation -	2196-42362-2-1	2196-42362-2-3
Sponsor Designation -	HENDERSON	IGL00
Date Collected -	04/02/92	04/02/92


Determinations in pCi/L unless noted

Gross Alpha - total	16 ± 13 *	20 ± 11 *
Gross Beta - total	33 ± 14 *	25 ± 11 *

\* Variability of the radioactive disintegration process (counting error) at the 95% confidence level, 1.96σ.

By: 

Bud Summers  
Radiochemistry Supervisor

BS/dh 



# Accu-Labs Research, Inc.

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## ANALYSIS REPORT

DATE: 04/24/92 PAGE 1

SUSAN R HENDERSON  
 5141 INDIAN RIVER DR  
 APT 265  
 LAS VEGAS, NV 89103

Lab Job Number: 2196-42362-2  
 Date Samples Received: 04/06/92  
 Customer PO Number: (none)

These samples to be disposed of 30 days after the date of this report.

ALR Designation -	2196-42362-2-1	2196-42362-2-2
Sponsor Designation -	HENDERSON	IGLOO
Date Collected -	04/02/92	04/02/92

Determinations in mg/L unless noted

Barium - total	0.06	0.59
Cadmium - total	<0.005	0.045
Chromium - total	<0.005	0.045
Silver - total	<0.005	0.032
Arsenic - total	0.007	0.007
Mercury - total	<0.0001	0.0001
Lead - total	<0.005	<0.005
Selenium - total	<0.005	<0.005
Nitrate (as N)	0.36	0.38

By: Eyda Hergenreder  
 Eyda Hergenreder  
 Water Laboratory Supervisor

EH/dh dh

**APPENDIX D**

**ARCHIVES SEARCH  
U.S. ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY**

ARCHIVE SEARCH REPORT  
FOR  
THE FORMER BLACK HILLS ORDNANCE DEPOT  
IGLOO, SOUTH DAKOTA  
REPORT NO. A006

SEPTEMBER 1980

US ARMY TOXIC AND HAZARDOUS MATERIALS AGENCY  
ABERDEEN PROVING GROUND, MARYLAND 21010

Distribution Limited to Government Agencies Only: September 1980,  
Requests For This Document Must Be Referred To: US Army Toxic  
and Hazardous Materials Agency, Bldg E4585, Aberdeen Proving  
Ground, Maryland 21010



#### STATEMENT

"The views, opinions, and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy, or decision, unless so designated by other documentation."

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- E. Standing Operating Procedure for Decontamination of Black Hills Army Depot.
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ORDNANCE AMMUNITION CENTER

U. S. ARMY  
JOLIET, ILLINOIS

WCWaddell/jms/5224

IN REPLY  
REFER TO:

ORDLY-M-E

2 March 1953

SUBJECT: Disposal of Explosives Effluent

TO: Commanding Officer  
Black Hills Ordnance Depot  
13100, South Dakota

1. There is now under consideration the development of a standard plan for disposal of explosives effluent at loading plants and depots.

2. In order to determine the nature and magnitude of the problem it is necessary to have specific data on explosives effluent which may be produced from load line, washout or other operations at your installation. Therefore, your cooperation is requested in supplying this office the following information, at the earliest possible date:

a. Volume of explosives effluent encountered. Nature and concentration of the contaminant.

b. Equipment and procedure in current use for disposal of contaminated water. (Including drawings, if available) Possibility of contaminating local water supply.

c. Volume and summer temperatures of underground and surface waters available for heat exchanger.

d. Copy of State and local ordinances which are applicable to pollution of streams and underground water supply.

e. Average and dry weather flow in streams available for receiving explosive effluent.

f. Available area and character of soil with respect to possible use of evaporation ponds, leaching beds, or broad irrigation methods for disposing of contaminated water.

g. Immediate and anticipated future problems in connection with disposal of explosives effluent.

3. Replies should be addressed to the attention of ORDLY-M-E.

FOR THE COMMANDING GENERAL:

*Carroll H. Staley*  
CARROLL H. STALEY  
Assistant

## I. General

### A. Purpose of the Assessment

To search historical records, in order to identify and assess actual or possible contamination at the former Black Hills Ordnance Depot (BHOD), South Dakota (Figure 1).

### B. Authority

United States Army Technical Escort Unit (TEU) performed this assessment in conjunction with the Installation Restoration program of the United States Army Toxic and Hazardous Materials Agency (USATHAMA).

### C. Introduction

The following TEU personnel were assigned to conduct the historical assessment of BHOD:

1LT John M. Wuthenow  
SSG Francis E. Marks  
SGT Thomas J. Reavis  
SGT Gary Labarge

In addition to the archives search, interviews were conducted with local residents, as well as with a representative of the US Forestry Service. The findings of this report are based upon currently available data which may not be inclusive of actual conditions existing during Army operations and closure of BHOD.

### D. History

(1) In accordance with a directive from the Secretary of War dated 4 September 1941 and instructions from the Adjutant General dated 18 September 1941, a Board of Officers was appointed representing the Quartermaster General, the Ordnance Department, and the Zone Construction Quartermaster. The mission of the board was to investigate and report upon suitable sites for the location of ammunition storage depots. The board's instructions specified that an ammunition storage depot would be located in the southwestern South Dakota - western Nebraska area. Furthermore, the site would permit the construction of 1,500,000 square feet of ammunition storage area and be convenient to railroad lines. Since the site was intended for the storage of munitions filled with lethal chemical agents in addition to conventional high-explosive munitions, it was necessary that the site be situated in a thinly populated location. A section of land 21,095 acres in size, located in the southwest portion of Fall River County, South Dakota was recommended by the board. The site was eight miles west of Edgemont, South Dakota, which then had a population of approximately one thousand (Figure 1). There were no settlements within 50 miles radius having a population of more than 2000 people. Railroad connections were available at Provo, South Dakota, a village approximately one mile from the proposed site. The site was accepted and the installation was designated the Black Hills Ordnance Depot in DA General Orders #9, dated 5 February 1942.

(2) During early April through mid-May 1942, construction materials were moved to BHOD. Construction began to flourish in late May, peaking in late summer 1942. All igloos were completed by 10 October 1942. Local representatives of the State Employment Service and County Commissioner's Office originally estimated that nearby towns had a large number of uninhabited houses which could accommodate workers. This was not borne out in fact, and provisions were made to construct family-type housing for military and civilian personnel. For the health and welfare of workers and their families, hospital facilities and a five room school were constructed.

Potable water was a problem during the construction period. For the first ten months, the only potable water available was from a single well. Distribution of the water from this well created logistical problems due to the large number of personnel at the depot (approximately 5400 construction workers and 500 depot personnel in late summer 1942). To help remedy the situation, drinking water was brought into BHOD by truck and railroad.

(3) BHOD received its first shipment of ammunition on 4 November 1942. The amount of ammunition received at BHOD increased monthly, reaching a peak of 586 railroad carloads during January 1944. Records do not specify the types of ammunition received at BHOD during this period. The shipping of ammunition out of BHOD lagged behind the receiving activity during 1942-1943, but during 1944-1945 the amount of ammunition received and shipped at BHOD was approximately equal.

The number of workers at BHOD fluctuated between 1100-1400 during the period 1943-1945. Due to insufficient family housing and higher wages offered elsewhere, the depot suffered from a shortage of workers, mostly in the munitions handler category. Shortages of personnel usually averaged 200-300 at any given time. A reduction of civilian workers during late 1945-1947 reduced employment at BHOD to the 650-700 level. From 1947-1949 the workload consisted primarily of demilitarizing unserviceable and obsolete ammunition, renovating general supply stocks and ammunition, and disposing of surplus property.

(4) Activity at BHOD increased sharply in July 1950 due to the Korean emergency. Shipping, renovation, and maintenance activities all received intense revitalization. By the end of 1950, the depot was operating at nearly maximum capacity and all buildings and structures were in active use. Employment at BHOD stabilized at approximately 1300 workers for the period 1950-1953. Shipping activity decreased after the Korean truce, and emphasis was switched to receiving ammunition. A reduction of civilian workers in April 1954 reduced the depot strength to 1000 workers. Declines in employment at BHOD continued through 1955, finally stabilizing at approximately 570 workers.

(5) Workload at BHOD during the period 1955-1960 consisted of receipt, storage, maintenance, demilitarization and issue of conventional and chemical munitions. Receipt, issue and storage of general supplies was dropped from the Depot mission by section X, AR 750-970, 14 October 1960. Department of the Army General Orders No. 51, dated 21 August 1962, designated BHOD to be Black Hills Army Depot (BHAD). During 1962, the depot was commended for successfully completing the modification of 90MM ammunition; however, the details of the modification were not found.

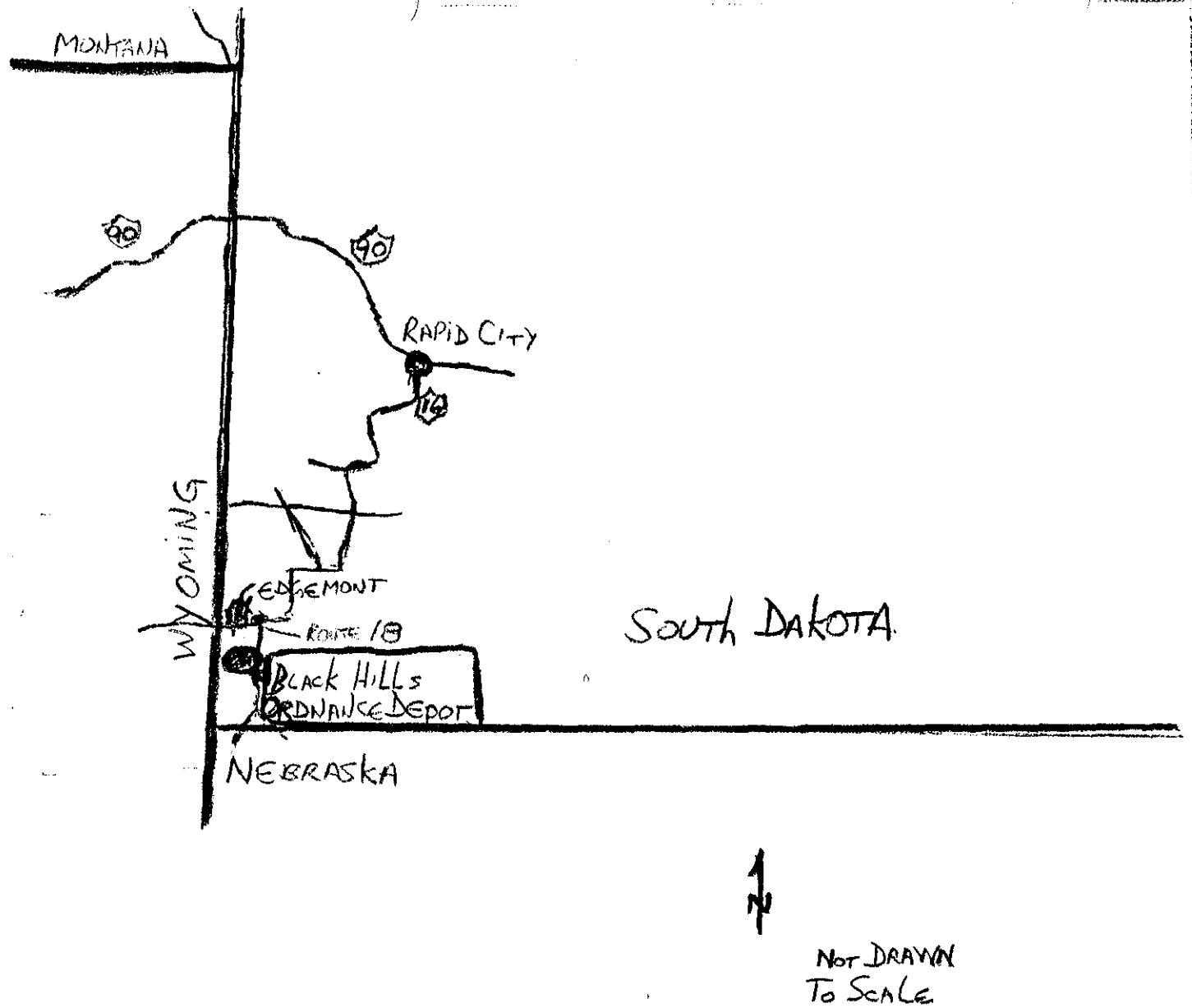


Figure 1

Geographical Setting of Black Hills Ordnance Depot



105

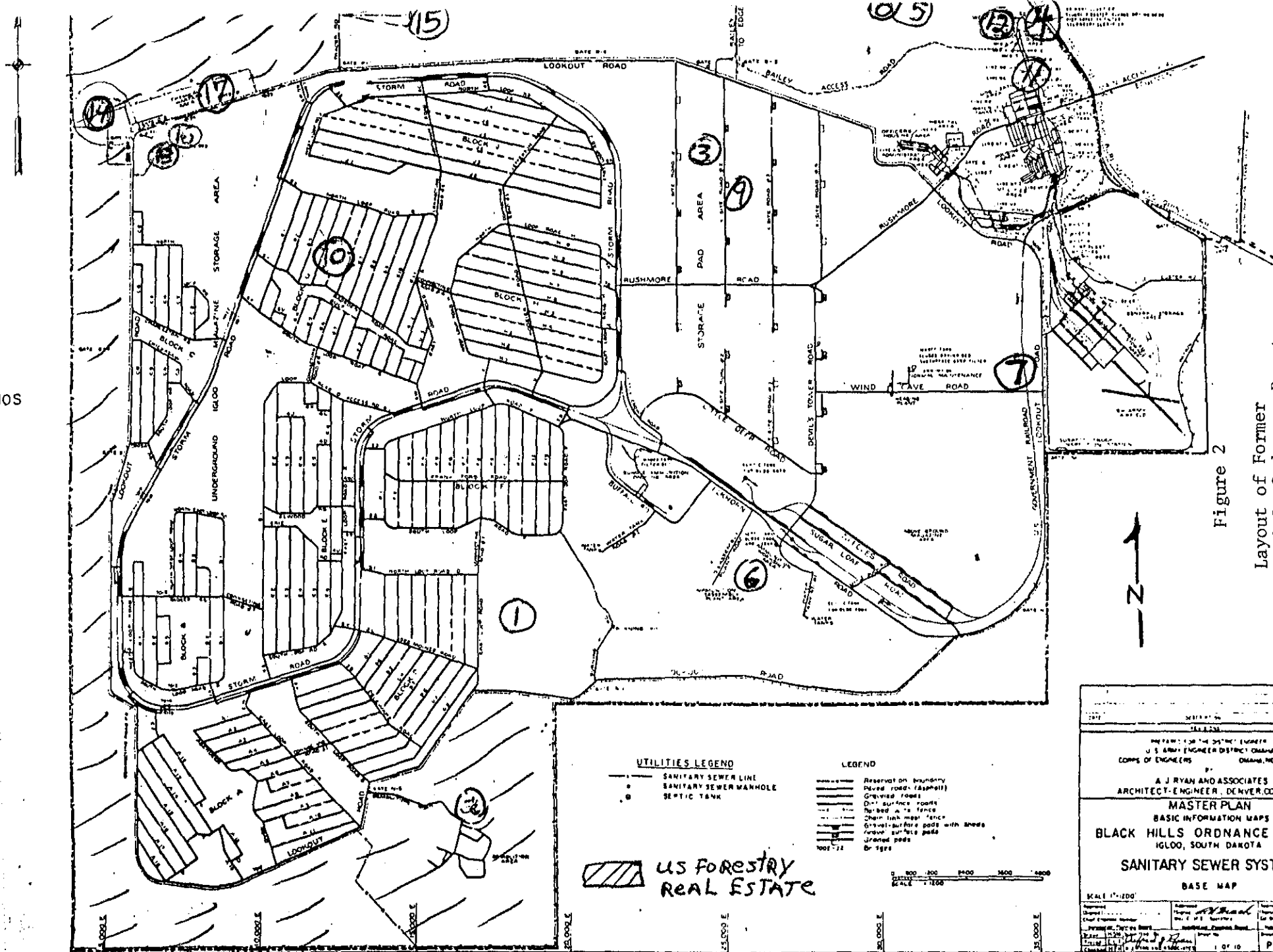


Figure 2  
Layout of Former  
Black Hills Ordnance Depot

(6) Decontamination of the depot was conducted in 1966 in accordance with "Standing Operating Procedure for decontamination of Black Hills Army Depot" (Appendix E). A statement of clearance was issued by the Commanding Officer on 31 January 1967 (Appendix F). According to the statement of clearance, all land within BHOD was given a careful search and was cleared of all dangerous and/or explosive materials reasonably possible to detect. The depot was closed on 30 June 1967, and declared excess by the Department of the Army in 1968. The city of Edgemont, South Dakota purchased all land within the boundary fence; the remainder of the former BHOD was transferred to the United States Forestry Service (Figure 2). Most of the BHOD is currently used for sheep and cattle grazing.

(7) In response to allegations which had been made by local residents to the effect that mustard gas (H) was contaminating the atmosphere, the former BHOD was surveyed 18-22 January 1971 by a team led by Mr. R. Kerr, Safety Engineer, Edgewood Arsenal. An additional survey was conducted 21-27 July 1971 by a team led by Mr. Dean Dickey, Weapons Development and Engineering Laboratories, Edgewood Arsenal. No surface contamination or odors were detected during either survey. The M18 Chemical Agent Detection Kit was utilized in testing the air, pieces of metal fragments, and patches of soil; all tests were negative. Air bubblers were installed and activated to obtain air samples. The bubblers were chemically analyzed; the results of this test were negative. The results of a second test were also negative. Thirty-five soil samples were collected and chemically analyzed; no contamination was detected. These tests were conducted in an area known as Burning Site Number 2, which is located in the SW portion of BHOD (#2 Figure 2). Leaking mustard (H) filled munitions have allegedly been buried in this area (Appendices B and C).

E. Environmental Setting - BHOD comprised 21,095 acres and was located in the Fall River District of the Buffalo Gap National Grassland Central Plains Forestry Office. Fall River County has a population of 7,500; most of the inhabitants are farmers or ranchers. The elevation of Provo, South Dakota is 4,549 ft above sea level.

(1) Meteorological Setting - The climate at BHOD is semi-arid with low humidity. Annual precipitation averages 16-20 inches, with approximately 40 inches of snow. BHOD experiences great ranges in temperature. Every summer, there are days when the temperatures reach 100 degrees or higher; below zero weather is common during winter months. Wind velocities are quite high, with frequent strong winds coming out of the west and north.

(2) Biota - The predominant trees in the region are pine and spruce. Most of BHOD is covered by western wheat grass with some buffalo grass present. In addition to these, a small amount of black sage, salt grass, and needle grass can be found. Sheep and cattle are raised within the boundaries of the former BHOD. Wildlife species managed by the South Dakota Department of Game, Fish and Parks include mule deer, white-tailed deer, pronghorn antelope, waterfowl, prairie grouse and cottontail rabbits. Important nongame species include, but are not limited to, prairie dog, coyotes, bobcats, badger, raccoon, hawks, owls, shorebirds, small rodents, passerine birds, reptiles, amphibians and insects. Due to fences surrounding BHOD, most of the larger wildlife species never enter within the boundaries, but they can be found in areas adjacent to BHOD. Species found in the area that are classified as

threatened include the prairie falcon, greater prairie chicken, trumpeter swan, golden eagle, swift fox, ferruginous hawk, burrowing owl mountain plover and great blue heron.

Cottonwood Creek, a stream which circles the Fall River District is heavily choked with cattails and other water plants. The South Dakota Game, Fish and Parks Department is interested in developing the stream for water fowl and fish. Several dams have been constructed for the purpose of providing a more suitable habitat for certain species of fish and fowl. The predominant species of fish are pike, pike perch (walleye), bass, bluegill, sunfish, and bullheads.

The duck population has increased greatly in the Fall River District due to construction of the dam. Species include mallard, green-wing teal, blue-wing teal, lessen scrap, ruddy duck, canvasback, pintail, redhead, and western grebe.

(3) Geology. The topography of BHOD varies from undulating to rough and is somewhat rolling, with numerous ravines. The Black Hills area is rich in carnotite ore, from which uranium is refined.

(a) Soils. The soil at BHOD is characterized by a high percentage of Bentonite. This type of soil is very resistant to water absorption.

(b) Surface Water. The entire BHOD area lies in the Cheyenne River Watershed. The Black Hills region is bordered on the north and south by two major rivers, the Cheyenne and the Belle Fourche. The Cheyenne River flows into Angostura Reservoir, which is located approximately 20km east of BHOD. A watershed, running north and south through the approximate center of BHOD, divides the drainage to the west into Alim Creek, and to the east into Softwater and Coal Creeks. These streams are dry most of the year.

(c) Subsurface Water. Water for BHOD operations was supplied by three artesian wells. Information concerning these wells is provided in Table I:

TABLE I

Well Data, BHOD

Well #	Depth (Ft)	Water Level (Ft)	Casing (In.)	Artesian Flow (gpm)
1	3990	3619	16	150
2	3855		16	250
3	1930	1330-1350	7	70

Water was pumped from the two deep wells to a hot water storage tank; the water coming out of the wells had a temperature of approximately 150 degrees fahrenheit. The water flowed by gravity from the hot water tank to a 200 gallon per minute pump which circulated it to two permulite pressure type zeolite softeners connected in parallel. From there, the water entered three

Fairbanks - morse evaporative coolers connected in series. The cooled water then entered the chlor-nation room where it was metered and chlorinated. Subsequently, the water flowed into a cold water storage tank. Wells #1 (#11 Figure 2) and 2 (#12 Figure 2) and the water treatment facilities were located in the northeast section of BHOD. Well #3 (#13 Figure 2), the water which was used for industrial purposes, was located in the northwest section of BHOD.

(d) Leases. No records of leases during Government operations at BHOD were found.

(e) Legal Actions. A former resident of South Dakota, who lived approximately 5km west of BHOD, is suing the US Government for health problems which allegedly resulted from government operations at BHOD.

## II. Past and Current Activity Review

### A. Installation Operations

(1) Industrial Operations. The former BHOD received, stored, and shipped ammunition including propellants and chemical ammunition under the accountability of the Ammunition Procurement and Supply Agency, Joliet, Illinois. Additionally the former BHOD received, stored, and shipped supplies of General Services Administration in accordance with instructions from the US Army Supply and Maintenance Command.

BHOD operated an ammunition disassembly plant where small arms ammunition (.30-.50 cal) was unpacked from original containers and reassembled into functional packs by either linking, belting or clipping. Additionally, the depot restored ammunition to serviceable condition. This was usually accomplished by the replacement of components.

BHOD operations also included the demilitarization of unsafe, obsolete, and surplus ammunition, ammunition components, chemical toxics and general supplied.

(2) Laboratory Operations. Specific information on laboratory operations at BHOD was not found. BHOD had a Research and Development section, but records indicate that the depot utilized the laboratory facilities of the South Dakota School of Mines and Technology, Rapid City, South Dakota.

(3) Material Proof and Surveillance Tests. All munitions filled with chemical agents were visually inspected periodically for leakers. Generally, each munition was inspected at least once a month. When a leaker was discovered among the mustard (H)-filled munitions, a decision was made to either destroy or repair it, depending on the economic feasibility of the latter choice. If a leaker was judged too costly to repair, it was transferred to an isolated area designated for leakers, pending disposal at burning pits.

Normal maintenance for mustard bombs consisted of inspections, derusting, cleaning, and greasing of the burster well tube, the bomb tail threads, and the fin back nut. After cleaning, sealing compound was applied to the flange of the nose plug. This prevented moisture and other foreign matter from entering the burster well.

Leaking mustard munitions were divided into four classifications. These were serviceable (class A); serviceable, but not available for immediate issue (class B); unserviceable, retained for rework with new burster wells (class C); unserviceable, to be destroyed by pit burning (class D).

BHOD had repair procedures for munitions with other chemical fills. Phosgene (CG) and cyanogen chloride (CK) munitions were subjected to periodic pressure tests. The needle valves on M-78 and M-79 bombs filled with chemical agents were replaced as needed. Due to an overpressure problem with these bombs, a refrigeration unit was installed at BHOD in 1958. Internal pressures over 100psi were considered hazardous, and venting the bombs to relieve pressure was undesirable.

(4) Training Areas. A small arms firing range was located in the north central section of BHOD. (#15 Figure 2)

(5) Toxic and Hazardous Material Handling & Storage

(a) Munitions. BHOD was a storage depot for high explosives (HE), white phosphorous (WP), mustard (H), cyanogen chloride (CK), and phosgene (CG) in 105mm, M-70, M-78, and M-79 munitions. Prior to the early 1960's, all chemical munitions except WP and HE were stored in the chemical storage area (#17 Figure 2), in the northwest section of the depot. Most munitions were stored in open areas, although some were kept in enclosed structures. WP and HE munitions were stored in igloos.

In the early 1960's, M-55 rockets filled with nerve agent (GB and VX) were stored in G-Block (#10 Figure 2). This is the only known storage of chemical munitions outside of the chemical storage area

(b) Industrial Chemicals. Ammonium nitrate (1.5 million pounds) was stored at BHOD in the early 1940's. Records did not indicate the location of this storage area or the ultimate disposition of this material.

(c) Chemical Agents. No chemical agents were manufactured at BHOD. However, storage, transfer and disposal operations involving mustard (H), cyanogen chloride (CK), and phosgene (CG) were conducted. M-55 rockets containing nerve agents (GB & VX) were stored at BHOD, however, records did not indicate the ultimate disposition of these rockets.

(d) Biological Agents. None found in search.

(e) Radiological Materials. None found in search.

(f) Pesticides/Herbicides/Fertilizer Usage. Herbicides (unspecified) were used to control weed growth in chemical storage yards. No documentation was found concerning pesticide and fertilizer usage.

B. Disposal Operations.

(1) Liquid Waste Treatment.

(a) Sanitary Wastewater Treatment. In order to provide shower and washing facilities to use after handling leaking chemical munitions, the

following equipment was installed in 1956; four shower stalls, three 80 gallon foot controls and a leaching field to handle waste water. The site of this shower system and leaching field was the change house, building 6000 (#16 Figure 2).

In areas other than the change house, sanitary waste water was treated in septic tanks. Lagoons were used to contain the overflow of septic tanks. Records indicate that a sanitary sewage plant was constructed prior to 1963.

The sewage collection system for the plant consisted of gravity-type mains throughout the administration area, utilities area, housing area, and mobilization area. All pipes were vitrified tube except those under railroad tracks which were iron. The sewage treatment plant was located in the northeast section of BHOD (#4, Figure 2). It had the capacity to service a population of approximately 4,000. The plant, which provided primary and secondary treatment of sewage, consisted of: a small grit chamber and bar screen, two comminutors; one 8-inch Kennison nozzle connected to the Chronoflow telemetric transmitter and receiver; two reinforced concrete clarifier tanks; one high rate trickling filter, equipped with rotary distributor; one each reinforced concrete fixed cover primary digester and secondary digester equipped with scum breaker and heat exchanger; one final clarifier and two sludge drying beds.

(b) Industrial Waste Water Treatment. Records indicate at least two leaching ponds were utilized for the disposal of contaminated water. Each leaching pond was approximately 4 feet deep, 100 feet long and 100 feet wide. It is known that at least one leaching bed contained explosive effluent. One leaching bed was located in the WP disposal area (#5, Figure 2), another was located in the ammunition disassembly area (#6, Figure 2).

(c) Storm Water Drainage. During October 1956, extensive work was performed by the Post Engineers to improve the drainage system in the mustard (H) agent storage area (no information was found concerning the original drainage system). This work consisted of filling in washouts around storage sheds, establishing additional drainage ditches, placing culverts under roadways, and distributing gravel where required. This work was needed since the old drainage systems did not adequately carry off the surface water after heavy rains. This resulted in deep washouts around sheds and open pads to such an extent that extensive repairs were required to correct leaning stacks of bombs.

(2) Solid Waste Treatment.

(a) Sanitary Landfills. Records indicate the location of a sanitary landfill at BHOD, however, the location of the landfill was not specified. The collection and disposal of installation garbage, refuse and ashes in this landfill were performed by unidentified civilian contractor. Post engineering personnel were responsible for digging trenches in the landfill and covering the garbage with earth after disposal operations were completed.

(b) Contaminated Waste. Items and material contaminated by chemical agents were destroyed by pit burning. Records indicate that scrap metal remaining from burning operations were sent off the depot to a reclamation center. The name and location of this center were not identified.

(3) Demolition and Burning Grounds.

(a) Burning site #1 (#1 Figure 2) was the initial demolition and burning area at BHOD. Records show that mustard (H)-filled munitions were destroyed at this site. These munitions were AN-M47 series, 100 pound bombs. Although the date when burning site #1 was first used is unknown, no records were found concerning demolition activities at site #1 after 1946. A second burning site (#2) (#2 Figure 2) was constructed in 1946 since burning site #1 was located too close to the magazine area.

(b) Mustard(H)-filled munitions are known to have been destroyed at burning site #2. The exact dates of usage for site #2 are unknown. In 1950, three new burning pits were recommended for construction at burning site #2. The initial number of burning pits at site #2 is unknown. Each new burning pit was proposed to be 100 feet long, 16 feet wide, and 12 feet deep. It is not known whether the three new burning pits were ever constructed or used.

(c) Due to a large number of leakers in certain lots, a decision was made in 1949 to transport 500 M70 mustard(H)-filled munitions to Rocky Mountain Arsenal for evaluation. The 500 bombs represented 10 bombs from each of the 50 lots stored at BHOD. In 1950, approximately 310,000 M70 mustard(H)-filled bombs were stored at BHOD. The results of the tests at RMA during 1949-50 indicated that all 310,000 bombs were potential leakers. Accordingly, on 9 May 1950, Chief, Chemical Corps directed BHOD to establish facilities for disposal of approximately 30,000 M70 H-filled bombs per year. Records did not indicate the number of bombs, if any, which were destroyed as a result of this recommendation.

(d) In order to increase BHOD's capacity to destroy leakers to the specified level of 30,000 per year, the construction of a new burning site was recommended in November 1951. According to records, the proposed mustard bomb burning site was to be located at the northeast corner of the reservation. The proposed site was 2400 feet from the east boundary fence and 2400 feet from the north boundary fence. This site was bounded on the west by 2400 feet of uninhabited land, and on the south by bomb storage pads containing M70 H-filled bombs. The nearest depot operational road, inhabited building or magazine, was located approximately 6000 feet from the proposed burning site. Records do not indicate that this site was ever constructed. A new burning site was constructed but it was located in the northwest corner of BHOD (#14 Figure 2). Its actual date of construction is not known.

(e) On 5 December 1951 a meeting was held to decide whether to renovate or destroy the bombs. At that time, it was estimated that BHOD was storing 60,000 leakers. The course of action decided upon was to renovate the bombs. All M70 (H)-filled bombs were fitted with new lead gaskets in 1952.

Since the major problem with the M70 bombs was interior corrosion of the burster well tubes, this action considerably reduced the number of leakers at BHOD after 1952. Additionally, a program was initiated to ship the bombs to RMA for replacement of burster well tubes. It is estimated that between 50,000 to 100,000 M70 bombs were shipped to RMA and had new burster well tubes installed before the program was curtailed on 13 April 1953.

(f) In 1952, records indicate 21 M79, phosgene (CG) and cyanogen chloride (CK) bombs were destroyed. This is the only record of chemical agents other than mustard (H) being burned.

(g) During 1953-56, the destruction of unserviceable high explosive (HE) munitions was given a higher priority than the destruction of leaking M70 mustard (H)-filled bombs. Only one day per week was authorized for the destruction of mustard leakers at the burning pits. As of 1957, plans called for the destruction of mustard leakers only once per year.

(h) Burning site #3 (#3 Figure 2) was used for the destruction of white phosphorous (WP). The casings from these operations were buried in the northern section of BHOD near Storm Road (#9 Figure 2).

(4) Demilitarization. A test project was conducted on 9-10 May 1957, in hopes of finding a suitable method for the final demilitarization of M70 mustard (H)-filled bombs. The contents of 150 bombs were transferred to four 1-ton containers. The recovery rate of mustard from this operation was 64 percent. Although this operation was considered successful, plans to demilitarize all M70 mustard-filled bombs in this manner were dropped.

On 21 November 1957, a proposed method of demilitarization (for the M70 bombs) was submitted to Chemical Corps Material Command. The plan called for the bombs to be destroyed in a rotary, oil-fired kiln. In order to facilitate burning of the mustard, the bombs were to be sawed or cut in half prior to entering the kiln. It was estimated that 500 bombs could be demilitarized in an eight-hour shift. A cost estimate indicated this method was less expensive than open pit burning, and BHOD did not have the resources to support massive open pit burning. Arrangements were made with the South Dakota School of Mines and Technology, Rapid City, South Dakota, to determine the feasibility of the proposed kiln method. The incinerator was located at the northwest corner of the depot. Demilitarization of the M70 mustard (H)-filled bombs by incineration began in early 1961, and was completed in April 1962. Records do not indicate the number of bombs demilitarized or the disposition of the facility upon completion of the effort.

The demilitarization of phosgene (CG) and cyanogen chloride (CK) was conducted by the Research and Development Section at BHOD. The location of this demilitarization operation and the methods utilized, other than the burning conducted in 1952, could not be found in records. In addition, records do not indicate the total timeframe of operations but reference was found indicating some demilitarization took place in 1964.

C. Water Quality (Data from 1963). Well #1 and well #2 provided the drinking water for BHOD; the water from well #3 was not used for drinking,



but was utilized by the shower house. Water at well #1 had a temperature of 150 degrees fahrenheit and a compensated hardness of 760 ppm. Water at well #2 had a temperature of 150 degrees fahrenheit and a compensated hardness of 670 ppm.

(The question of contamination migration was considered in 1953, in conjunction with disposal procedures of effluent, from explosives (Appendix C.) At that time the conclusion was reached that contaminant migration at BHOD was unlikely for the following reasons:

1. Drinking water at BHOD is obtained from depths greater than 3,000 feet.
2. The soil contains a high percentage of bentonite.
3. There are no flowing streams within BHOD.

### III. Installation Assessment

#### Findings

1. Records did not indicate the burial of any chemicals or munitions at Black Hills Ordnance Depot.
2. Garbage, refuse, and ashes were disposed of in a sanitary landfill by an unidentified civilian contractor. Post engineering personnel were responsible for excavating trenches at the landfill and covering the garbage with earth after disposal operations were completed.
3. Munitions containing white phosphorous, high explosives, mustard, cyanogen chloride, phosgene, and nerve agents were stored at BHOD.
4. Records indicate that 1.5 million pounds of ammonium nitrate were stored at BHOD in the early 1940's.
5. At least three burning areas were utilized during various periods of government operations at the depot. Records indicate burning of munitions containing mustard, phosgene, and cyanogen chloride was conducted at the depot.
6. An incinerator for the demilitarization of mustard-filled munitions was operated at BHOD during 1961-62. Records do not indicate the number of bombs demilitarized or the disposition of the facility upon completion of effort.
7. The demilitarization of phosgene (CG) and cyanogen chloride (CK) was conducted at BHOD. The location of this demilitarization operation and the methods utilized could not be found in records. In addition, records do not indicate the total timeframe of operation, but a reference was found indicating some demilitarization took place in 1964.
8. A visual inspection in November 1979 of the mustard-filled munitions incinerator area of BHOD revealed no evidence of surface contamination. Cattle were grazing in this area. No odors of any kind were detected. There was no debris, metal, or foreign matter in the area; there were no indications of an incinerator. The entire area was covered with grass, as a result of reseeding by the US Forestry Service.

## APPENDIX A

### List of Archives Sources Contacted

1. Washington National Records Center, Suitland, Maryland
2. National Personnel Records Center, St. Louis, Missouri
3. US Forestry Service, Hot Springs, South Dakota
4. City Hall, Edgemont, South Dakota
5. Office of Economic Adjustment, Washington, D.C.
6. South Dakota School of Mines and Technology, Rapid City, South Dakota
7. University of South Dakota, Vermillion, South Dakota
8. Augustana College, Sioux Falls, South Dakota

APPENDIX B

REPORT OF VISIT TO BHOD AREA, 18-22 JANUARY 1971

SMJEA-SA-8

25 January 1971

SUBJECT: Report of Visit to Black Hills Army Depot Area, 18-22  
January 1971

MEMORANDUM FOR RECORD

References: 1. TMX CG USAMC to CG USAMJCOM, 22 Dec 70, Subject:  
Survey of Former Black Hills Depot.

2. Letter, AMSMU-SF to CO, Edgewood Arsenal, MD.,  
6 Jan 71, same subject.

1. Purpose of Visit. To obtain information relative to the extent  
of alleged contamination and location of buried chemical munitions.

2. Persons Contacted.

- a. M
- b. M
- c. M
- d. M
- e. M
- f. M
- g. M
- h. M

*Surveyed in winter.  
H freezing point is +58°F.*

3. Discu  
location  
validity  
"escaping  
alleged bu

Interrogat  
to accomplish the mission; statements of those persons are appended  
as Tabs A through F.

When road and weather conditions permitted and approval was obtained  
for passing through commercially controlled areas the destruction  
site referred to by Mr. Straight (Tab B) was surveyed. The entire  
area was traversed along with outlying perimeter areas. No surface  
contamination was found and no odors of any kind were detected.  
Considerable shrapnel is scattered throughout the area as a result  
of the previous destruction activities. The entire area of Burning  
Site No. 2 is fenced and is said to be the property of the US Forestry  
Service.

Three and one-half hours (0300-0630) were spent in the neighborhood  
of the Straight residence in Provo, South Dakota. No odors, mustard  
or otherwise, were detected. A wind estimated at 5-6 knots was pre-  
valent during most of this period; the temperature was approximately  
44°F and an inversion (lapse) condition prevailed.

Statement(s) from Mrs. Pauline Straight, Provo, South Dakota

Informant states she was formerly employed at the Black Hills Army Depot as an ammunition handler and that her husband, Mr. Donald C. Straight, also had been employed at the Depot and had worked at a destruction site where various ammunition items were destroyed. Mrs. Straight says that "one day several years ago Mr. Straight came home and said that some mustard shells were dumped over the bank and covered over with dirt"; she says that this practice was repeated several times. Mrs. Straight further states that she and her husband have discussed the buried mustard many times and are concerned with the potential hazard to persons in the future. The lady also indicates that on occasion, generally during the early morning, pre-dawn, hours "the odor of mustard gas is so strong at home as to be extremely nauseous."

Statement(s) from Mr. Donald C. Straight, Provo, South Dakota

(Interviewed at VA Center, Hot Springs, South Dakota.)

Mr. Straight states that he was employed as an ammunition handler and (later) a janitor at the Black Hills Ordnance Depot. Periods of employment were 1951-52 and 1955-1966. In 1962 Mr. Straight "developed an allergy to TNT" and was transferred from ammunition handling to the position of janitor in the Post Engineers.

Mr. Straight says that during the period when he was employed at "Burning Hill No. 2" it was not uncommon for "leaking 105 shells full of mustard to be dumped on the ground and covered over with dirt with a bulldozer." The number of items disposed of in this manner is estimated at "8-10 per shift with a total of as many as 100 buried out there." Mr. Straight says there were no fuzes with the rounds but believes there were bursters in them.

The informant states that he doubts that the burial of the mustard shells was recorded; he says that the "depot operations manager did not know all that went on around the place." Mr. Straight further states that a Mr. James Stewart, formerly in depot planning, would be a good source of information on this subject. (Inquiry reveals that Mr. Stewart is now employed at Umatillo Army Depot, Oregon.)

The informant indicates willingness to personally escort anyone to the site of the alleged burial and point out exact locations.

Statements of Mr. Richard Vande Bossche, Mayor, Edgemont, South Dakota.

This informant states that the City of Edgemont purchased certain parcels of land from the Black Hills Depot after the US Government had ceased operations there. Certain areas such as destruction grounds were restricted for access, exploration, or excavation. Those areas are fenced and properly identified on existing maps of the areas. The city has disposed of all EHOD holdings through purchase/lease arrangements with private firms; all such buyers/lessees have been briefed on the potential hazards existing within the restricted areas. such hazards considered to be explosive rather than chemical.

Mr. Vande Bossche had no knowledge of the burial of chemical munitions.

Statement of Mr. Donald DuBois, Edgemont, South Dakota

Mr. DuBois was the BHOD Fire Chief at the time the installation was phased out. His department had been charged with the surveillance and standby responsibilities during destruction operations. To Mr. DuBois' knowledge all mustard-filled munitions were destroyed by burning rather than burial.



Statements of Mr. Matthew Brown, Manager, Black Hills Industrial  
Freeport, BHOD, South Dakota

Mr. Brown has spent many years in around the BHOD area both prior  
to and since the Department of the Army relinquished control of the  
site. He has neither seen nor smelled any known or suspected  
chemical munition since the close of the installation.

Statement (by telephone) of Mr. George Hall, Umatillo, Oregon.

Mr. Hall states that he was manager of Depot Operations at BHOD during the period 1950-64. During that time 100-16 mustard items were destroyed at the BHOD destruction site. Mr. Hall says that all items were burned out and metal components decontaminated and stored near a rail siding for eventual sale and shipment to a firm in Omaha, Nebraska; shipment occurred "sometime in 1960."

Mr. Hall could recall no instance when mustard-filled shells or similar items had been buried.

AMXBH

6 February 1967

SUBJECT: Neutralization (Decontamination) of Black Hills Army Depot

TO: District Engineer  
U.S. Army Engineer District, Omaha  
ATTN: Real Estate  
215 North 17th St.  
Omaha, Nebraska 68101

1. Reference Para 11, AR 405-90.
2. Statement of clearance with drawing no. PE 1004 attached and Standing Operating Procedure No. SSMBH 5-66 with drawing no. PE 1003 attached, are submitted as inclosures 1 and 2.
3. Neutralization of the contaminated and hazardous areas designated on drawing no. PE 1003 was performed in accordance with SOP SSMBH 5-66 with completion date 15 Dec 66.
4. The following technicians supervised the work performed:  
Francis R. Salvo, Chief Surveillance  
Herbert A. Geffre, Ammunition Inspector (Surveillance)  
Francis F. Finkle, Maintenance General Foreman  
Robert C. Schmidt, Foreman

2 Incl  
as

Copy furnished:  
AMC

WALTER C. GARTHWAITE  
Major OrdC  
Commanding

BLACK HILLS ARMY DEPOT  
Igleo, South Dakota

STANDING OPERATING PROCEDURE FOR:

SUBJECT: DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

ACTIVITY: DECONTAMINATION

USASMC CONTROL NUMBER:

DEPOT ORGANIZATIONAL SYMBOL: SSMSE

SOE NO: SSMSE 5-66 DATE: 13 Jul 66

PREPARED BY:

*James C. Culp*

TITLE:

*Production Control*

PHONE EXTENSION:

*2425*

CONCURRENCES:

SURVEILLANCE OFFICE

*Francis R. Salvo*

CHIEF, SURVEILLANCE OFFICE

SAFETY OFFICE

*Francis R. Salvo*

SAFETY DIRECTOR

T

*Thomson W. Zipe*

DST

APPROVED BY:

*Jack C. Culp*  
1st Lt. C. C. Culp  
Lt. Col., 1st Corps  
Commanding

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SECTION I

GENERAL NOTES FOR DECONTAMINATION

SOP NO: SSMBH 5-66

DATE: 13 July 1966

## GENERAL INFORMATION

1. Purpose: To provide a safe and effective procedure for the complete decontamination of all explosives storage locations, operating buildings and areas, loading aprons at Black Hills Army Depot.
2. Scope: This S.O.P. affects all phases of required operations.
3. Objectives: To assure that all buildings, equipment and grounds are properly decontaminated in a safe manner and to assure that the equipment can be utilized at another installation, and the buildings and grounds for other purposes.
4. Responsibilities:
  - A. Chief, Surveillance is responsible for:
    - (1) Adequacy of S.O.P. to conduct decontamination.
    - (2) Final inspection, certification, and signing of certificate that all buildings and equipment were decontaminated in accordance with these procedures.
    - (3) Furnish the technical advice and instructions for decontamination that may not be fully covered in this S.O.P.
    - (4) Preparation and signature of the statement of clearance required by references, para. 7D.
    - (5) Furnishing the necessary supporting records to the statement of clearance as required by references, para. 7D.
  - B. D.S.T. is responsible for:
    - (1) The accomplishment of decontamination in accordance with approved S.O.P.
    - (2) Prepare addenda as necessary, to incorporate additional decontamination procedures for problem areas, if any, that may not be covered in this S.O.P.
    - (3) Assist the Chief of Surveillance Division as required by him in discharging the responsibility of para. 4A5.
  - C. Chief, Depot Facilities Division is responsible for:
    - (1) Furnishing the necessary engineer tools and equipment that may be required for decontamination operations.
    - (2) Furnishing necessary skilled personnel such as electricians, plumbers, etc., to operate such tools and equipment and/or to perform dismantling operations falling within the category.
5. Marking of Buildings and Equipment:
  - A. To prevent contaminated equipment or buildings from being erroneously designed or mistaken as decontaminated, buildings and equipment will be marked with yellow paint (see "Definitions" para. 4) to indicate the degree of decontamination which has been performed. Tags shall be used in addition to indicate the extent and progress of treatment of treatment given. Tags are used and are to be signed by the inspector and supervisor and the extent of decontamination performed (such as cleaned with hot water, steam, or approved solvent) will be stated on the tag under their signatures.
6. Definitions:
  - A. "Decontamination" means the complete removal of explosives contamination, from all buildings and structures, equipment, and ground areas which are contaminated with explosive elements. This includes doors, vents, walls, ledges, ceilings, cracks, and joints in concrete floors, exterior water, steam and air lines, sumps and other places exposed to explosives. Contamination will be removed by use of vacuum, steam, water, and approved solvents, swabbing, scraping or flashing; whichever is appropriate for the material or item involved. Only approved type

3. Objectives: To assure that all buildings, equipment and grounds are properly decontaminated in a safe manner and to assure that the equipment can be utilized at another installation, and the buildings and grounds for other purposes.

4. Responsibilities:

A. Chief, Surveillance is responsible for:

- (1) Adequacy of S.O.P. to conduct decontamination.
- (2) Final inspection, certification, and signing of certificate that all buildings and equipment were decontaminated in accordance with these procedures.
- (3) Furnish the technical advice and instructions for decontamination that may not be fully covered in this S.O.P.
- (4) Preparation and signature of the statement of clearance required by references, para. 7D.
- (5) Furnishing the necessary supporting records to the statement of clearance as required by references, para. 7D.

B. D.S.T. is responsible for:

- (1) The accomplishment of decontamination in accordance with approved S.O.P.
- (2) Prepare addenda as necessary, to incorporate additional decontamination procedures for problem areas, if any, not covered in this S.O.P.
- (3) Assist the Chief of Surveillance Division as required by him in discharging the responsibility of para. 4A5.

C. Chief, Depot Facilities Division is responsible for:

- (1) Furnishing the necessary engineer tools and equipment that may be required for decontamination operations.
- (2) Furnishing necessary skilled personnel such as electricians, plumbers, etc., to operate such tools and equipment and/or to perform dismantling operations falling within the category.

5. Marking of Buildings and Equipment:

A. To prevent contaminated equipment or buildings from being erroneously designed or mistaken as decontaminated, buildings and equipment will be marked with yellow paint (see "Definitions" para. 6) to indicate the degree of decontamination which has been performed. Tags shall be used in addition to indicate the extent and progress of treatment of treatment given. Tags are used and are to be signed by the inspector and supervisor and the extent of decontamination performed (such as cleaned with hot water, steam, or approved solvent) will be stated on the tag under their signatures.

6. Definitions:

A. "Decontamination" means the complete removal of explosives contamination, from all buildings and structures, equipment, and ground areas which are contaminated with explosive elements. This includes doors, vents, walls, ledges, ceilings, cracks, and joints in concrete floors, exterior water, steam and air lines, sumps and other places exposed to explosives. Contamination will be removed by use of vacuum, steam, water, and approved solvents, swabbing, scraping or flashing; whichever is appropriate for the material or item involved. Only approved type solvents compatible with the specific explosives will be used.

B. Markings:

- (1) Single "X" indicates only partial decontamination. This marking is temporary and subsequent decontamination must be done.
- (2) Three (3) "X's" indicate that the equipment or building has been examined and approved after decontamination, but still should not be treated with open flame or high temperature heating devices, and is not to be considered toxically safe.

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(5) Five (5) "X's" indicate that the equipment or building has been inspected after decontamination, and is entirely safe, and may be released for general use.

NOTE: The procedures described in this S.O.P. cover, in most cases, complete decontamination as designated by a five (5) "X" (XXXXX) marking. In those instances where local decision or specific instruction from higher authority specifies that a lesser degree of processing is required, only the specified decontamination will be accomplished, i.e., as described above for one X (X) or three X's (XXX).

(4) Red car seals will be used on igloos that are free of contamination.

#### 7. References:

- A. AYCR 385-224, dated 4 September 1951 and all changes.
- B. S.E. 5-52, dated July 1945 (WD Supply Bulletin).
- C. Paragraph M1106 of OACI, dated 26 February 1959, concerning decontamination.
- D. AR 405-90, Disposal of Real Estate, dated 9 June 1959, para. 5B.

1. The DST office will maintain the master file for all reports and work orders required for decontamination of the Ammunition storage area at Black Hills Army Depot.
2. Daily reports will be submitted by the foreman in charge of decontamination to the DST office.
3. Format of report is as follows:

DAILY LOG

DATE: \_\_\_\_\_

- A. Building/Area Decontamination
- B. Procedure Used.
- C. Number Personnel.
- D. Certificate from Surveillance Inspector.
- E. Comment.

SIGNATURE: \_\_\_\_\_

(Foreman in Charge)

The foreman in charge will secure a certificate of decontamination (see below) for each storage location, building and/or area facility.

CERTIFICATE OF DECONTAMINATION

DATE: \_\_\_\_\_

I certify that the following building ~~site~~ (cross out word not applicable), has been decontaminated to a \_\_\_\_\_ category. The following procedure was used: \_\_\_\_\_

Webster's reagent was used to determine that decontamination was complete. Car seal number was used to secure magazine or building.

SIGNATURE: \_\_\_\_\_

(Ammunition Inspector)

- Foreman in charge of decontamination will coordinate with the DST office on submission of work orders to the Depot Facilities Division.

## I. General:

1. Steam used to heat water for decontaminating shall have a maximum pressure of five (5) lbs. PSI (228° F).
2. Protective equipment, such as showers, goggles, uniforms, gloves, rubber boots, rubber aprons, respirators and laundry facilities must be available for the use of the workers.
3. Hot water is recommended for the removal of black powder and Explosive D.
4. Steam is recommended for TNT and mixtures of TNT with other explosives.
5. Acetone is recommended for the removal of tetryl contamination. In this connection, when acetone is used, special care should be taken to provide adequate ventilation to prevent high concentration of vapors which might cause asphyxiation. Working supply of acetone must be kept in safety type container.
6. Safety solvent with a flash point above 100° F, may also be employed for scrubbing, however, such solvents do not ordinarily dissolve explosives, but merely act to loosen or float explosive particles.
7. Where disassembling or dismantling are required for decontamination, all nuts, bolts, screws, studs, cotter pins, etc., will be removed while wet. When a sensitive explosive is present and undue force is required, penetrating oil will be used and a stream of water played on items being removed.
8. Contaminated equipment or material and waste explosives will not be disposed of by burying.
9. Personnel shall be held to a minimum to assure a safe and efficient operation.
10. Explosive waste, contaminated acetone or solvent and contaminated rags shall be transported to burning ground in approved container before accumulation at the operation creates a hazardous condition. This should be done at least once each shift, or more often, when required.
11. Operators employed in steam cleaning operations shall wear goggles, gloves and rubber boots or overshoes.
12. Portable steam cleaning equipment (Steam Jenny) will be stationed outside of building being cleaned.
13. Oily or greasy rags will be placed in a self-closing container partially filled with water.
14. Metal scrapers will not be used at any time to clean floors.
15. Restricted area fences will remain intact until all decontamination operations have been completed. Contaminated buildings will be kept locked except while decontamination operations are in progress.
16. Fire protection equipment and personnel are to be readily available at all times.
17. During all phases of decontamination high temperatures and rough handling will be avoided to prevent explosive accidents.
18. Striking explosive material with hammers will be prohibited. Frictional heat will also be avoided.
19. Smoking will be permitted only in the existing designated locations.
20. Personnel engaged in decontamination operations will wear protective clothing and equipment as required.
21. If pipe lines have to be cut, this can be approved after explosive material has been flushed out, using high pressure water through both ends and all branches. The pipe filled with water, using a roller type cutter with the pipe full of water and playing a water hose over the outside pipe. Such a pipe should not be hammered or subjected to heat of a torch.

SECTION III

OPERATION I

DECONTAMINATION OF IGLOO & STANDARD STORAGE MAGAZINE AND GROUNDS AROUND  
MAGAZINES

SOP NO: SSMBH 5-66

DATE: 13 July 1966

OPERATION: DECONTAMINATION OF IGLOO STORAGE MAGAZINES AND GROUND MAGAZINES

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: Minimum required for a safe and efficient operation.

STEP NO.	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	Unlock igloo and open door, remove all surveillance inspection cards, placards, etc., place them into a trash container.	1. (O) Transfer to BG#2 via stake truck as required for burning.
2.	Inspect all ventilators, screens, doors, gutters, floors, walls, etc., in the interior of the magazine for any foreign material, such as ammunition components, etc., and accumulation of explosive dust.	2. (S) Only safety approved flash lamps and hand lamps will be used.
3.	With the aid of a non-sparking hook, remove the plates from the drains on each side of igloo and inspect for any explosive contamination and foreign material.	3. (S) Hook non-sparking will be made of brays or copper.
4.	In the event any ammunition or ammunition components are found, immediately notify the foreman in charge who will determine a safe method of handling in accordance with existing regulations for the specific item.	4. (S) Ammunition and/or ammunition components will be transferred to BG#2 and destroyed by detonation in accordance with Section 27 of AMCR 385-224 for the specific item.
5.	In the inspection, any accumulation of dust found, bulk of the dust will be removed, sprinkle a sufficient amount of water on floor to prevent the circulation of dust. Sweep floor and remove sweepings by use of a dust pan or shovel non-sparking	5. (S) Sweepings will be placed in a container with a sufficient amount of water to completely submerge the sweepings, transferred to BG#2 and destroyed by burning.
6.	Apply Webster reagent indicator to any location in the interior of the magazine where there is any suspicion of explosive contamination. To identify contamination when using Webster reagent, the reagent turns from light orange to a bright red when applied to surface which is contaminated.	6. (O) Webster reagent indicator only reacts with TNT, or a mixture of TNT with other explosives such as amatol, amonol, comp B and B <sup>2</sup> , picrate, tetryol, etc. Smokeless powder, Black powder and explosive "D" will not show evidence of contamination when reagent is applied.
7.	The presence of explosive contamination which cannot be detected	7. (S) Surveillance Inspector or qualified personnel will take

1. Unlock igloo and open door, remove all surveillance inspection cards, placards, etc., place them into a trash container.
2. Inspect all ventilators, screens, doors, gutters, floors, walls, etc., in the interior of the magazine for any foreign material, such as ammunition components, etc., and accumulation of explosive dust.
3. With the aid of a non-sparking hook, remove the plates from the drains on each side of igloo and inspect for any explosive contamination and foreign material.
4. In the event any ammunition or ammunition components are found, immediately notify the foreman in charge who will determine a safe method of handling in accordance with existing regulations for the specific item.
5. In the inspection, any accumulation of dust found, bulk of the dust will be removed, sprinkle a sufficient amount of water on floor to prevent the circulation of dust. Sweep floor and remove sweepings by use of a dust pan or shovel non-sparking.
6. Apply Webster reagent indicator to any location in the interior of the magazine where there is any suspicion of explosive contamination. To identify contamination when using Webster reagent, the reagent turns from light orange to a bright red when applied to surface which is contaminated.
7. The presence of explosive contamination which cannot be detected by use of the reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.
8. In the event reagent or inspection does not indicate contamination, the entire magazine will be washed down with water and magazine swept out. Magazine will be considered decontaminated.
2. (O) Transfer to B3#2 via snake truck as required for burning.
2. (S) Only safety approved flash lamps and hand lamps will be used.
3. (S) Hook non-sparking will be made of brass or copper.
4. (S) Ammunition and/or ammunition components will be transferred to B3#2 and destroyed by detonation in accordance with Section 27 of AMOR 385-224 for the specific item.
5. (S) Sweepings will be placed in a container with a sufficient amount of water to completely submerge the sweepings, transferred to B3#2 and destroyed by burning.
6. (O) Webster reagent indicator only reacts with TNT, or a mixture of TNT with other explosives such as amatol, ammonal, comp B and B<sup>2</sup>, pentolite, tetryol, etc. Smokeless powder, Black powder and explosive "D" will not show evidence of contamination when reagent is applied.
7. (S) Surveillance Inspector or qualified personnel will make visual inspection.
8. (S) Magazine will be closed and marked in accordance with step No. 11 and No. 14 of this S.O.P.

*Page 3 of 27 Pages*

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
9.	<p>In the event reagent or the visual inspection indicates contamination, the following material will be used for swabbing.</p> <p>A. Use water in magazine contaminated with black powder.</p> <p>B. Use steam and hot water in magazine contaminated with explosive D, TNT, and mixtures of TNT with other explosives such as Amatol, ammonal, comp B and B<sup>2</sup>, pentolite, terrytol, etc.</p> <p>C. Use acetone in magazines contaminated with terrytol.</p> <p>D. Use a 20% solution of hot sodium sulphite for cleaning floor cracks and rinse copiously with water.</p>	<p>9.</p> <p>B. (S) Steam Jenny used for steam and hot water will be positioned outside magazine 25 feet from door of igloo.</p> <p>(S) Operators using steam will be required to wear flamaproof coveralls, goggles, rubber gloves, rubber boots, or overshoes.</p> <p>C. (S) When using acetone in magazine, adequate ventilation will be provided to prevent high concentration of vapors. (See Safety Requirements, Section II, para.5)</p>
0.	<p>After magazine has been swabbed, the entire magazine will be rinsed with clear water and swept out. Magazine will be considered decontaminated.</p>	
1.	<p>Close and secure magazine, by the use of registered car seal.</p>	
2.	<p>Police and visually inspect grounds within a fifty (50) foot radius of magazine and manually test at various locations to detect any explosive contamination.</p>	<p>12. (I) Webster's reagent indicator will be used to test for contamination.</p>
3.	<p>If test shows that the ground is contaminated, the contaminated area will be burned in the following manner:</p> <p>A. Place adequate scrap material over area to ensure a hot and complete burn.</p> <p>B. Prior to ignition of the burn, a radius of 1200 ft. will be cleared of all personnel. Road blocks will be set up on all roads leading to area.</p> <p>C. Burn will be ignited by aid of safety and fuze lighter. Burn will be burned in the direction from which the wind is blowing.</p> <p>D. When burn is set up and safety fuze is in position, foreman in charge will be assured that all personnel are out of the danger area. When he is assured area is clear, he will ignite the burn by pulling pin or twisting pin and retire to a safe location from burn, 1,200 feet.</p>	<p>13.</p> <p>A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated areas.</p> <p>C. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.</p> <p>D. (S) Depot Fire Department will be on standby during burning operations.</p>

...contaminated with explosive of TNT, and mixtures of TNT with other explosives such as amatol, ammonal, comp B and B<sup>2</sup>, pentolite, tetrytol, etc.

C. Use acetone in magazines contaminated with tetrytol.

D. Use a 20% solution of hot sodium sulphite for cleaning floor cracks and rinse copiously with water.

10. After magazine has been swabbed, the entire magazine will be rinsed with clear water and swept out. Magazine will be considered decontaminated.

11. Close and secure magazine, by the use of registered car seal.

12. Police and visually inspect grounds within a fifty (50) foot radius of magazine and manually test at various locations to detect any explosive contamination.

13. If test shows that the ground is contaminated, the contaminated area will be burned in the following manner:

A. Place adequate scrap material over area to ensure a hot and complete burn.

B. Prior to ignition of the burn, a radius of 1200 ft. will be cleared of all personnel. Road blocks will be set up on all roads leading to area.

C. Burn will be ignited by aid of safety and fuze lighter. Burn will be burned in the direction from which the wind is blowing.

D. When burn is set up and safety fuze is in position, foreman in charge will be assured that all personnel are out of the danger area. When he is assured area is clear, he will ignite the burn by pulling pin or twisting pin and retire to a safe location from burn, 1,200 feet.

14. After burn is completed and area has cooled, crew will return to magazine and paint required "X's" on the door of magazine to indicate the degree of contamination.

15. Release the magazine and area without any restrictions.

and not enter will be positioned outside magazine 25 feet from door of igloo.

(S) Operators using steam will be required to wear flameproof coveralls, goggles, rubber gloves, rubber boots, or overshoes.

C. (S) When using acetone in magazine, adequate ventilation will be provided to prevent high concentration of vapors. (See Safety Requirements, Section II, para.5)

12. (Z) Webster's reagent indicator will be used to test for contamination.

13.

A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated areas.

C. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.

D. (S) Depot Fire Department will be on standby during burning operations.

14. (Y) A log will be maintained and shall include location of magazine, degree of decontamination, method of decontamination, date and car seat number.

*Page 9 of 29 pages*



REQUIREMENTS GENERAL: See Section II

SECTION OF COMPONENTS AND PACKING MATERIAL:

ammunition and/or ammunition components to Burning Ground #2.  
trap material to Burning Ground #2 such as placards, etc.  
weepings to Burning Ground #2.

WENT, TOOLS, GAGES, SUPPLIES:

, rubber boots, gloves, squeegees  
-closing containers, safety containers for acetone  
Jenny, trucks - dump or stake  
as, dust pans, shovel (non-sparking)  
-proof coveralls, goggles  
ry fuse, fuse lighters, fuel oil #2  
lights, hooks (non-sparking) respirators  
trucks (fire), Webster reagent indicator  
s, paint-yellow, paint brush  
p lumber  
y can w/yellow paint and stencils

AS REQUIRED

SECTION III - OPERATION II

DECONTAMINATION OF OPERATING BUILDINGS AND GROUNDS AROUND BUILDINGS

SOP: SSMBH 5-66

DATE: 13 July 1966

STANDING OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

OPERATION NO: II  
SOP NO: SSMBH 5-66 DATE: 13 Jul 66

OPERATION: DECONTAMINATION OF OPERATING BUILDINGS AND GROUNDS AROUND BUILDINGS

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	Coordinate all work requiring the service of the Depot Facilities Division by submission of proper work orders.	
2.	All main incoming electrical power will be switched off and switches will be locked in the off position.	
3.	Completely cover all exposed outlets inside and outside to protect against water seepage.	3. (S) Water-proof tape will be used.
4.	Remove and turn in all equipment and/or other extraneous material not listed as part of building, in accordance with supply regulations.	4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.
5.	Apply Webster reagent indicator to any location in the interior of the building where there is any suspicion of explosive contamination. To identify contamination when using reagent, the reagent turns from a light orange to a bright red when applied to a surface that is contaminated.	5. (I) Webster reagent indicator reacts only with TNT, or a mixture of TNT and other explosives, such as amatol, ammonal, Comp B and E <sup>2</sup> , percolite, etc. Smokeless powder, black powder and explosive "D" will not show evidence of contamination when reagent is applied.
6.	The presence of explosive contamination which cannot be detected by the use of reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.	6. (S) Surveillance inspectors or qualified personnel will make the visual inspections.
7.	In the event reagent or the visual inspection does not indicate contamination the building will be washed down with water and mopped; cleaned building will be considered decontaminated.	7. (O) Building will be closed and marked in accordance with steps of this S.O.P. (Steps #13 & #14).
8.	In the event reagent or visual inspection indicates contamination, the following materials will be used for swabbing. A. Use water in buildings contaminated with black powder. B. Use steam and hot water in buildings	8. (S) Swabbing material will be such as rags, mops, brooms, appropriate fiber brushes.

1. Coordinate all work requiring the service of the Depot Facilities Division by submission of proper work orders.
  2. All main incoming electrical power will be switched off and switches will be locked in the off position.
  3. Completely cover all exposed outlets inside and outside to protect against water seepage.
  4. Remove and turn in all equipment and/or other extraneous material not listed as part of building, in accordance with supply regulations.
  5. Apply Webster reagent indicator to any location in the interior of the building where there is any suspicion of explosive contamination. To identify contamination when using reagent, the reagent turns from a light orange to a bright red when applied to a surface that is contaminated.
  6. The presence of explosive contamination which cannot be detected by the use of reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.
  7. In the event reagent or the visual inspection does not indicate contamination the building will be washed down with water and mopped; cleaned building will be considered decontaminated.
  8. In the event reagent or visual inspection indicates contamination, the following materials will be used for swabbing.
    - A. Use water in buildings contaminated with black powder.
    - B. Use steam and hot water in building contaminated with explosive D, TNT, and mixtures of TNT with other explosives.
    - C. Use acetone in buildings contaminated with tetrytol.
    - D. Use a 20% solution of hot sodium sulphate for cleaning floor cracks and rinse copiously with water.
3. (S) Water-proof tape will be used.
  4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.
  5. (i) Webster reagent indicator reacts only with TNT, or a mixture of TNT and other explosives, such as amatol, ammonal, Corp B and B<sup>2</sup>, pentolite, etc. Smokeless powder, black powder and explosive "D" will not show evidence of contamination when reagent is applied.
  6. (S) Surveillance inspectors or qualified personnel will make the visual inspections.
  7. (O) Building will be closed and marked in accordance with steps of this S.O.P. (Steps #13 & #14).
  8. (S) Swabbing material will be such as rags, mops, brooms, appropriate fiber brushes.
    - B. (S) Steam Jenny used for steam and hot water will be positioned outside 25 feet from building.
    - C. (S) See Safety Requirements Section II, (para. 5).

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STEP  
NO

DESCRIPTION

(SAFETY, OPERATIONAL, INSPECTION)  
SPECIFIC INSTRUCTIONS

9. After building has been swabbed down, the entire building will be washed with clean water and mopped out. Building will be considered decontaminated.
  10. Close and secure building by the use of registered car seals.
  11. Police and visually inspect grounds within a fifty (50) foot radius of building and manually test ground at various locations to detect any explosive decontamination.
  12. If the test shows that the ground is contaminated, the contaminated area will be burned off in the following manner.
    - A. Position adequate scrap material over area to ensure a hot and complete burn.
    - B. Burn will be ignited by the aid of safety fuze and fuze lighter. The burn will be burned in the direction from which wind is blowing.
    - C. Prior to ignition of the burn, the area, for a radius of 1200 feet will be cleared of all personnel. Road blocks will be set up on all roads leading to area.
    - D. When foreman is assured that all personnel are outside of the danger area, he will ignite the burn by pulling or twisting the pin of the fuze lighter. Foreman will return to a safe location from burn 1200 feet.
  13. After burn is completed and area has cooled, crew will return to building and paint required "X's" on building to indicate the degree of decontamination.
  14. Release the building and area without any restrictions.
11. (I) Webster reagent indicator will be used to test for contamination.
    - A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated area.
    - B. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstance will the fuze length be under three feet, having a minimum burning time of 120 seconds.
    - D. (S) Depot Fire Department will have a tank truck on standby during burning operations.
  13. (I) A log will be maintained and shall include location of building, degree of decontamination, method of decontamination, date and car seal number.

SAFETY REQUIREMENTS GENERAL: See Section II

DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

1. Sweepings to Burning Ground #2.
2. Scrap to Burning Ground #2.

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Rags, rubber boots, gloves, squeegees

Self-closing containers, safety containers for acetone

Steam Jenny, trucks - dump or stake

Brooms, dust pans, shovel (non-sparking)

Flame-proof coveralls, goggles

Safety fuze, fuze lighters, fuel oil #2

Flashlights, hooks (non-sparking) respirators

Tank trucks (fire), Webster reagent indicator

Seals, paint (yellow), paint brush

Scrap lumber

Spray can w/yellow paint and stencils

AS REQUIRED

SECTION III - OPERATION III

DECONTAMINATION OF VACUUM COLLECTING SYSTEMS AND VACUUMS BUILDINGS

SOP: SSMBH 5-66

DATE: 13 July 1966

OPERATION: DECONTAMINATION OF VACUUM COLLECTING SYSTEMS AND VACUUM BUILDINGS

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION.

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	Coordinate all work requiring the services of Depot Facilities Division by submission of work orders.	
2.	All main incoming electrical power will be switched off and switches will be locked in the off position.	
3.	All exposed outlets inside and outside will be covered completely to protect against water seepage.	3. (S) Waterproof tape will be used.
4.	Remove and turn in all equipment and/or other extraneous material not listed as part of building in accordance with supply regulations in the following manner. A. Vacuum collecting systems. 1. Remove all explosive from vacuum collectors and place in a container for transfer to EG#2 for burning. 2. Clean surface of the collectors inside and outside using steam at 5 lbs. pressure or less for TNT and explosive D. 3. Use acetone for the removal of tetrytol. 4. The piping serving the collection tank will be flushed using water under pressure, to remove as much of the explosive as possible. While the interior of the pipe is wet, penetrating oil with a flash point of higher than 1060° F. will be applied to the joints, bolts, or pipe flittings and a sufficient time allowed for the oil to enter the threads before nuts or pipe sections are separated. B. Dry type primary and secondary vacuum collector. 1. Remove the fabric sack from the collectors, remove the entrapped explosive from sack by	4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.  A.  2. (S) Operators using steam will be required to wear flame-proof coveralls, goggles, rubber gloves, rubber boots or overshoes. 3. (S) See Safety Requirements, Section II, (Para. 5). 4. (S) When nuts or pipe sections cannot be removed without undue force, the pipe may be cut. See Section II, Safety Requirements (Para. 21).



1. Coordinate all work requiring the services of Depot Facilities Division by submission of work orders.
2. All main incoming electrical power will be switched off and switches will be locked in the off position.
3. All exposed outlets inside and outside will be covered completely to protect against water seepage.
4. Remove and turn in all equipment and/or other extraneous material not listed as part of building in accordance with supply regulations in the following manner.
  - A. Vacuum collecting systems.
    1. Remove all explosive from vacuum collectors and place in a container for transfer to EG&2 for burning.
    2. Clean surface of the collectors inside and outside using steam at 5 lbs. pressure or less for TNT and explosive D.
    3. Use acetone for the removal of tetrytol.
    4. The piping serving the collection tank will be flushed using water under pressure, to remove as much of the explosive as possible. While the interior of the pipe is wet, penetrating oil with a flash point of higher than 1000° F. will be applied to the joints, bolts, or pipe fittings and a sufficient time allowed for the oil to enter the threads before nuts or pipe sections are separated.
  - B. Dry type primary and secondary vacuum collector.
    1. Remove the fabric sack from the collectors, remove the encrusted explosive from sack by shaking explosive loose into a container w/water to completely cover explosive. Transfer to EG&2 for burning.
    2. Decontaminate the sacks by washing where practicable.
    3. Reassemble sacks to collectors.
  - C. Vacuum separator tanks.
    1. Remove the bottom collector's balls and thoroughly clean them of all encrusted explosive.

3. (S) Waterproof tape will be used.
4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.
  - A.
    2. (S) Operators using steam will be required to wear flame-proof coveralls, goggles, rubber gloves, rubber boots or overshoes.
    3. (S) See Safety Requirements, Section II, (Para. 5).
    4. (S) When nuts or pipe sections cannot be removed without undue force, the pipe may be cut. See Section II, Safety Requirements (Para. 2i).

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of explosive contamination.

D. WET TYPE VACUUM COLLECTING SYSTEMS.

1. Drain all water from tank and transfer to Burning Ground #2 for burning.

2. Clean interior of tank and the piping in the manner provided for dry type collectors and piping.

3. Sludge tanks and pumps forming a part of the wet collecting system will be cleaned of explosive deposits using approved material.

4. Joints in the equipment that were in contact with explosive, where they were secured by screws, bolts, or other type of fastenings, are to be carefully separated after lubricating threads.

5. Wash or clean all parts with approved material.

6. After cleaning this equipment will be coated with oil for rust prevention; it will then be reassembled.

7. Paint the required "X's" on equipment as to degree of decontamination. Transfer to shipping building for inventory shipment.

8. Wash the interior of building.

9. In accordance with Section III, Operation II, S.O.P. for the Decontamination of Operating Buildings and Grounds around Buildings.

D.

3. (S) Operators cleaning tank and pumps will wear the required protective equipment for cleaning material being used.

5. (S) See Section II, (Part. #5 and #7).

SAFETY REQUIREMENTS GENERAL: See Safety Requirements Section III.

DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

1. Explosives to Burning Ground #2 for burning.
2. Equipment to shipping building.

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Locks, tape, hand tools, (non-sparking)

Steam Jersey, (safety type can for acetone)

Containers for explosive, rags, mops, brooms

Oil, paint, paint brushes, flame-proof

Coveralls, rubber gloves, rubber boots or overshoes

Goggles, trucks - stake, acetone

AS REQUIRED

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STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY-OPERATIONAL-INSPECTION)
4. C.	<p>2. Steam will be used for TNT and explosive D.</p> <p>3. Use acetone for the removal of tetrytol.</p> <p>4. The interior of the tank and the connecting pipe outlets from the tank shall be likewise cleaned of explosive contamination.</p> <p>D. <u>Wet type vacuum collecting systems.</u></p> <p>1. Drain all water from tank and transfer to Burning Ground #2 for burning.</p> <p>2. Clean interior of tank and the piping in the manner prescribed for dry type collectors and piping.</p> <p>3. Sludge tanks and pumps forming a part of the wet collecting system will be cleaned of explosive deposits using approved material.</p> <p>4. Joints in the equipment that were in contact with explosive, where they were secured by screws, bolts, or other type of fastening, are to be carefully separated after lubricating threads.</p> <p>5. Wash or clean all parts with approved material.</p> <p>6. After cleaning this equipment will be coated with oil for rust prevention; it will then be reassembled.</p> <p>7. Paint the required "X's" on equipment as to degree of decontamination. Transfer to shipping building for inter-depot shipment.</p> <p>8. Wash the interior of building in accordance with Section III, Operation II, S.O.P. for the Decontamination of Operating Buildings and Grounds around Buildings.</p>	<p>4. C. 2. (S) Operators using steam will be required to wear flame-proof coveralls, goggles, rubber boots, and rubber gloves.</p> <p>3. (S) See Safety Requirements Section II, (Para. 5).</p> <p>D.</p> <p>3. (S) Operators cleaning tanks and pumps will wear the required protective equipment for cleaning material being used.</p> <p>5. (S) See Section II, (Para. #5 and #7).</p>

SAFETY REQUIREMENTS GENERAL: See Safety Requirements Section III.

DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

1. Explosives to Burning Ground #2 for burning.
2. Equipment to shipping building.

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Locks, tape, hand tools, (non-sparking)  
 Steam Jenny, (safety type can for acetone)  
 Containers for explosive, rags, mops, brooms

AS REQUIRED

SECTION III - OPERATION IV

DECONTAMINATION OF LEACHING BEDS FOR EXPLOSIVES AND ACTDS

SOP: SSMBH 5-66

DATE: 13 July 1966

STANDING OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

OPERATION NO: IV  
SOP: SSICM 5-66 DATE: 13 July 1966

OPERATION: Decontamination of Leaching Beds for Explosives and Acids

EXPLOSIVE LIMITS: None

PERSONNEL LIMITS: OPERATORS: Minimum Required for a Safe and Efficient Operation.

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	<p>The following procedures and recommendations are made as they relate to the decontamination with the most reasonable degree of 3 X (XXX) necessary to deactivate and/or dispose of the leaching beds at Black Hills Army Depot with restricted covenants.</p> <p>A. Receive scrap material from storage sites, dunnage will via van trailer and/or dump trucks.</p> <p>B. Position adequate scrap material over leaching beds contaminated with explosive to ensure a hot and complete burn.</p> <p>C. Obtain required number of safety fuzes and fuze lighters from storage. Proceed to burn site. Safety fuze will be tested for burning rate prior to using and when a new coil of fuze is used. Safety fuze will be cut to required length so as to allow personnel time to clear the area.</p> <p>D. Activate fuze lighters by pulling or twisting pin. Make sure lighter starts safety fuze. Retire to the safe distance of 1,200 feet from the burn. Prior to activating safety fuze, foreman in charge will be assured that area around the burn is free of all personnel and equipment.</p> <p>E. Black Hills Fire Department will be on standby at time of burning.</p> <p>F. After fire is out and the bed cooled, tests will be made at different locations to be sure beds are cleaned of contamination.</p> <p>G. If test shows that no contamination is present, bed will be considered decontaminated. With the aid of a bulldozer, close bed with earth.</p>	<p>1.</p> <p>B. (S) Trucks transferring scrap material will not be allowed to drive over contaminated area.</p> <p>C. (S) Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.</p> <p>D. (O) A small amount of propellant may be used to ignite the fire.</p> <p>(S) The area around the leaching bed for a radius of 1,200 ft. will be cleared of all personnel, and road blocks will be set up on roads leading into area.</p> <p>F. (O) Webster reagent indicator will be used for testing for contamination.</p>
2.	<p>Decontamination of leaching beds used for acids.</p> <p>A. Receive limestone from supply point via dump trucks.</p>	

1. The following procedures and recommendations are made as they relate to the decontamination with the most reasonable degree of 3 X (XXX) necessary to deactivate and/or dispose of the leaching beds at Black Hills Army Depot with restricted covenants.
  - A. Receive scrap material from storage sites, dunnage will via van trailer and/or dump trucks.
  - B. Position adequate scrap material over leaching beds contaminated with explosive to ensure a hot and complete burn.
  - C. Obtain required number of safety fuzes and fuze lighters from storage. Proceed to burn site. Safety fuze will be tested for burning rate prior to using and when a new coil of fuze is used. Safety fuze will be cut to required length so as to allow personnel time to clear the area.
  - D. Activate fuze lighters by pulling or twisting pin. Make sure lighter starts safety fuze. Retire to the safe distance of 1,200 feet from the burn. Prior to activating safety fuze, foreman in charge will be assured that area around the burn is free of all personnel and equipment.
  - E. Black Hills Fire Department will be on standby at time of burning.
  - F. After fire is out and the bed cooled, tests will be made at different locations to be sure beds are cleaned of contamination.
  - G. If test shows that no contamination is present, bed will be considered decontaminated. With the aid of a bulldozer, close bed with earth.
2. Decontamination of leaching beds used for acids.
  - A. Receive limestone from supply point via dump trucks.
  - B. Position limestone over contaminated area to a depth approximately 1 inch deep.
  - C. With the aid of a bulldozer, close bed with earth.
3. Recommendations for future use.

Release area with no restrictions.

1.

B. (S) Trucks transferring scrap material will not be allowed to drive over contaminated area.

C. (S) Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.

D. (O) A small amount of propellant may be used to ignite the fire.

(S) The area around the leaching bed for a radius of 1,200 ft. will be cleared of all personnel, and road blocks will be set up on roads leading into area.

F. (O) Webster reagent indicator will be used for testing for contamination.

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DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Scrap Material

Safety Fuze

Fuze Lighters

Truck - Dump

Fire tank truck

Road blocks

Bulldozers

Limestone

AS REQUIRED

SECTION III - OPERATION V

DECONTAMINATION OF DEMOLITION AND BURNING GROUNDS AT BLACK HILLS ARMY DEPOT

SOP: SSMBH 5-66

DATE: 13 July 1966



OPERATION: DECONTAMINATION OF DEMOLITION AND BURNING GROUNDS

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	The following procedures and recommendations are made as they relate to the decontamination, with the most reasonable degree of 3X (XXX) necessary to deactivate and/or dispose of the demolition and/or burning ground area facility of Black Hills Army Depot with restricted covenants.	
2.	<p><u>Demolition Grounds and Area.</u></p> <p>A. Police the area within a radius of 2,400 feet of demolition site</p> <p>B. Surface clean all exposed and passable areas of all ammunition items or scrap in the following manner.</p> <p>C. 1. Unexploded lumps of explosives and unfuzed ammunition may be picked up and prepared for the next shot. Position unexploded lumps of explosive or unfuzed items of ammunition in groups not to exceed 500 lbs. of explosive.</p> <p>2. When all groups are set up, and prior to capping sites, all personnel will retire to the barricade control station.</p> <p>3. One team of two qualified operators will obtain a sufficient amount of electric blasting caps (two (2) per group) from storage and proceed to demolition area.</p> <p>4. Remove shunts from the lead wires of the blasting cap. Test cap for continuity using a galvanometer. When test is completed short the lead wires of the cap. Position the blasting cap into the demolition material on items to be destroyed.</p> <p>5. Check the firing line for stray currents and continuity using a dummy test circuit and radio pilot lamp #47 or equal and a galvanometer. If test checks out satisfactorily, unshort the cap wires and connect them to the</p>	<p>2. Blasting machine shall be kept locked at all times when not in use. Foreman or his assistant will be personally charged with the sole custody of all ignition devices. Keys to fire control panel will be in the hands of foreman and not loaned to anyone.</p> <p>2. When foreman is assured that all personnel are in the control station, sites may be capped. (S)</p> <p>3. (S) Blasting caps must be carried in a closed container. Under no circumstances will caps be carried in operator's pockets.</p> <p>4. (S) When uncoiling the lead wires of the blasting cap, cap will not be held directly in the hand but by the wire, approximately six inches from cap. Lead wires should be straightened out as far as required by hand.</p> <p>5. (S) Test for stray current will be made at point where cap wires are connected to the firing circuit. Connection between the blasting cap and the circuit firing line will not be made unless the power end of the firing wire is shorted and</p>

1. The following procedures and recommendations are made as they relate to the decontamination, with the most reasonable degree of 3X (XXX) necessary to deactivate and/or dispose of the demolition and/or burning ground area facility of Black Hills Army Depot, with restricted covenants.

2. Demolition Grounds and Area.

A. Police the area within a radius of 2,400 feet of demolition site.

B. Surface clean all exposed and passable areas of all ammunition items or scrap in the following manner.

C. 1. Unexploded lumps of explosives and unfuzed ammunition may be picked up and prepared for the next shot. Position unexploded lumps of explosive or unfuzed items of ammunition in groups not to exceed 500 lbs. of explosive.

2. When all groups are set up, and prior to capping sites, all personnel will retire to the barricade control station.

3. One team of two qualified operators will obtain a sufficient amount of electric blasting caps (two (2) per group) from storage and proceed to demolition area.

4. Remove shunts from the lead wires of the blasting cap. Test cap for continuity using a galvanometer. When test is completed short the lead wires of the cap. Position the blasting cap into the demolition material on items to be destroyed.

5. Check the firing line for stray currents and continuity using a dummy test circuit and radio pilot lamp #47 or equal and a galvanometer. If test checks out satisfactorily, unshort the cap wires and connect them to the firing lead wires.

5. Repeat steps C 3, 4 and 5 for capping subsequent groups.

3. Operate fire control panel by use of blasting machine

A. Lock panel door and be assured

2. Blasting machine shall be kept locked at all times when not in use. Foreman or his assistant will be personally charged with the sole custody of all ignition devices. Keys to fire control panel will be in the hands of foreman and not loaned to anyone.

2. When foreman is assured that all personnel are in the control station, sites may be capped. (S)

3. (S) Blasting caps must be carried in a closed container. Under no circumstances will caps be carried in operator's pockets.

4. (S) When uncoiling the lead wires of the blasting cap, cap will not be held directly in the hand but by the wire, approximately six inches from cap. Lead wires should be straightened out as far as required by hand.

5. (S) Test for stray current will be made at point where cap wires are connected to the firing circuit. Connection between the blasting cap and the circuit firing line will not be made unless the power end of the firing wire is shorted and grounded.

6. (O,S) Radio pilot lamp will be checked daily to be assured it is in working order.

3. A. (S) Fire control panel will be kept locked when not in use.

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STEP NO	DESCRIPTION	(SAFETY, OPERATIONAL, INSPECTION)
3.	<p>B. Move dial handle to the number of the firing wire that is being used. Insert Mallory Plug No. 85 into Mallory Jacks, and test circuit for continuity using a galvanometer. A reading of 10-25 ohm indicates a satisfactory circuit.</p> <p>C. Connect the wires from the Mallory Plug to the blasting machine and fire shot by twisting or plunging handle, depending on type of blasting machine used.</p> <p>D. Disconnect the lead wires from the blasting machine. Repeat steps 3. A, B, and C before firing subsequent shots.</p>	<p>3. B. (S) If circuit continuity is not obtained, a search will be made after all other shots have been fired for a break in the firing line, repairs made and demolition completed.</p>
4.	<p>A. Fuzed ammunition or items which may have internally damaged components will be created as duds and destroyed in the following manner.</p> <p>B. When duds are found in the search, they will be marked with a rod placed in the earth by the side of the item, and marked with a red or yellow tag.</p> <p>C. A number tag also will be used.</p> <p>C. Duds will be destroyed in place by placing a charge next to but not in contact with the dud.</p> <p>D. Prepare the shot in accordance with Step 3. C-3, 4, 5, and 6.</p> <p>E. Shoot the shot in accordance with Step 3. A, B, C and D.</p>	<p>C. (S) If firing wires are energized and shot fails to fire (misfire), 30 minutes must elapse before investigating cause of misfire. Investigation is to be made by no more than two people, i.e., foreman and his assistant or ammunition inspector. All other personnel will remain in shelter until cause of misfire is determined, repairs made, and demolition completed.</p>
5.	<p>A. After demolition ground is cleared of all explosive items and scrap, with the aid of a bolt cover demolition pits will be closed.</p> <p>Fence the area with a five strand barbed wire fence and post area as in surface cleaned and release for active use.</p>	<p>4. B. (S) Tags will be used to keep track of all duds and that the ones found will not be missed when preparing shots.</p> <p>C. (S) Duds will be handled carefully at all times.</p> <p>D. Same as Step 11.</p> <p>E. Same as Step 11.</p>
7.	<p><u>Demolition of Barrage Grounds or Bluff Walls After Shot</u></p> <p>A. Bolide the area within a radius of 2,400 feet of sites where bombing operations actually took place.</p> <p>B. Surface clean all exposed and passable areas of all ammunition items or scrap in the following manner.</p> <p>C. 1. Undetonated lumps of explosives and unfuzed ammunition may be picked up and prepared for the next burn.</p> <p>2. Position adequate scrap material over sites where bombing operation actually took place to ensure a hot and complete burn of</p>	<p>7. B. (S) Duds found will be marked with a rod placed in the earth by the side of the item and marked with a red or yellow tag. Numbered tags will also be used.</p> <p>C. 2. (S) Trucks hauling scrap or combustible material will not be allowed to drive over contaminated area.</p>

C. Connect the wires from the Main-  
lory Plug to the blasting machine  
and fire shot by twisting or plugging  
handle, depending on type of blasting  
machine used.

D. Disconnect the lead wires from  
the blasting machine. Repeat steps  
3, A, B, and C before firing subse-  
quent shots.

4. A. Fuzed ammunition or items which  
may have internally damaged components  
will be created as duds and destroyed  
in the following manner.

B. When duds are found in the search,  
they will be marked with a rod placed  
in the earth by the side of the item,  
and marked with a red or yellow tag.

A number tag also will be used.

C. Duds will be destroyed in place  
by placing a charge next to but not  
in contact with the dud.

D. Prepare the shot in accordance  
with Step #1, C-3, 4, 5, and 6.

E. Shoot the shot in accordance with  
Step #3, A, B, C and D.

5. After demolition ground is cleared of  
all explosive items and scrap with  
the aid of a bulldozer demolition  
pits will be closed.

6. Fence the area with a five strand barbed  
wire fence and post area as in sur-  
face cleaned and release for burning.

7. Preparation of Burning Grounds at  
Black Hills Army Depot

A. Fence the area within a radius  
of 2,400 feet of sites where burning  
operations actually took place.

B. Surface clean all exposed and  
passable areas of all ammunition items  
or scrap in the following manner.

C. 1. Unburned lumps of explosives  
and unfuzed ammunition may be  
picked up and prepared for the  
next burn.

2. Position adequate scrap mate-  
rial over sites where burning  
operation actually took place to  
ensure a hot and complete burn of  
area.

3. Burns will be ignited with  
the aid of a safety fuse and fuse  
lighters.

4. Retrieve safety fuse and fuse  
lighters from storage and proceed  
to the burn area. Prepare safety  
fuse in the following manner.

C. (S) If firing wires are equip-  
ped and shot fails to fire  
(a) fired. 30 min. after failure  
of fire investigating cause of mis-  
fire. Investigation is to be made  
by no more than two people, i.e.,  
foreman and his assistant or  
ammunition inspector. All other  
personnel will remain in shelter  
until cause of misfire is deter-  
mined, repairs made, and dem-  
olition completed.

4. B. (S) Tags will be used to keep  
track of all duds and that the ones  
found will not be missed when pre-  
paring shots.

C. (S) Duds will be handled care-  
fully at all times.

D. Same as Step II.

E. Same as Step III.

3.

3. (S) Duds found will be marked  
with a rod placed in the earth  
by the side of the item and marked  
with a red or yellow tag. Numbered  
tags will also be used.

C. 2. (S) Trucks hauling scrap or  
combustible material will not  
be allowed to drive over con-  
taminated area.

4. (S) Safety fuse will be  
tested for burning rate prior  
to burn and when a new coil is  
used.

*Page 23 of 29 pages*

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
7. C. 5.	<p>5. Cut safety fuse to required length and secure fuse lighter to one end of fuse. Position end of safety fuse three or four feet from the combustible material. A small amount of proellant may be used to insure a complete start of combustible material.</p> <p>6. Burn will be burned in the direction from which the wind is blowing.</p> <p>7. When foreman is assured that all personnel are out of the danger area, 2,400 feet from burn, he will activate the fuse lighter by twisting or pulling pin and retire to a safe distance from burn area. 2,400 feet.</p>	<p>7. C. 5 (C) Under no circumstances will the fuse length be under three (3) feet, having a minimum burning time of 120 seconds.</p> <p>(S) Fuse length will be adequate to enable foreman to walk to a safe distance.</p>
8.	<p>Buds found will be handled in the same manner as in Step 4, A,B,C and D.</p>	<p>(C) Same as Step 4, A,B,C and D.</p>

#### SAFETY REQUIREMENTS GENERAL:

1. Demolition area will have telephone communication available.
2. Chief, Maintenance Branch will be contacted before items are detonated. He will decide if weather conditions are favorable for demolition.
3. AMCR 285-474, Section 27 will be complied with in its entirety.

#### DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

Buds, unfused ammunition, ammunition strap destroyed.

#### EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP  
Rags, red or yellow  
Tugs, fire control panel  
Radio pilot lamp, galvanometer  
Blasting caps  
Demolition material  
Firing wire  
Blasting machine  
Bladozer  
Safety fuse  
Fuse lighters

SECTION III - OPERATION VI

DECONTAMINATION OF WASHOUT PLANT AND AREA AT BLACK HILLS ARMY DEPOT

SOP: SSMBE 5-66

DATE: 13 July 1966

OPERATION: DECONTAMINATION OF WASHOUT PLANT AND AREA AT BLACK HILLS ARMY DEPOT

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION.

STEP

NO

DESCRIPTION

SPECIFIC INSTRUCTIONS

(SAFETY, OPERATIONAL, PREVENTION)

1. The following procedure and recommendations are made as they relate to the decontamination with the most reasonable degree of SX necessary to deactivate and/or dispose of the wash-out plant and area at Black Hills Army Depot with restricted covenants.
2. Coordinate all work requiring the services of the Depot Facilities Division by submission of proper work orders.
3. Main incoming electrical power will be switched off and all incoming electrical power lines leading into plant will be removed for a distance of at least 100 feet from buildings.  
A. Remove all equipment and/or extraneous material that is not listed as part of building and turn in, in accordance with supply regulations.
4. Remove scrap combustible material from damage mill and/or storage locations. Position explosive material in and around buildings 3045 and 3046 to ensure a hot and complete burn.  
A. Remove safety fuse and fuse lighters from storage and proceed to the burn area. Prepare the safety fuse in the following manner:  
B. Cut the required length of safety fuse from coil of fuse and secure fuse lighter to one end of safety fuse. Position other end of safety fuse over propellant or combustible material.  
C. Burn will be burned in the direction from which the wind is blowing.  
D. When foreman is assured that all personnel are out of the danger area (100 feet from buildings), foreman will activate the fuse lighter by twisting or pulling pin and securing to a safe distance from burn - 1000 ft.
5. When fire is out and the burn is cooled, area will be tested for contamination. If no contamination is present,

4. (5) Trucks transferring scrap material will not be allowed to drive over contaminated area.

A. (5) Safety fuse will be tested for burning rate prior to burn and when a new coil is used.

B. (6) Under no circumstances will the fuse length be under three (3) feet having a minimum burning time of 120 seconds. (5) Fuse length will be so that foreman can walk to a safe distance - not run.

D. (6) Depot Fire Department will be on standby during burning operations.

- [illegible]

3. ಪ್ರತಿಭಾ ಪುಸ್ತಕವನ್ನು ಅನುಸರಿಸುವುದಾಗಿ ಪ್ರತಿಜ್ಞೆ ಮಾಡುವ  
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[illegible]

第一、因古詩中多有「悲秋感時」之句，故古人多悲秋。如杜甫之「悲秋」詩，白居易之「悲秋」詩，李商隱之「悲秋」詩，皆以悲秋為主題。此等詩，多感嘆人生之短促，時代之易逝，故有悲秋之感。此等詩，多感嘆人生之短促，時代之易逝，故有悲秋之感。

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**COPIES OF THE REPORT**

# SECRET

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19



SECTION III - OPERATIONS VII

DECONTAMINATION OF CHEMICAL PLANT AND PLANT AREA

SOP: SEMM 5-66

DATE: 13 July 1966

STANDARD OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

OPERATION NO: VII  
SOP: SEVEN 5-66 DATE: 13 JUL 66

OPERATION: DECONTAMINATION OF CHEMICAL PLANT AND PLANT AREA.

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION.

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSTRUCTION)
1.	The following procedures and recommendations are made as they relate to the decontamination, with the most reasonable degree of 3X necessary to deactivate and/or dispose of the Chemical Plant and plant area facility at Black Hills Army Depot with restricted covenants.	
2.	Coordinate all work, requiring the services of the Depot Facilities Division by submission of the proper work orders.	
3.	Main incoming electrical power will be switched off and all electrical power lines leading into plant will be removed. A. Remove all equipment and/or extraneous material that is not listed as part of building. Turn in in accordance with supply regulations.	
4.	Burning Pit Area. A. Receive combustible material from storage location and/or damage will via dump truck. B. Position combustible material or scrap into pit. C. Obtain a sufficient amount of safety fuse and fuse lighters from storage and proceed to burn area. D. Prepare safety fuse in the following manner: 1. Cut safety fuse to the required length and secure fuse lighter to one end of safety fuse. 2. Position other end of safety fuse into a small amount of propellant and/or combustible material. 3. Burn will be burned in the direction from which the wind is blowing. E. When command is assured that all personnel are out of the danger area (up wind, 2,400 feet), he will activate the fuse lighter by striking or pulling pin and retire to a safe distance (2,400 feet up wind of burn).	4. A. (3) Trucks hauling scrap material will not be allowed to drive over contaminated area. B. (5) Adequate material will be used to ensure a hot and complete burn. C. 1. (3) Under no circumstances will the fuse length be under three (3) feet having a minimum burning time of 120 seconds. Fuse length will be so that personnel can walk to a safe distance, not run. D. (3) Depot Fire Department will be on standby during burning operations.

- Handwritten conditions are made as they relate to the decontamination, with the most reasonable degree of BX necessary to decontaminate and/or dispose of the Chemical Plant and plant area facility at Black Hills Army Depot with restricted coverings.
2. Coordinate all work, requiring the services of the Depot Facilities Division by submission of the proper work orders.
  3. Main incoming electrical power will be switched off and all electrical power lines leading into plant will be removed.
    - A. Remove all equipment and/or extraneous material that is not listed as part of building. This is in accordance with supply regulations.
  4. Burning Pit Area.
    - A. Receive combustible material from storage location and/or damage will via dump truck.
    - B. Position combustible material or scrap into pit.
    - C. Obtain a sufficient amount of safety fuse and fuse lighters from storage and proceed to burn area.
    - D. Prepare safety fuse in the following manner:
      1. Cut safety fuse to the required length and secure fuse lighter to one end of safety fuse.
      2. Position other end of safety fuse into a small amount of propellant and/or combustible material.
      3. Burn will be burned in the direction from which the wind is blowing.
    5. When foreman is assured that all personnel are out of the danger area (up wind, 2,400 feet), he will deactivate the fuse lighter by twisting or pulling pin and retire to a safe distance (2,400 feet up wind of burn).
    6. When fire is out and ground cooled, a test will be made of burning pit. If test shows no contamination, pit will be closed with earth with the aid of a bulldozer.
    7. Fence pit area with a five strand barbed wire fence and post as to contamination.
    8. If test shows contamination still present, pit will be returned in the same manner as step 4, 5 and 6.

4.
  - A. (G) Trucks hauling scrap material will not be allowed to drive over contaminated area.
  - B. (G) Adequate material will be used to ensure a hot and complete burn.
  - C. 1. (G) Under no circumstances will the fuse length be under three (3) feet below a minimum burning time of 120 seconds. Fuse length will be so that personnel can walk to a safe distance, not run.
5. (G) Depot Fire Department will be on standby during burning operations.

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APPENDIX C  
REPORT OF VISIT TO BHOD, 21-27 JULY 1971

WEAPONS DEVELOPMENT AND ENGINEERING LABORATORIES  
Edgewood Arsenal, Maryland 21010

SDUEA-W-CP-ED

4 August 1971

MEMORANDUM FOR: DIRECTOR OF WEAPONS DEVELOPMENT AND ENGINEERING LABORATORIES

SUBJECT: Report of Trip by Dean H. Dickey to the Former Black Hills  
Army Depot Burning Site Number 2, 21-27 July 1971

1. References.

a. Message, CG, AMC to CG, MUCOM 22 December 1970, subject:  
Survey of Former Black Hills Army Depot.

b. Letter, AMSMU-SF to CO, Edgewood Arsenal, 6 January 1971,  
same subject.

c. Letter, AMSMU-SF to CO, Edgewood Arsenal, 1 April 1971.

2. Purpose of Visit. To determine the validity of an allegation  
that leaking mustard agent from buried munitions is contaminating the  
atmosphere.

3. Persons Contacted.

a. Mr. Fred Conner, US Army Engineer District, Omaha, NE.

b. Mrs. Elizabeth Mullen, US Forestry Service, Hot Springs, SD.

c. Mr. Donald C. Straight, Provo, SD.

d. Mr. Matthew Brown, Edgemont, SD.

4. Summary.

A. The former US Army Black Hills Ordnance Depot, Igloo, SD was  
declared surplus for military needs in 1968 and was sold. Part of  
the depot was purchased by the city of Edgemont, SD and later resold  
to private enterprise for cattle grazing. A portion of the depot was  
retained by the US Forestry Service and sheep graze in their portion.  
The two properties are divided by a fence. Five years after the  
depot had closed, Mrs. Pauline Straight of Provo, SD wrote a letter  
to Senator McGovern (SD) alleging that vapors from mustard agent  
were affecting her throat and face. Upon receipt of her letter

4 August 1971

SUBJECT: Report of Trip by Dean M. Dickey to the Former Black Hills  
Army Depot Burning Site Number 2, 21-27 July 1971

of complaint, Senator McGovern requested a report on the matter Mrs. Straight described. Mr. R. Kerr, Safety Engineer, Edgewood Arsenal, investigated the matter in January 1971. In an interim report he concluded, "No evidence was found to corroborate the statement made by Mrs. Straight." Army Materiel Command requested a second survey be made, "When climatic and soil conditions are proper." A team from Edgewood Arsenal made the second survey in July 1971. The temperature during the tests conducted in July ranged from 81 to 94°F. in winds from NNW at 3-5 miles per hour.

b. Permission was granted the team to enter the area by the US Forestry Service, Hot Springs, SD. Mr. Straight accompanied the team to the area where he stated he had witnessed leaking mustard rounds being buried. He directed the team to a remote section of the depot approximately five miles from his home. It was known as Burning Site Number 2 when the depot was in operation and was primarily used for destruction of high explosive-filled munitions. Mr. Straight remembered the general area but could not definitely identify the approximate spot where he saw the munitions being buried. Burning Site Number 2 consists of approximately forty acres, of land interlaced with ridges and ravines. Vegetation ranges from sparse on the shale-covered ridges to heavy in the ravines. Sheep were grazing in the area.

c. A cursory examination of the area revealed a high density of metal fragments, no odors except that from sheep, no bleached vegetation or bare spots normally associated with chemical burial sites or disposal areas. There were no signs posted, no contours of old pits and in fact, nothing which would separate Burning Site Number 2 from the surrounding terrain. Deep eroded washes were followed from the crest of the ridges to the ravines. Nothing was found in the eroded areas.

d. The first check of the area was made by using the components of the M18 Chemical Agent Detection Kit. The air was sampled as well as pieces of metal fragments and patches of soil. All tests were negative.

e. The team then located an area to sample prevailing winds from the burning site flowing toward Mrs. Straight's home. At this site air bubblers were installed and activated to obtain air samples. The bubblers were chemically analyzed with negative results. A second test was made to further confirm the first test. The results of this test were also negative.

SMUEA-W-CP-ED

4 August 1971

SUBJECT: Report of Trip by Dean M. Dickey to the Former Black Hills  
Army Depot Burning Site Number 2, 21-27 July 1971

f. Thirty-five selective soil samples from the area were collected and also chemically analyzed. The samples were negative.

5. Conclusions. No detectable contamination exists in the area examined by the team from Edgewood Arsenal.

6. Recommendations. No further surveys for chemical agent be made in the area once known as Burning Site Number 2 of the former Black Hills Ordnance Depot, Igloo, SD.

*Dean M. Dickey*  
DEAN M. DICKEY  
Safety Engineer  
Demil/Disposal Office

*J. R. Kerr*  
JOSEPH R. KERR  
Safety Engineer  
Safety Office

*Jerald E. Kleager*  
GERALD E. KLEAGER, 2LT  
Training Officer  
USATEC

*William P. Juncin*  
WILLIAM P. JUNCIN  
Acting Chief, Chemical Process Laboratory

APPENDIX D

CORRESPONDENCE CONCERNING THE DISPOSAL OF EXPLOSIVES EFFLUENT  
AT BLACK HILLS ORDNANCE DEPOT



ORDMC-W 471/583

1st Ind

ORSEC-3 400.7/4443

SUBJECT: Disposal of Explosives Effluent

CG, Black Hills Ordnance Depot, Igloo, Sdak

pgs 1-5

TO: CG, Ordnance Ammunition Center, Joliet, Illinois

1. Information requested in basic letter is as outlined below:

Paragraph 2a - Approximately 200 pounds of (TNT Scrap) explosive effluent was carried over into the evaporation ponds during the washing out of Shell, HE, M, 105MM Howitzer (50/50 Asistol Load).

Paragraph 2b - Equipment in use for the disposal of contaminated water - two leaching ponds of approximately 100 feet x 100 feet, depth 4 feet. Due to the percentage of Bentonite in the soil in this area, there is absolutely no possibility of contaminating the local water supply as the Bentonite prevents the absorption by the soil of the water.

Paragraph 2c - Volume unlimited, winter time temperature approximately 45°F. Summer time temperature approximately 76°F.

Paragraph 2d - To obtain a copy of state and local ordinances which are applicable to state and local water supply would require the purchase of copies of the entire South Dakota Code of Laws, covering approximately seven or more volumes.

Paragraph 2e - This depot is not in an area close to flowing streams whereby they would be affected.

Paragraph 2f - Available area and character of the soil are as outlined in sub-paragraph 2b.

Paragraph 2g - The maximum length of time that the present wash-out facilities can be operated is approximately 6 to 8 weeks, due to the capacity of the two evaporating ponds. The evaporation rate is insufficient to take care of the rate of flow into the ponds.

2. In the event that large-scale washout operations are anticipated for this installation, it is recommended that a complete water filtration and recovery system, as now installed at Letterkenny Ordnance Depot, be provided as a part of the washout facilities at this depot.

CONCURRENCE:

Dictator INB

Chief, Storage GAO

Chief, R & D Br RO

AIO CG

R. C. BRELLER

Major, Ord Corps  
Commanding

APPENDIX E

STANDING OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS ARMY DEPOT

APPENDIX F  
STATEMENT OF CLEARANCE, 31 JANUARY 1967

31 January 1967

All lands within the Black Hills Army Depot, Igloo, South Dakota, located approximately 8 miles south west of Edgemont, South Dakota, have been given a careful search and have been cleared of all dangerous and/or explosive materials reasonably possible to detect. Six areas depicted on the inclosed drawing PE 1004-1, dated 27 Jan 67, are designated as restricted. Area No's 1, 2, 4, 5, and 6 are entirely restricted from any use. Area No. 3 is restricted to surface use only. All other tracts are recommended for any use for which the land is suited.



WALTER C. GARTHWAITE

Major, Ord C  
Commanding

Attached PE 1004-1

Copy furnished;  
AMC

**APPENDIX E**

**INTERVIEW WITH THE  
FORMER DEMOLITION FOREMAN,  
FRANCIS FINKEL, AND THE  
FORMER BHAD FIRE CHIEF, LOUIS RICKARD**

**CONVERSATION INTERVIEW BETWEEN  
KEVIN KLIPSCH (KK), DAVE HENDERSON (DH), LOUIS RICHARD (LR),  
AND FRANCIS FINKELL (FF)  
THURSDAY MORNING, JULY 2, 1992**

**Blank lines represent undecipherable portions of the interview.**

FF: We had a tank up there, we didn't really know where that it is.

DH: In fact we've found two of them now. It something to do with maybe a timer with something in the center of this thing. This thing is this big probably and on the outside is bolt holes.

FF: Bolted down or something:

LR: Sounds like a tank cover, I mean with the vent holes and all, or a cap.

FF: But you could never manage it.

DH: It's kind of big for that.

LR: That's what it sounds like though, they've got these holes. You know they got these vents on the

DH: We found one and it took two of us to get it turned over, this spring we found it. Then they said they found another one yesterday.

FF: You see that Burning Ground was run before I got here. It run ever since the depot was here and old Slim Williams was head of that up there then and he might have done anything pushed them away or whatever was up there.

LR: Wagner might too.

FF: Yeah, that's right, let's see, Wagner came after I left.

KK: Some of those cluster bombs, we were talking about earlier, those butterfly bombs, did they burn those in designated places?

FF: We never destroyed them. I don't think I ever destroyed butterflies.

KK: Any that might be found out here probably still alive?

FF: I don't think you'll find any butterflies.

KK: We found one yesterday. Was the helicopter still on it, were the wings still on it?

DH: I don't know what they were. I wasn't with them. They just said it was a little square, she picked it up and them guys told her to set it right back down.

FF: Don't pick up anything.

LR: That's right.

FF: I was up there with I don't know, someone else tried to pick up come back. He was up there looking and he picked up some jerseys that were blown down below. A lot of them blew out you know. He said look at this yellow stuff. And its pure TNT or tetryl or something in these boosters. They are still up there. Their all over the place.

DH: There's a whole truck load of them dumped there that are still alive.

FF: Just the booster caps and these are still alive up there. Whew.

DH: I guess - their a brass thing?

FF: Yeah

DH: And then on them there's a steel deal with, its round and kind of comes to a kind of this shape stick out of it.

FF: Well look, a lot of them were made out of the pot metal.

DH: Yeah, there was those too and some are depends on how many grains there were. Some are short, some are big. And they've always been on the bottom of the fuze after booster was set the big one on. It depends on what they've been explosive was to. A lot of their explosive sticks never jolt. Its like a cap on - you use a #6 on dynamite, can't use it on TNT, so they had to use different size caps. A lot of them exploded and they just flew through the air. Their harmless, I mean their not harmless but they won't go off because you have to have a blow or a fire or a strike to set the explosion off. If you laid them on an anvil and hit them with a sledge hammer they might go off. I know that.

Lr: They wouldn't do that much either.

FF: They take quite a jolt to set them off.

LR: That stuff your talking about, that crystallizing inside that case. Any kind of crystals?

FF: That's terrible - that's nitroglycerin. Pure nitroglycerin. That's what dynamite does.

DH: Then these 155s we found down there in this dam. Do you think that's TNT that's in those?

FF: Its either TNT or comp B or whatever explosive is in there.

LR: Does comp B crystallize?

FF: No. Neither one of them do. The only thing that I known crystallizes is dynamite.

DH: That's kind of a granular stuff that is in them. Its not really

FF: Yellow

DH: Yeah

FF: That TNT.

KK: When you got rid of some of these bombs that were deteriorating, do you usually try to do them in all in one spot, all the 155s in one area and all the 75s in another?

FF: We were allowed so much poundage and weight allowed in each one of our pits and they had to be so far apart so they wouldn't ignite each other.

KK: And then next week or the next month when you went back out there to do.....

FF: Every other day we'd go out there.

KK: Every other day?

FF: Every day sometimes, go every day. The fires the only thing we'd have worry about because we had to let them cool 24 hours, but we blow, we set them up in the morning when we went to work and they'd blow them usually around noon or after noon then that day we'd go back and look for duds. Next morning go back and fill them up and do it over again.

KK: Do you usually put the same stuff in the same hole?

FF: It depends on what we brought up there. We'd blow up whatever they brought up there.

KK: So there could be a lot of different things in the each hole.

FF: We'd blow fuses, we'd blow boosters, bombs and shells - other than what they brought up there whatever they found unstable or unsafe then they'd send it into the post or headquarters and they'd tell them this is obsolete, destroy it. So we'd destroy it. It depends on how the lots were sometimes it could be 50 or 60, sometimes it could be thousands depending on how big the lots were. It was steady.

KK: You really couldn't designate a specific hole for a specific type of munition.



FF: No. The only thing we kept was our Pits for chemicals. We never used HE in any one of the pits so we could keep using them over and over again. Those are all salvaged the next day. After 24 hours we'd go down to the train and the men would go down, we had a crane, we would go down there, the men would hook on to them and we would pull them out and they would haul them out, sell them for salvage.

KK: How deep were these pits?

FF: 20-25 feet deep and they'd have about here to that wall wide (approximately 20 ft) and we could make two lines, two pallet loads per pit, then they'd be a couple 300 feet long.

KK: You mean over there on Burning Ground 2?

FF: Yes

KK: Over where those fences are that I showed you earlier.

FF: No, Burning Ground 2 is up

KK: Where did that go?

DH: This is brand new one. We found this in the place with 12 or so other ones in a crate (David shows his 75mm shell).

FF: That's a solid weight. That makes good door stops.

DH & LR: That's an armor piercing

LR: That's solid steel

DH: It's got the date it was made. Okay, the question I have for you how much of the tracer is .....

FF: There's nothing at all.

DH: How much stuff is in there, like a teaspoon, tablespoon or a whole bunch?

FF: Now it will burn out. Its just like a tracer. When you shoot it and it goes through there and the fire goes. Well that's what burns is that

DH: Yeah, I understand that, but how much stuff is in it?

FF: It wouldn't shoot a bullet that far. (Arms spread wide)

KK: You were worried about how much is in there?

DH: Yeah. They said that burn it out was the easiest way to get it out.

FF: We're just taking the fire out. You don't want to loose the paint metal on it. No that won't explode, it will just burn.

DH: A guy could just take a piece of copper wire and just scrape it

FF: Either that or just take torch or shoot a flame in there, it will burn it out.

DH: Oh, it will?

KK: Dave wants to save as many of those artifacts as he can.

FF: Use those against tanks and that way they can see where they hit it.

KK: On those sizes, not everyone had a tracer on it, did they?

FF: No, actually I'm not surprised. Usually they were just

DH: There was a whole case of them still banded and wired and sealed and used for a counter weight for a door down in the old work shop building.

FF: That's harmless. That's just a piece of iron.

KK: Just a lead weight?

FF: Yeah.

LR: It's got a copper ban on it.

DH: Yeah that where the date is stamped.

FF: That's what makes it rotate.

DH: This is what those 155s look like except their bigger and it got the threaded nose.

FF: Yeah that's call the fuse tips.

DH: And that thing is all full of powder on the inside, just TNT, or whatever they pulled this wad up out of there yesterday and that's what spooked the other guys and they were saying it probably wasn't an HE it was a chemical or incendiary or whatever they call it.

FF: Then that would be a burster that goes down there. It was filled with a higher explosives. Then when the fuse went off it would blow that thing out and that thing would set your TNT and to blow the whole bomb up.

DK: OK, well that makes more sense than what these guys are supposed to be professionals and know all that stuff.

LR: They didn't work there with iron or somebody is going to get their hat blown off.

DH: It was heavy iron, it was shrapnel.

FF: Its still explosives. A lot of them chemicals you have you can look clean through there on a chemical bomb or else you can look down in there and its a well of 50s booster that blows up the chemicals and on the HE its a booster, it just ignites the explosives, it need another booster to blow up that much explosives at one time.

DH: In other words the tube that was inside of the shell would be basically like a primer tube in your casing.

FF: It come out didn't it?

DH: Yeah.

FF: You got it out in the open.

DH: Yeah.

FF: Its just a tube that got explosives in it.

DH: She said it didn't have holes in it though. Looked like a solid tube.

FF: Well this kind of explosive didn't. See a fuse would set that off.

DH: Well that makes more sense.

FF: These primer tubes, like I said, they put those down in the brass case, then your powder bag goes around that then if there's several bags in there, under a normal charge you set two of them off, you shoot the cap, it sets the powder off and it blows the projectile out of the gun.

DH: We found a bunch of those primers.

KK: Igniter tubes?

DH: Yeah and they had some clips on them. Was that for like hooking them together.

FF: You put your powder bags on those clips and you could cut off as many as you want. They fasten inside the brass.

DH: Did they stay inside the brass casing too?

FF: They stayed inside the casing.

DH: They had a tool to reach down in there, hook in there?

FF: They usually came in them. You could put them in.

DH: Or you can take them out. There was a round nose and some had a square nose. We found them in the same area.

FF: Clips.

DH: Yeah, they would go down over them but they would get pretty snug.

FF: They just pulled them in there, but that's differ grains, little ones, big ones and great big ones, depends on the shells. It was black powder in those because you want the powder bags to burn in the casing. You had three different types of the loading shells. You've got fixed ammunition, that's the one right at 10 pounds, then you've got the semi-fixed, that's where the brass comes in one and the shell in the other one, then you've got separate loading - put your projectile on, then you've got your powder bags in behind them. Like you see in the Navy - that's what they do.

DH: That's what these primers with the little clips on them were for, separate loaders?

FF: No they were used in the casings. None of them go into the shell. They all go in the brass or steel.

KK: Burning Ground 2 - I mentioned earlier that there were trenches here. Are these really the pits, the chemical pits?

FF: In our place

KK: In the pits, what you would get rid of the deteriorating chemical bombs. In Burning Ground 2, do you remember where some of those are?

FF: I remember where their at, they are on top of the hill. There's non down over the hills.

KK: You come up the hill here. Are these right along side of the road?

FF: We might have burned along side of the roads sometimes-just throw them out on the roads and fire because you just need to fire on both sides of the road. Then we had some over in here where we drained.

KK: Yeah, that's what you were telling me over her by the flat there

FF: Out in here is the blowing area. They closed it, the land manager or something put fences up to try and keep people or cattle out of the pits.

DH: There's no fences up there now. They dozed it all in and seeded it. It looks like a beautiful cow pasture except you can't step anywhere because of the shrapnel. In this little draw, where it kind of drains down into this dam, back right in here is where we found those 155s.

FF: Down the end of the hill, inside the area.

DH: Yeah, it is in your Burning Ground. You come up the road and right up here is the bunkers where you blew them, you the barricade and the bunker

FF: Yeah

DH: OK then, there's none of these holes and stuff there now, but down

KK: Wait, there's 7 of them?

DH: Yeah, well these are all right here in this little drainage right here.

KK: 7 holes are?

DH: Yeah.

KK: Oh, Okay.

DH: The fence comes across about right at this dam, right in here, where the grasslands fence is. In fact, it might be right here. This line that's it right there.

FF: You got a road someplace that comes along in there too.

DH: Yeah.

KK: That's this road here.

DH: The fence comes in just past that road. Those shell that we were just talking about, that we found are right here. The dam is pretty well dried out. In this other drainage way there is 5 or 6 more crater holes. All this here, the grass, the clover is about this high (3 to 4 feet). They filled those all up.

FF: Oh, Burning Ground 1 over here some place.

DH: It's right up here.

KK: This north, there's 3, there's chemical

FF: Where's the first one?

LR: When did you take these pictures?

KK: We bought these out of the aerial photograph place in Denver.

LR: How long ago?

KK: We bought these a month ago.

LR: What date were these taken?

KK: Some in 54, some in 65, this one here

FF: I am just trying to figure out where we are.

DH: This dam is outside the fence, this is out on

FF: It's out in the next man's over in Trotter's land

DH: Yeah.

FF: Now, oh well your a long ways away.

DH: This is just a little dike here and that's just about the end of where, the fence comes down here now and there's a gate and when you look back into this area it is says Buffalo Gap National Grassland or something and the same way over here at this other gate. There is a little trail road that comes down here and comes up to this area and you have to drive around here into this trench. It looks like they just took a Cat and just dozed stuff right out to the edge and just let it kind of fall over into these brakes. Its all shale here. Then straight south, of course this is in 1954, none of it is visible now, but one over here is. Its right along side the road except now the road comes from this side. It runs parallel with road - its just a big deep gouge out with a cat we don't know what it is.

LR: When was this shooting range? Do you remember that?

KK: The tracer range?

FF: We had a big kettle, where we are at now.

LR: Right in here you shot across the canyon and you had a dead over on that side.

DH: Right down here would be where the electric gate is. You'd come up the hill to the bunkers.

FF: There's a kettle down here we used to burn and stick em in there.

LR: There was a shooting range down there.

FF: But I never shot down there.

LR: You never shot there?

FF: The only place where we shot is down yonder over there.

LR: Well they shot there because I stood by with the fire truck and put the fires out.

**Two conversations at once, one with DH & FF, the other with LR & KK**

DH: Do you know what this building was or what this thing is on here?

FF: What's my big barricade.

DH: Yeah, that your barricade, do you know what that building is here in 1954?

FF: There's no building out there now.

DH: No there isn't but I was wondering what that might be.

FF: No.

DH: Okay, where the barricades are you'd turn and go down into your pits.

FF: Then you go through the gates there, there's a gate up there you can go out as you go her, there's you go up here someplace and there's a fence and this is all Trotter's. this is outside the area.

DH: Now, right at the barricades you can turn and back down towards this gate, what was this road for, what was all this stuff down in here for?

FF: This little building here we burnt stuff in and this road here we just drive down there, you'll find all kinds of fragmentation and everything up in there. No we never did anything out here.

DH: OK, the other road that does down across the draw and dead ends at a wooden bridge dock against the hillside over there. Do you know what that was?

**End of dual conversations**

DH: You go straight south of the bunkers then you turn to back east or turn to go west you can go down across

KK: Isn't it down over here?

DH: Yeah and you can see

FF: Loads of people used to hunt I suppose because that's outside of our area. This is the only area we had. We didn't have nothing

DH: Yeah, we might be too far, its just across the draw here

KK: The first little draw may be

FF: We were all inside the fence. There's a fence here, a regular 3 barbed wire fence.

DH: I think this is the fence line here, Yeah, this is it here.

**Second of the two simultaneous conversations**

LR: I know that much. I though maybe you'd remember just exactly where it was. I bet the frame works over there yet on the other side or some sign of it. I can find it. I think. Them tracers would clear back across sometimes they clear back to where we were and set fires in that tall grass..... I know there's a ranger there. Nobody yet is not.....

KK: What were they using, hand guns, rifle?

LR: No 50 caliber

KK: 50 caliber guns?

LR: Yeah.

KK: And there's also a little pistol range.....

LR: The one over there I don't know about. I was never over there one single time. Now that one over there I was at, at least 3 times. Stood by with a tanker truck and put out these fires, so I know damn well its there.....There good be stuffin there too.....

KK: Yeah.

LR: \_\_\_\_\_ I can't remember for sure whether it's \_\_\_\_\_ or what.

KK: Coming up that hill, we kept looking and we didn't see any wood still standing.

LR: Well I think I can go to it, I don't know for sure, but I think I can.

**End of dual conversations**

DH: A wooden bridge dock against the hill. Against this shale bank south of the bunkers there's all kinds of 50 caliber bullets there.

FF: The ones you were shooting across?



KK: Yeah, must be the ones he's talking about.

DH: The Lakey boys said that in the 70s it looked like the road went down across south of your bunkers, there's a culvert in the bottom there south of the bunkers, then you go back up the other side and its kind of a shale bank over there, the road looks like it turns and you drove across this big wooden platform. He said it looked like they just dumped truck loads of 50 caliber bullets.

KK: Maybe that's where they took, brought them from here and took them over there and dumped them.

DH: You were saying you stopped at the locked gate down there?

LR: Well I don't remember which side of the gate I stopped, whether I was just inside the gate or was on the other side.

FF: Well that's down here. That used to be the gate, before you come up the hill.

LR: But definitely its in this area right here and you shot across the canyon. By the looks of the map, it's probably in right about here.

FF: At the hill on the other side?

LR: Yeah the hill on the other side. I still think I can find it. If we have time, I'll show you afterwards here.

KK: You usually kept the pits for the chemicals close to the road.

#### Simultaneous conversation

FF: Yeah, they are undoubtedly filled up now. Put the dirt out over them, otherwise you could see them because they're 20-25 feet deep. They're covered up.

LR: They'd wash and blow close anyway, because that shale blows like hell out there. Just like I know it would drift full.

FF: Some of these pits up here have water in them. And I still think they have water in them

DH & KK: Some of them still do.

FF: Yeah we'd hit water and we had to go and move it someplace else we got down to the top water. Yeah. A lot of springs up in that area.

DH: How deep were those?

FF: 15-20 feet deep, 25 feet deep.

LR: Don't drink it.

KK: Why, whats wrong with the water?

LR: There's poisonous water in them shale hills.

FF: So we couldn't get down in there any more.

KK: Not because of the depot.

LR: No nothing to do with the depot at all.

KK: But because of what's already there?

LR: I hunted coyotes in this damn think for years and I was raised in the area.

FF: A lot of springs up there.

KK: Were the animals able to drink that water and survive?

LR: No they weren't able to drink it either. Nothing drank that damn white stuff coming out of that shale.

KK: When we were walking over here, there were a couple of springs and that milky white stuff was coming out of them. Too much alkaline?

FF: That's the only thing I can think of that could come out white.

LR: That's alkali coming out of that

FF: Some chemicals or something. Well it ain't from our burning or blowing.

KK: Every once in a while we'll stumble across a carcass of a cow. You know any reason. There's three of them right by the building.

FF: Just died, I guess.

LR: Well lightning is a possibility.

DH: And there eis some, well their all over out there.

FF: That's Snow's outfit.

DH: Yeah

LR: How many cattle are out there?

DH: There's quite a few.

LR: You know cattle die and then they get him by lightening. There is a reason for them be dead. They don't drink that water. I promise you that.

FF: He calls every time it rains. How much you got?

DH: Buss Parkley?

FF: Yeah.

DH: He has some sheep out there right now?

FF: Yeah, well I don't know if he has now or not he had called me and asked me how much rain you got last night and I figured he still had them out there and he's got some cattle out there too I think. Out in J Block.

DH: We didn't see any sheep but doesn't mean.

FF: Well he might have brought them in.

KK: The only chemicals you ever came across were phosgene and cyanogen chloride.

FF: And mustard. Those were the gasses I ever destroyed there.

KK: And then the nerve gases.

FF: We had nothing to do with it. They came and stored.

KK: Its just stored over there in G and they were VX and GB.

LR: In my mind I can remember the nerve gas and where it was stored but not the block it was in.

DH: Do you guys know what 105RR stands for?

FF: 105 millimeter.....RR?

DH: Yeah, you see there's 155 HE which is high explosive.

FF: Yeah.

DH: There's CG which is ah..... what did they say?

KK: Phosgene

DH: Phosgene

FF: the \_\_\_\_\_ is different

DH: H is mustard, right?

FF: Yes

DH: They had 155 high explosive mustard

RF: Millimeter, HE

DH: What was that, was that powder

FF: That's big powder bags

LR: That's a lot of \_\_\_\_\_

DH: Then the grenades and VX and GB rockets and BS 155 mm what was that?

FF: VX? That was the nerve gas.

DH: 155 mm what.....rockets?

FF: 155? That was Howitzer shells

DH: Now hat is a Howitzer?

FF: A Howitzer was a short barrel cannon that shot 105 mm, 155 mm, but others were rifle and longer but shot 20 mm. That's a rifle. But Howitzers were artillery.

DH: On this list, they didn't even have 10 and 12,000 lb. bombs.

FF: Those were all gone before

DH: That was earlier. I just got a few of them and blew up and I don't know what happened to the rest of them.

DH: And this CK and CG that was.....

FF: Cyanide chloride and phosgene

KK: Well is phosgene CG or G

DH: CG I think is phosphene

LR: As far as I remember

KK: CG is phosgene?

FF: Yeah

KK: Do you know what G is then, all by itself?

LR: CK, G I don't remember.

FF: G, I don't know. Not practice rounds.....CG.....Nope nothing on that RR though

LR: I don't remember ever hearing about that

FF: I don't remember ever seeing it. For surveillance they've got the magazine, the book about - the Bible - it tells you everything about every type of ammunition that we have in our arsenal. You know that's conventional.

LR: My brother may have one.

FF: I don't know if I have, I would have to look, I don't remember now.

DH: If he does, I'd like to look at it.

KK: Yeah.

FF: It's about that thick (1/2 inch) and about that square (8 inch). It got everything in it. That's the one that tells you to burn up, as far as the way the wind was coming from and.....

KK: Do you always follow that book?

FF: Well it gives you an idea of what you can do. And the distinction between may or shall or should be. Depends on how the wording is too. If it doesn't say will be, you can step off the line a little but if it definitely said this is it, that that's it.

LR: Well knowing the ordnance, he ought to be good at it because he started in the Army, and then the ordnance, that's the way he went all the way through.

DH: Your brother? (James Richard)

LR: Yeah. He went to the Jamaican Islands, then the ordnance, then he came out here and went into the same thing. He ought to know what these designations are. I can find out for you. I don't know if he'd tell you or not. I don't know if he would be willing to meet with you or not.

FF: He could forget too that's the trouble.

LR: Well he's younger than we are. Quite a little bit. We're old buzzards, you know that. We got to be old buzzards.

FF: Yeah, starten to be.

KK: I think that's about all. We talked about how you demilitarized some of the chemical bombs. Thousands and thousands is the amount and you got rid of them the whole time you were here. You got rid of them in Burning Ground 2 until the early 60s and then they started using the incinerator.

FF: They built the plant out there designed by a professor from, 2 professors from School of Mines (SD), \$50/hr they got and boy I'm telling you that was big money for them guys to come in and tell us how to burn up our ammunition.

KK: You only worked with phosgene and cyanide chloride and mustard and you only stored nerve gases over in Block G. You never had to get rid of those. They cam in and were just stored in G Block.

LR: There was never a leaker in these nerve gas that I ever heard of. Now those damn mustards they were something.

FF: I never heard anything about the nerve gas either, but if there was any doubt I think they shipped it to Rocky Mountain. I think they shipped one or two or something like that. And then they took the whole works out.

LR: I was nearly kicked out of the fire department. There was a mustard leaker in one of them turkey sheds long time. And I and Jerry Beaver were out there, you know they had a schooling if you always hollered gas and held your breath and put this thing on we'd run into that and I said phew let's get the hell out of here. That was in the turkey shed that leaker that day. And I was out there once a month.

FF: It doesn't hurt you if you don't get on you.

LR: No

FF: Everyone out there got mustard burns one time or the other.

LR: I don't like the smell.

FF: Yeah, she smells. that other stuff smell too.

KK: What do they smell like?

LR & FF: Phosgene?

LR: That's the green corn smell

FF: Yeah green corn

KK: What kind of corn

FF: Green corn

KK: Phosgene smells like green corn. What does mustard smell like?

FF: Mustard has a peculiar, odd smell. But it stinks.

LR: Yeah it stinks, that's the best way you can say it. It flat stinks.

FF: It burns black smoke and that's more dangerous than the mustard. The smoke is.

KK: Oh yeah.

FF: Yeah, gets in your lungs and then you've had it.

KK: And you can't breath any more.

FF: That's right.

KK: Cyanogen chloride, does that have a smell to it?

FF: CK

KK: Yeah

FF: That was supposed to have been odorless, but you could if you had cigarettes in your pocket and was working with it, and lit one up boy you could taste it in those cigarettes.

LR: The cigarette didn't taste good.

FF: No way

KK: OK

KK: We said chemicals were either poured out on the ground or burned up. There were no pits over in the chemical areas.?

FF: No what?

KK: No pits, no burial ground, no burning grounds in the chemical area.

FF: No

KK: Just the incinerator in the early 60s. So all those berms that exist over there are just open storage areas.

FF: Yes

KK: You don't remember any jet or rocket fuel?

FF: No.

KK: Do you know is Peterson dealt with that?

FF: No, we didn't have much, if it was, it was confidential.

DH: The fire daily logs it was referenced to standing by Burning Ground 3 while they were burning acid fuel, oxygen fuels and rocket or jet fuels.

KK: Even Mr. Macke mentioned something about that. The fire department was out there while they were burning it.

FF: I never seen it.

LR: I never was there.

FF: I never knew about it

LR: nor did I ever hear about it.

FF: I didn't either, that's first time hear about it now.

KK: What about the call letters UDMH?

DH: There's a lot of reference to that.

LR: UGNH?

KK: UDMH

LR: UDMH

FF: It don't ring a bell with me.

LR: It don't ring a bell with me either.

DH: They looked it up, what it was because they didn't know and it's

FF: I don't know where they destroyed it at

DH: They were burning it up and they said it was like a heavy.....

LR: This was in a structure, this wasn't in a practice field

DH: No this was.....they were burning it in Burning Ground 3 up there.



LR: In Burning Ground 3

KK: They were pouring it on the ground or burying it.

FF: They never did when I was there.

LR: I never heard of it either.

FF: That was a burning ground until we built it up that time.

KK: When did you build it up?

FF: It must of been in the 60s.

DH: Yeah, these were in the 60s records, 62, 64

FF: I don't remember anybody being out there before that.

LR: You know it because I was here from 46 until a year after they closed it.

KK: It closed in 66.

DH: There's a lot of records that Burning Ground 3 was burning acids.

FF: I had nothing to do with it.

LR: In the fire department log?

DH: Yeah, right in the daily logs

LR: You got the logs

KK: No we have them, We're looking at them.

FF: That would be like burning gasoline it wouldn't contaminate nothing.

KK: Just the water.

LR: We burned stuff down in combat in those practice fires but this was no destruction of anything. We had those ungodly fires that we would put out. We just practiced fire training. I don't know what they put on there. I know they put in water and put in about 4-6" of fuel on top of it of some type and I don't even know what they put on and then they lit the thing and we'd put it out.

FF: We had the best fire department in the county.

DH: Everybody knows that

FF: They'll let you know too

LR: They're about all dead too.

FF: Yeah, boy were they trained.

KK: Year, lots of practice?

FF: Oh, he worked them, him and chief both worked them. I'll tell you.

DH: Was Berber a chief?

FF: Who?

LR: Was Barber a chief in Edgement?

DH: Yeah.

LR: Yeah.

DH: Okay. Him and Beewater spoke together a lot back and forth.

FF: Well, the firemen were very good with everything they'd do, children, drilling, and everything you wanted.

LR: We trained and trained and trained for 22 years something like that.

KK: That's why the depot had the best safety record around?

LR: The only loss of our safety record was that phosphorus fire. He charged us with that fire loss.

FF: They did charge you for that thing. You could never get near that hot thing.

LR: Not it was to be destroyed anyway. They were going to destroy it. Where did they load that phosphorous? Wasn't that done in Donnie's house 7? Remember they loaded that phosphorus in cars when they emptied them bombs out.

FF: I don't know what they did with.

LR: They shipped it out.

FF: Oh, did they? There was a company in here bought that. They used Donnie's house 7. I believe it was out there. They took the phosphorous out in under water some how and shipped it out in tanks. It would have to be underwater otherwise as soon as it hits the air, it would burn. It was done right close to where that burn was.

DH: I told you I though it was phosphorous.

FF: That's WP.

DH: Remember yesterday when we were eating lunch and that stuff they had in the vials and they would reach in there with the tweezers and get a little bit out and it was WP phosphorous.

LR: Where did you find that?

DH: Our school class in chemistry lab, it was a white.....

FF: If it gets on you it will burn right on through

DH: Yeah, the deal was they'd take it out of the vial and put it on a piece of paper or piece of wood and let it burn through. Or they would lay on a dish and nothing would happen until it would start to dry out and it would start to smoking, it wouldn't take very long. And it was phosphorous.

FF: That's for sure.

KK: There wasn't any bombing ranges here.

FF: Not that I ever knew of.

KK: They discontinued the bombing range 1 back in 46 and they just burned wood and paper there.

FF: Yeah, no explosives or anything.

KK: There was only the three burning grounds except Peterson found that one.

FF: I just don't know for sure. But it was just up from that surveillance building, just up that hill.

KK: You only had a couple different places where you took care of the chemical disposal areas on Burning Ground 2.

FF: That's the only place I ever got rid of it and over here at the incinerator.

KK: The butterfly bombs - you never had to dispose of those?

FF: I can't recall just blowing any of those up.

KK: The craters that are out there are from detonation and not from dropped bombs?

FF: From blowing bombs and shells and all kinds of commercial ammunition.

KK: That white phosphorous fire was to the east of Burning Ground 3, right along side the road up there in the north here.

FF: Going through the gate here. You take this road here and go right along that fence and you'll come right by that area where it was.

KK: Is there any visible signs there now of where that was?

LR: & FF: There should be.

KK: Well, here is where the white phosphorous fire occurred, supposedly.

DH: Here's the fence, this area is all fenced off now or is now and has surface use only. Here's the silica carbide building.

FF: Yeah, this is right because this is where we burned all of our propellants and stuff, burned out shells, primers, and once in a while we would have a high order on one and it would blow up. So this could be dug all over. He's right, I see what he means now. This was the burning ground with the WP was up here someplace.

DH: Outside of the fence?

FF: Yeah, you know go through this gate here, go up along that fence. But, I don't know if Betty's has got her gate open right now. She's got an oil well here. But if you can get by that it's right along this road. As you go out this road, its about a mile or so and you should run into it someplace.

KK: Before one of these pads?

FF: You can go all the way if the gate is open, she's got an oil well out here someplace.

DH: Yeah, the oil well is way up here.

FF: It's outside the fence. She's got a gate here and if its open you can go all the way out the C Block on the south side loop road. But that stuff should have burnt right in here someplace. I always figured it was just in here someplace.

LR: I have a little different idea where it was. I thought it was in here.

FF: That's too far out, I believe.

LR: Or possibly here.

FF: That's rough ground.

LR: Yeah, it's rough ground. That's why I'm concerned because where it burned, it was smooth ground.

DH: Well this is smooth ground where he's at.

KK: Did you ever hear of white phosphorous casings being buried.

No - I don't know what they did with them. There was a lot of casings.

There was just piles and piles of them.

The fire went to days and days.

It was only a couple of days from what I can remember.

The main fire didn't last over 20 hours. But it was a dandy, most of those things would go up in the air and they were spewing as they went into the air.

Our report is strictly unexploded ordnance. The Huntsville Division is really good about getting out here quickly, within a year of the finished report.

Will they clean up all the \_\_\_\_\_ and all the other stuff?

That I don't know.

How in the world would they over that down in the ravines to find some that have been covered up with dirt since the rains and everything. Their still down there some place.

Well that's what our investigation is hoping to uncover. Maybe we can pinpoint some of the locations.

All they have to do is figure out how to get down into some of them canyons.

Metal detectors can go 20 feet deep.

Somebody brought a metal detector that only went like 4 feet deep. Because there is so much frag out there they desensitized it so much you had to be an inch over the frag in order to pick it up. Fortunately some of the Corps of Engineers were here and we all talked about the what field physical surveys they could use.

One of the questions was "how did they go about demilitarizing some of the chemical bombs that are out there". I known you were a fireman out there at the time and did you have to sit there and come out every time?

No the only time we sat out there was when we were firing tracers.

Out on the north end?

No out on the south end.

We burned lots of propellant there. You might find some cases sometimes when we burned them they might have a high \_\_\_\_\_ and they'd blow. You can find some anywhere.

We found some fragile - but they look like pads or mounds on this side of the road.

## **SIDE 2**

Was there a lagoon in this area.

Yes, there was a dam over there. There was pads on that side. We just leveled them off. At one time they had ammunition filed out there. When they made it a burning ground they just took everything of there. If you go down here by this house you'll see maybe 1, 2, or 3 of them along here. Our work was all on this side.

### **Discussing map locations**

This is the one that blew up. That's the one with the three men?

Yah.

Then we had one man killed up here when a mustard shell hit him the face. Then we had those three, then we had one killed over here over, tipped a fork lift over at the barricades and there was one more.

That was at the burning ground?

No. In the popping furnace. They were burning primers and they got stuck up in the chimney and he got up on top and was poking when they blew up on him.

So that popping furnace was in this area?

Yes, this where they tore that 10,000-12,000 lb bombs apart.

Where the television barracks is. We built that barracks and the burning pit on the hill where those big barricades are.

So that was 6 of them killed.

Do you know how you were talking last night that one of the ways you got rid of the chemical bombs was to put the caps on the ends of them and pop off the plugs and pour out the \_\_\_\_\_ chloride.

The ones we couldn't get the plugs out manually we'd have to blow the plugs out and then drain them onto the ground.

That was on Burning Ground 2.

I was looking for the one that had all the holes on it.

Were those craters formed by demolition or clean drop?

They were performed by us. We had 12 \_\_\_\_\_ and we had them all wired to underground so close, then we ran short wires to all the holes then we had electrical firing inside the barricade.

The barricade with the garage doors on it?

The littler one down the hill.

That's Burning Ground 2 though.

### **Discussion of map**

Then there's trenches up here too? Do you know what they look like?

No - I was up there after I got back. There was nothing put in after I - because all this was completed. Oh, they dug a thing out there in front to put the trucks in so they wouldn't get hit with fragmentation.

So you came back in 196??

I came back here? No I left, I came in 46 and left in 66.

And there were no trenches there in 66.

Yah, they were there before, I was just trying to remember unless we just used them to burn propellents or black powder primers. We'd just lay them out and ignite them.

How did you empty out some of the other bombs?

Mustards?

Over here in the chemical area we had a great big \_\_\_\_\_.

Along them blasts up there, when that burning gets to them that stuff would come down like hail.

Over in C Block is where we had to burn all the mustard and CKs.

This is C Block here? And you burned there?

No, we didn't do anything there. These were big what they called Turkey Sheds and these are great big storage sheds where they stored chemical bombs out there. On this side is where we stored all our mustard shells. We'd wash them out and burn them and then lay them out in the sun. You can walk out there you can see there's no grass. That all should have been decontaminated pretty good.

Was the warning fence out there yet.



It was when I left here.

The buildings are all pretty well shot.

There was a fenced out area roughly right in here. It looks like dry lagoons. Two of them. What was in that?

Mustard

Buried in these lagoons?

That was the open storage area for the mustard. That's where we kept it unless we'd find leakage then we'd take them up to the burning ground and destroy them. That was before they got this big operation.

After the big operation here, you just burn them in the incinerator? When was that?

That went on in the 1960s. Maybe 4 years.

There wasn't no ammunition left when they closed this thing. All the mustard and gas they sent over to Rocky Mountain and they destroyed it there. Transported by truck. No bombs were destroyed. They were all burned down here.

Mustard was stored in some igloos, wasn't it?

I can't remember. I don't think they ever stored chemicals. Oh there was some of them big new gas outfits, X and GB, they were stored over here in G Block. The igloos still have different ventilators on them. Their the round runs.

That's what Russ was talking about. Their aluminum and their a little taller and got a different ventilator. And those are in G?

Yes.

Was there any other kind of gases or chemicals?

Before I came over here on the railroad track, there was \_\_\_\_\_ site, but it was gone before I got here from WWI. I doubt if there was 50 -100 shells stored there. They had a sign up there on the outside perimeter road. I knew there was a sign out there - contaminated area or something like that.

Is that the same area, lets see this says "disposal of white phosphorous"

That's the fork lift operator. They had thousands of them outside there. When they blew up they could see the smoke clear to Rapid City.

This is where they buried the casings, down along J block there between the road and the track.

I never buried any. Its probably before my time.

Where does the big fire take place?

Right close to J block. Look where your burning ground is - the first map you showed me -  
**discussing map**

This is where the white phosphorus was burned. Some place along this area.

Here's the silica carbide building.

This is where we burned stuff.

On the map it shows it was burned off over here but this is really ruff hilly country.

No it was up here in the flats.

That's what I thought.

But that was before my time, I just know from everybody talking about it.

Were you here Willy?

Yah, I was here but I wasn't out on it.

They just let it go didn't they?

There wasn't a thing you could do. You just sat out there and dodged the ones when they come back down.

How long did that last?

The main burn was probably 20 hours.

Some of the them were just bombs just sitting there?

Some of them went into the air.

Anything like that that gets hot enough, if they don't blow its going to go, just like small arms, you get them burning, their going to go all over the place.

How long after the - everybody noticed that your able to go out there and walk around and look at that.

It was all gone when I got here. We did everything. Everybody drove up and down that hill.

Do you know how long?

No I don't.

By the end of the week?

Well the fire department was out during the fire and at that particular time, June 30, I was laid off the fire department and I went to work for the \_\_\_\_\_ Engineers and this thing went, I think the 4th of July.

What year was that?

It had to be July of 46. The only thing I think the fire department could do was try to stop it from burning the area.

They were parked way around it.

Do you know what they did with it afterwards?

No.

Was there any other chemical that you know of.

Mustard. That rocket you have down there is gray?

Galvanized, it was galvanized.

Oh it was silver.

It had a thick white band and a thin yellow band and another white band but half the size of the first one. The top was all galvanized, then the fuze.

Was there a pipe or hole through it?

This was all empty.

Its a canister?

It kind of looked like it but its all connected into one piece. About this tall and about 5 inches. They said this area was the propellant. This area up here, the galvanized area had the liquid in it.

No markings on it?

Just those colored bands.

What color were they?

This one was white this one was yellow and this one was white again. They thought the liquid was in this area. This area was probably 2 feet.

The nose part of it had the detonator in it.

You got it down here yet?

Yah, under lock and key. Its down in the \_\_\_\_\_ shop.

If its gray its chemical, if its blue its practice and if its brown, HE.

Well there was blue striations on the paint.

All markings above the galvanized are completely gone. So we couldn't read any stamps. Now in the white markings it looked like there was lock and gate and a 115 rocket.

Them guys were call it a 5 inch rocket.

It stood almost 6 feet tall and it didn't have its fins on it.

About down to here was aluminized color then there was those bands and then a little bit of writing and from there it was just rusty going down. It had liquid in the top and started to leak out where the fuse was.

The practice bombs, they load them up when they drop because they have to have the same ballistics.

Well there is a mention of a bombing range.

Not around here.

Well those rockets were dropped out of planes?

No they were stored here if they were here but I don't remember having anything like that stored here. Unless it was those GB and BX rockets. They were about 6-7 foot tall. It sure in the world couldn't have been one of those biggies. If we had a leaker, we had to put them in special containers and take them over to Denver so they could drain. That's all I can think of.

Where did they find it?

D or G block. It was just laying out amongst the igloos. There's a second one in one of the ravines in one the burning grounds. We were supposed to go there one day and look.

This one looks like it was tried to be destroyed. It looks like it soft-landed somewhere because the nose of it is kind of scarred up then theres kind of a little bit of pink like

---

I never destroyed anything like that.

The only rockets we had were GBs and they came in later.

Write a little note to me to ask my brother.

Jim would know?

Yes.

How many chemical bombs came through?

Thousands. There was more than you could imagine. There was thousands of them in one turkey shed.

They were 500 x 300 buildings. They would start with mustards and then started out in the open.

What are these two little tiny igloos?

That's where they kept blasting caps and little stuff.

Was that the only two out there.

That's all there is.

Then that would relate to the 3 sizes of igloos that were here.

They were practice igloos. They were square ones. They were just smaller, just like miniature igloos, they were covered with dirt.

Some of them were only 40 - 60 feet.

One is in A and D and those were smaller than G and H. And then we came across those two little bity ones. They look just like regular igloos.

Did you see a cement house out here too?

That's where I stored my blasting caps.

There's horse feed in there now.

What were the 3 different sizes?

40, 60, 80 and I can't remember if any were 100 feet.

I worked on pretty near everyone of them from the start to the finish.

The Corps commented how nice the pads were put in, how flat they had to be....

We found out they wouldn't take what they were supposed to.

We had rockets up in them rockets. That's right, we stored them rockets in there. I forget how many they had in there, 100 or 200 then they just blew up the front of it because theres no reinforcement. Then we put a couple hundred into it then it blew it.

Well there no attachments on any of the igloos over on E block.

The front walls, the side, and the back wall - theres no connection with the concrete, all there is pressure connection. Theres a complete seam there.

Just the dirt?

No, that rebar does not go into the footing. They were explained to us that the front wall went out and then exploded, the sides went up and let the blast go out and collapsed on top of that. It was supposed to contain that. The back won't go. There still is no concrete connection, reinforcement connection, or anything between the barrel, the front walls, the back walls and the footing.

That's what happened over in D?

We tried it, but they didn't take what they were supposed to take. Just like F block that blew. They figured 3-4 boxes because a lot of them were still in the boxes that didn't blow. That igloo was over a 1/3 or more full yet when this blew. From the front wall, that think is just setting there with absolutely nothing holding it.

The reason they did that was so that the weakest part in an explosion, your blast is going where the weakest part is.

What did they do with the clean up.

We got rid of the rest of them. You mean the rifle grenades? They brought them up there and we blew them.

No, with the cement and all that stuff, where did they take it?

Dumped it I suppose in one of those ravines.

How did you get rid of the bombs with the phosdene in them?

Well what we did to stabilizing them was soak them in ice water over night and when that liquid would get cold we could take the plug out and put a stabilizer in it and its supposed to be good for another 10-15 years. The ones we couldn't get, that's the ones we had to blow. That's the only way to get rid of them because they could be dangerous if they didn't have the stabilizer.

Once you were able to get them stabilized, where did they go?

Back to storage.

And from storage?

I suppose they shipped to Colorado, I don't know. I just destroyed the ones that were deteriorated or obsolete or dangerous.

You destroyed them in Burning Ground 2?

Yah, we destroyed most of them up there. This was a big operation. That's why we built this big plan out there to drain all this mustard and cyanide out there.

Were you here when that was dismantled?

No.

That's what I wonder. Is that what got in that fence. Is that's whats left of that plant? The barrel of \_\_\_\_\_.

All the piping all that kind of stuff, I wonder where it went.

I don't know.

I don't either, I just wonder where it went when they dismantled because they've got that fenced area out there and I don't know whats in it.

They've got a sign on the fence that says something like "contaminated area".

Did he go in there yesterday?

Yah.

He walked around a little.

The well out here. That's a shallow well isn't it?

I don't think there's any shallow wells in this country.

Up on Burning Ground 2 you said yesterday that cyanide chloride you would dump out on the ground.

Yes

What did you do with the phosdene? Just blow those?

Phosdene you never had to put stabilizer in them. I don't know if they shipped out or not.

The deteriorated ones?

We'd blow anything that was deteriorated.

Did you blow them up.

Yes, blow holes in them and burn at the same time.

Is there more than just the 3 burning grounds?

That's all that I know of.

This is where the two water tanks are. Whats this other building out here.

That's surveillance.

What all was it?

There was a little road right behind the surveillance building. There was a lot of shale and they destroyed little stuff up there.

I never remember anything like that being destroyed up there.

They burned it, was it like primers.

Igniter tubes?

Some of them are this long, their various lengths, and their all full of holes. There was a lot of those up there. There was a lot of those glass .....

Their about a nickel thick and about a nickel wide.

Do you have any out in your jeep out there?

50, 100, 300 grain primers that's what we used to burn all over the place. They don't blow, they just burn, its just like powder. And the little holes are sealed with a wax or something. They're made of brass with salvage. And the other ones are made of some alloy or something so we just buried them.



Does Peterson have any other area where he .....

No these are all standard magazines.

Any other burning grounds that he ran.

No, this one didn't even have a name.

Over in the chemical area, we had talked about the lagoons that were there, he mentioned that theres a semi-circular area, a berm, and then there was a depression in the middle. It seemed separate and different than the lagoon out there.

They were just stuff stored in the area.

Somebody mentioned one time that jet and rocket fuel, I think it was the fire department's log, that they had to stand by because they were testing jet fuel, testing rocket fuel, or they were watching it being transferred or something.

Who was he?

I don't know. Somebody else was reading it.

Bingham is the \_\_\_\_\_.

I wonder who the man was that was a standby.

All that time, they didn't give a mans name. It would say truck number, etc.

And a different log would say who worked that day.

It just depended on who was writing the log out.

I'll bet they were shipping it or something, because never destroyed it. I don't even remember having it here except for these \_\_\_\_\_ and they were all classified.

\_\_\_\_\_  
That was just special crews, I worked a little bit on the rabbits, but Peterson took over that \_\_\_\_\_, once in a while I'd go out and help him.

I'm confused. The \_\_\_\_\_ paper you would take and just stick.....

\_\_\_\_\_ change color and then when you let rabbits in there and they died you knew.....

How did you use the \_\_\_\_\_ paper? Right on the chemicals themselves.

You can take it lay it in the shower. Now on my father I'd put it in the lids of the can. Whenever month we had forgotten to change, the \_\_\_\_\_ would change to another color and then we'd know it was deteriorated and we'd have to ship it.

Where did they keep the rabbits?

You know where the field office, they had one of them covered with rabbits. Where they worked on the fork lifts, one of the buildings just south of that.

The ones that got blew down by the tornado? In one of the rooms they built a dirt mound, they walled it with wood and started building a dirt mound. It didn't look like they quite finished.

No they barricaded in there. That was a barricade for the office in case something went wrong out on the line where they were working.

In the burning grounds, did they did pits and blow things up in the pits or did they also just lay them on the ground and cover them and blow them or did they try to burn everything?

The pits were used to burn, the dug them with big bulldozers. Now on the bombs, they automatically made a pit of their own and they blew. If it go into the big 10,000, they'd put them on pallets with dirt on top so they didn't blow the town up.

There's pictures of taking bands off the shelves.

Those are rotating banks. That was copper tube and they would cut it with the air hammer and the machine would just roll that big copper right off. It was worth a lot of money.

Oh, so this was the recycling part.

Everything was salvaged and they went down to the salvage yard and sold it.

Except the TV barricade, they never used that very much.

No they just took fuses off of it.

It was built for one that you didn't dare touch any other way.

You couldn't take them off any other way except behind that with remote control.

You did that with the big bombs?

I think 1,000 lb bombs is what we put in there.

Then how did they get rid of all the big ones?

The ones that were big we shipped out. This was a lot of stuff that was returned after the war and we stored it out there. Then the bad ones we'd have to blow.

Hundreds, hundreds, and hundreds of them bombs shelves like I bought, the ones that the big cradle on them with the 2 x 6s. A lot of them had been destroyed here.

I destroyed quite a few but nothing in that quantity.

I bought 100 of them.

Them couldn't store them in the igloo because they were too big to go in them.

Getting back to the way you had to destroy the big ones. The large bombs you would have pits dug and cover them with dirt and blow those. And then some you would just lay on the ground and just let them burn?

It depends on what we were blowing. If they were shells or something like this we would just lay them out on the pallets and wire them up and blow them. That's the reason all that frags all over the area. The pits were only used for chemical stuff. We had to dig pits and \_\_\_\_\_ wood and then blow holes in them, light the fire and they would burn in these pits, a lot of times they would blow up too.

What size bombs were those?

9 mm, 105s, 120s, 155s.

What was the largest size, 155s?

Well we had 120s too.

The shells we blew up, we just put a fuse in the well. The whole works would go up in the air.

The thing that I have, you know it has the real light tin and has a hole.....

\_\_\_\_\_ in an airplane.

What was in them?

I don't know, that's what I can't figure out.

There was some practice stuff down in the combat.

They were just empties.

I had a \_\_\_\_\_ except that it was real crumbly, scaly-like. I have no idea what that would be.

Is it a shell or a bomb? If its got those duel fins on it its a bomb.

Its about this long. A white fin so big around. The fins are already affixed to it. It looks like it. Its like a one-piece fin and they come off in four places.

That's the stabilizer.

What was in those.

That could have been filled with butterfly bombs, that a whole bunch of little pellets, you blow them up and they go all over the area. It could have been shrapnel from bombs, that's different from frags, you've got all them little b-bs. Some would get air burst then they'd go down. A lot of those bombs they blew because they were timed and before they'd hit the ground. That thing would just open up. What they did was just shoot shrapnel all over the place.

Those didn't have tenicals in them.

No.

They were cluster bombs then.

A lot of them had cluster bombs. There would be about 12 to a cluster in that whole bomb.

In this casing that I have there's a whole about this big around in it. How would they blow all that stuff out of it. Its still in one piece.

The only thing missing is the burster down the middle. The pipe down the middle.

How would they get all that stuff out?

Maybe it isn't out.

There's nothing in it.

Did you ever demilitarize those without blowing them up?

No we'd have to inspect these bombs. They come in a cluster, they're banded together and we'd have to take them and inspect for rust corrosion and stuff like that. If you ever broke that band you had troubles because the rings come out of them. If the rings come out of them they flutter down and all are timed different. That's the little bombs in these clusters. You may have a cluster case.

What does a mustard shell look like?

Just like any other shell only they were gray.

Did it look just like what he described?

No they looked like any other bomb, any shell. It was just the pillars that made the difference in them.

On these 155s that we found, they just have the very tip blowed off and you can see the shrapnel and there pretty thick shells. Their 2 foot long and 5-1/2 or 5-1/4 inch thick. They're full of crystallized, yellow-looking stuff.

That could be TNT.

That's what these guys were seeing when they were kind of scraping down and they pulled that out and said that was a \_\_\_\_\_ or pinicle stuff, not TNT. When you screw the nose on it what is that called? The detonator or fuse. This tube that was down in there, you activated it.

It had to be a booster.

They're heavy. They had a band on them.

A rotating band? Then its a shell not a bomb.

What could that be in it?

Only thing I can think, its an explosive only it wouldn't have a fin on it. Shells don't have fins on them.

Its just like a big bullet. Its real heavy. The treads are blowed out of the point of it. There's a whole bunch of them.

You found that in Burning Ground 2?

Some must be buried in there then.

It looks like these were disposed of and they didn't go. Maybe just the nose of it went and left the other stuff.

Its a wonder Lakey didn't get killed while he was digging all that stuff up out there. He was digging with a bulldozer.

Any time he'd come across live stuff like that, he'd just cover it over and go on.

That's what happened up there.

No he wasn't down in there.

### SIDE 3

#### Looking at map - driving

Who did this map?

I think the Army put that together.

The way Mr. Finkle was talking I thought there was something real close to his house.

I remember it being close to J Block.

This is the last of the storage sheds.

This is where they think they buried them all.

That's how you got rid of them, let them burn out and then bury them?

I have no idea. They let them burn and then they disappeared.

Down here is where the casings were buried. This is the area I remember. They just dozed off a path, flattened off an area and were piling them up for destruction. Looks like they took the culverts out down there.

Those were hauled in. Unless there was culverts around here, maybe that's what those culverts are, maybe they built a road over to the pad or something. It isn't here any more.

I'll bet we were looking at the area where that stuff burned. There was like a special place where they dozed off.

It wasn't a regular storage pad. They just dozed her off, leveled it and kept piling and they were going to destroy it. If they shipped it out and destroyed it I don't know.

They just poked a hole in one of those bombs and \_\_\_\_\_ WP  
\_\_\_\_\_.

That's what I remember.

There was nothing anybody could do. I think it wasn't even off the truck. I think they did it right on the truck.

Then they lost the truck and fork lift and the whole works.

I can't remember. I think they lost the truck but I'm not so sure they lost the fork lift.

I'm sure that grass has got to be different in that place than it is anywhere else.

Well you can it looks different.

They need to get a map about 1947, 1948.

Have you ever heard of anyone finding unexploded bombs or shells in the last ten years?

Nothing other the Lakey kids. They definitely found live rounds.

If you want to stop and look at it you'll get sick.

The polish is worn off, its a total disaster.

Those fires they used to build down in combat from that pit, the flames would go about 100 feet in the air. When they got to burning the full length of the pit, then they'd tell us to put it out.

Were you using foam or anything like that?

No just water. We had one thing happen that I didn't believe. They came out with this dry powder fire extinguishers. We had two great big ones that we had on the back of the truck and one of our crew chiefs at that time said "you know I think me the other crew chief can take two of them and if you'll cover us with cloth I think we can put that out". I'm talking about flames that were going twice as high as that tree. If you were standing here you couldn't take it. Them two guys took those two dry powder extinguishers and we covered them with cloth and they near put it out. They lacked just about 3 feet when they ran out of powder. They started at one end of that thing and put just about the whole thing out just with just two extinguishers.

**APPENDIX F**

**CHEMICAL FURNACE**  
**ANALYTICAL RESULTS**



HEADQUARTERS  
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY  
UNITED STATES ARMY MEDICAL SERVICE

CLASS & ACTIVITY  
OF  
THE SURGEON GENERAL

ARMY CHEMICAL CENTER  
DAHP/AND

IN REPLY REFER TO:

MEDRI-E

26 APR 1961

SUBJECT: Environmental Hygiene Survey

TO: The Surgeon General  
ATTN: MEDPS-FO  
Department of the Army  
Washington 25, D. C.

1. During the period 23-25 January 1961, Captains Donald J. Hernandez and William F. Gilley, Sanitary Engineers of this Agency, conducted an environmental hygiene survey of the mustard demilitarization plant, U. S. Army Ordnance Depot, Black Hills. The report of the survey is inclosed.

2. In view of the interest and responsibility of the Chemical Corps in the destruction process, it is requested that an information copy be provided the Commanding General, U. S. Army Chemical Corps Materiel Command, Army Chemical Center, Maryland.

1 Incl  
as

  
ADAM J. RAFALICK  
Colonel, MC  
Commanding

COMPLETED  
21 APR 1961

BHAD-0030

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HEADQUARTERS  
U. S. ARMY ENVIRONMENTAL HYGIENE AGENCY  
UNITED STATES ARMY MEDICAL SERVICE

CLASS & ACTIVITY  
OF  
THE SUBJECION GENERAL

ARMY ENVIRONMENTAL HYGIENE  
AGENCY

MEMRI-2

26 APR 1961

ENVIRONMENTAL HYGIENE SURVEY  
U. S. ARMY ORDNANCE DEPOT, BLACK HILLS  
PROJECT NO. 3672M39-60/61  
23-25 JANUARY 1961

1. AUTHORITY.

a. Letter, ORDEC-H, US Army Hospital, Black Hills, 25 April 1960, subject: "Request for Industrial Health and Hygiene Survey", to CO, USAKHL (USAHKA), and 1st indorsement thereto.

b. AR 40-205 and AR 40-25.

2. REFERENCES.

a. Magill, P. I., Holden, R. P., and Ackley, C. (Editors), Air Pollution Handbook, McGraw-Hill Book Company, Inc, N. Y., 1956.

b. Committee on Industrial Ventilation, Manual of Industrial Ventilation, American Conference of Governmental Industrial Hygienists, Lansing, Michigan, 1958.

c. Patty, F. A. (Editor), Vol II, Industrial Hygiene and Toxicology, Interscience Publishers, Inc, N.Y., 1949.

d. Report of the Annual Meeting of the American Conference of Governmental Industrial Hygienists, Rochester, N.Y., 23-26 April 1960.

e. Hygienic Guide Series, Sulfur Dioxide, American Industrial Hygiene Association, Detroit, Michigan, Dec 1955.

f. Hygienic Guide Series, Hydrogen Chloride, American Industrial Hygiene Association, Detroit, Michigan, Aug 1958.

g. TD MED 223, Respiratory Protective Devices, Change 1, dated 4 Sep 1959.

3. OBJECTIVES. The environmental hygiene survey at the M-75 munition demilitarization plant was undertaken to determine the presence and extent of environmental health hazards associated with the process. In view of the limited knowledge of the combustion products created in the burning of

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MEMO-2, Env Rpt Ser #3672037-40/61, USA Ord Dep, Black Hills, 23-25 Jan 61

mustard, the survey was designed primarily to ascertain concentrations of these products in stack emissions as this was felt to be the primary source of health hazards. The study did not attempt to evaluate the location of reported injuries with present sources of contamination since major plant modifications have taken place in the interim. With the data obtained, theoretical predictions of ground concentrations are useful in evaluating the existence of hazardous gas concentrations.

#### 4. BACKGROUND.

a. The development of a suitable burning process for disposal of M-70 mustard bombs has been in progress at the U. S. Army Ordnance Depot, Black Hills, South Dakota, for approximately two years. The operation has been changed a number of times, but the basic method has remained the same. The bombs are opened, and then conveyed into a rotary kiln where the contents are burned using fuel oil as auxiliary fuel. The exhaust gases pass through a multi-stage water scrubber and are discharged to the atmosphere through a stack. The hot bomb casings pass through a water seal and are conveyed to a track for disposal. The bomb opening chamber and kiln are under negative pressure to prevent mustard gas leakage to the atmosphere.

b. During the two years' development period, at least eight employees were treated in the local dispensary for conjunctivitis, laryngitis, and some blistering of the palate. These conditions were directly associated with the operations of the mustard demilitarization plant. The employees described the conditions predominantly as hoarseness and "red-eye" following exposure to an "acid" fume in the plant area. Mustard burns of the skin, particularly the forearm, during the early phases of the operation were also reported, but these were all allegedly acquired while repairing a mustard sump pump located under the original bomb sawing chamber. More recent process modifications have eliminated the use of the sump pump.

c. Preliminary visits by USAFMA personnel were made to the demilitarization plant during June 1960. During these visits the following were determined:

##### (1) Potential process irritants:

- (a) Mustard
- (b) Hydrogen chloride
- (c) Sulfur oxides

##### (2) Additional field investigations would be necessary, with sampling to include:

- (a) Air and stack sampling for  $\text{HCl}$ ,  $\text{SO}_2$ , total  $\text{SO}_x$ , and mustard
- (b) Scrubber water samples

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5. **PLANT OPERATIONS.** The layout of the plant facilities as they existed during the survey period, 23-25 January 1961, is shown on Figure 1. Bombs were loaded on the loading platform from the indicated storage area. The M-70, 129-pound mustard bombs were then loaded onto the conveyors and passed through the double door air-lock into the punch chamber. A hydraulic punch made two holes in the top of each bomb. The opened bomb was then conveyed through the conveyor tube into the kiln inlet head and then into the rotary kiln. The kiln is 4.0 feet in diameter and 30.4 feet long. The mustard was burned in the kiln using fuel oil as the auxiliary fuel. Combustion gases passed through a six-stage water scrubber and were discharged to the atmosphere from a 32-foot tile exhaust stack with an internal diameter of 30 inches, at an estimated rate of 12,000 cfm. The average rate of punching bombs and dumping them into the kiln was approximately 30 per hour, with a peak production rate of 46 bombs per hour. Daily production time was between 5.5 and 6.5 hours. After a 30-60 minute dwell time, empty bomb casings were discharged from the kiln discharge head through a water seal to a conveyor. The decontaminated bombs were then hauled away by truck for disposal as scrap metal.

6. **PROCEDURES.** The procedures followed for collection of air and water samples and basic plant data during the survey period were as follows:

a. **Exhaust Gases.** Samples of exhaust gases were taken at a point within, and approximately 1 foot below, the rim of the top of the stack. Determinations were made as follows:

(1) **Sulfur dioxide ( $\text{SO}_2$ ).** The MSA sulfur-dioxide gas detector was used with a maximum reading capability of 50 ppm (parts of gas per million parts of air, by volume).

(2) **Mustard.** Equipment used for determining by the Blue-dot method was contained in the Detector Kit, Chemical Agent, M-16.

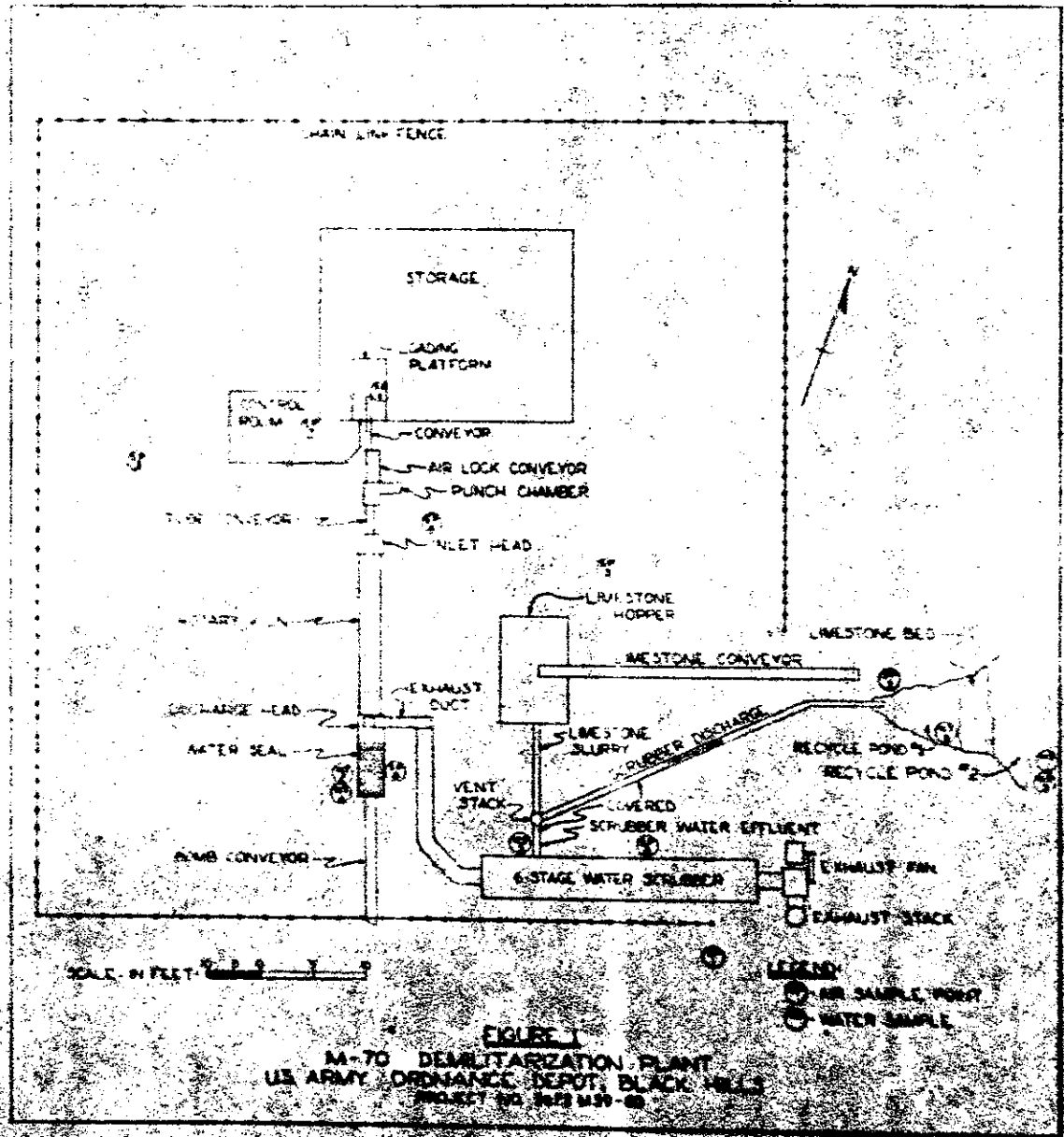
(3) **Hydrogen chloride ( $\text{HCl}$ ).** Samples of exhaust gases were absorbed in a 50-ml solution of 0.1-percent sodium hydroxide contained in a fritted glass bubbler, at a sample rate of 2 liters per minute for 10 minutes. Absorbed samples were returned to USAFMA for analysis.

(4) **Sulfuric acid ( $\text{H}_2\text{SO}_4$ ).** Exhaust gases were absorbed in 100-ml of re-distilled water in a large impinger at a sample rate of 1 cubic foot per minute (cfm) for 5 minutes. Absorbed samples were returned to USAFMA for analysis.

b. **Air Samples.** Air samples for  $\text{SO}_2$  were taken at sample points 1 through 10 (1-9 are shown in Figure 1). Sample point 10 was located between the plant area and the change house, approximately 300 feet WSW which does not show because of the drawing scale. Mustard determinations were made at sample points 1, 6, and 8. Samples for  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  were collected at sample point 3.

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3. **OBJECTIVES.** The environmental hygiene survey at the M-70 mustard demilitarization plant was undertaken to determine the presence and extent of environmental health hazards associated with the process. In view of the limited knowledge of the combustion products created in the burning of

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NRDEI-S, Env Hyg Sur #3672M59-60/61, USA Ord Dpt, Black Hills, 23-25 Jan 61

c. Water Samples. Water samples of 1-liter volume were collected at water sample points 1-6 as indicated on Figure 1. Sample 7 were taken from the deep-well system at the plant. Samples 1 and 5 were taken at approximately mid-depth of recycle pond #2 near the recycle pump intake, with a Puerst depth sampler. All samples were returned to USAFHA for analysis.

d. Stack Gas Velocity-Temperature. Stack gas velocity was ascertained by determining the static pressure with an inclined plane manometer at a point near the base of the stack, and obtaining velocity and volume ratings from the manufacturer's rating tables. Exhaust gas temperatures were taken at the same point with a standard laboratory mercury thermometer.

e. Weather Measurements. Wind velocity measurements were obtained from instruments located at the Depot fire station approximately 5 miles east of the plant. Air temperatures were taken at the plant site with the standard laboratory thermometer at times of sampling.

#### 7. FINDINGS.

a. Air Samples. The results of analyses of air samples, including stack gas samples are listed in Table 1. Table 1 shows date and time of sampling as well as gas concentrations. Depot personnel also made a number of mustard determinations during the period, all of which are negative. These are not included in Table 1.

b. Water Samples. The results of chemical analyses of water samples are shown in Table 2.

c. Physical Stack Measurements. During the survey, the exhaust stack static pressure was measured at 0.4 inches, and stack gas temperature varied from 52° F to 81° F. The static pressure of 0.4 inches and wheel rotation of 310 rpm, according to manufacturer rating tables\*, yielded a discharge of approximately 12000 cfm at 70° F and 29.92 inches of Hg.

d. Weather Conditions. Temperatures ranged between 15° F and 0° F during the survey period 23-25 January. On 24 January the average wind velocity was measured at 14 mph from the ESE, and gusts were up to 25 mph. On 25 January, wind velocity averaged 15 mph with gusts up to 30 mph from the ENE. Direction of prevailing winds is reportedly from the ESE.

e. Kiln Operations. During the survey period, a notation of the temperature of kiln exhaust gases was made as indicated by a pyrometer gun pointed at the discharge head. The temperature averaged approximately 200° F.

\* Storage Fan Company, Kalamazoo, Michigan (Size 125 Storage Fan 12 in. Diameter Fan Code Type Model).



(\*) Additional field investigations would be necessary, with sampling to include:

(a) Air and stack sampling for  $\text{HCl}$ ,  $\text{SO}_2$ , total  $\text{SO}_x$  and mustard

(b) Scrubber water samples

2

MEDKI-2, Env Hyg Ser #3672M39-60/61, USA Ord Dpt, Black Hills, 23-25 Jan 61

TABLE 1  
AIR SAMPLE ANALYSIS  
ENVIRONMENTAL HYGIENE SURVEY  
MUSTARD DEMILITARIZATION PLANT

Sample Point (SP)	Date	Time	$\text{SO}_2$ ppm (1)	Mustard	$\text{H}_2\text{SO}_4$ $\text{mg/m}^3$ (2)	$\text{HCl}$ ppm (3)
1	23/1	1030	15	-	-	-
Stack	23/1	1300	> 50	Negative	211	273
Stack	23/1	1430	> 50	Negative	77	19
Stack	24/1	0915	> 50	Negative	113	(4)
3	24/1	1030	10	Negative	13	(4)
2	24/1	1110	10	-	-	-
4	24/1	1115	5	-	-	-
8	24/1	1120	0	-	-	-
9	24/1	1125	0	-	-	-
5	24/1	1130	2	-	-	-
Stack	24/1	1330	> 50	Negative	143	(4)
10	24/1	1400	5	-	-	-
6	24/1	1410	Trace	Negative	-	-
7	24/1	1420	Trace	-	-	-
8	25/1	0930	< 1	Negative	-	-

(1) Parts per million parts air by volume

(2) Milligrams per cubic meter of air - Total  $\text{SO}_x$  as  $\text{SO}_2$

(3) Parts per million parts air by volume - Total  $\text{HCl}$  as  $\text{HCl}$

(4) Excessive turbidity and color - not readable

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TABLE 2  
ANALYSES OF WATER SAMPLES  
ENVIRONMENTAL HYGIENE SURVEY  
MUSTARD DEMILITARIZATION PLANT  
23-25 JANUARY 1961

Analyses	Water Sample (SW)						
	1	2	3	4	5	6	7
Location	Pond 2	Water Seal	Ser Kiff	Water Seal	Pond 2	Pond 1	Well
Date	23/1	23/1	24/1	24/1	24/1	24/1	24/1
Time	1300	1400	1120	1120	1110	1410	1420
Temp °C (1)	13	-	23	28	13	21	22
pH	3.7	2.7	1.3	2.9	3.8	3.2	9.4
Total Solids mg/l	27430	23105	23365	29269	28714	38360	1066
Suspended Solids mg/l	328	560	333	473	175	925	16
Specific Conductivity micromhos per cm @ 25° C	29054	30019	47282	32973	29656	36450	1578
SO <sub>4</sub> mg/l	1319	892	2628	1777	1986	2726	320
H <sub>2</sub> SO <sub>3</sub> mg/l	838	571	762	156	422	285	-
H <sub>2</sub> SO <sub>4</sub> mg/l	1346	910	2682	1815	2028	2783	-
Cl mg/l	11144	11305	14100	12940	12000	14920	260
HCl mg/l	11458	11624	14498	13305	12338	15341	-
Ca mg/l	-	-	-	-	-	-	2.9
Na mg/l	-	-	-	-	-	-	390.0
Acidity mg/l as CaCO <sub>3</sub>	822	1556	3572	1633	903	1148	-
Alkalinity mg/l as CaCO <sub>3</sub>	-	-	-	-	-	-	542.5
Fe mg/l	-	-	-	-	-	-	0.10
Mg mg/l	-	-	-	-	-	-	1.5
Mustard	Negative	Positive	Negative	Positive	Negative	Negative	-

(1) At time of sampling

by a  
cloth  
red  
cloth  
piece  
mask  
avail

sampl  
sist  
chlor  
the  
recon  
SO<sub>2</sub>  
time-  
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f. Protective Clothing and Equipment. Protective clothing worn by all workers in the plant area consisted of multiple layers of impregnated cloth of which the coverall portion, hood, and gloves were dyed with indigo red to indicate mustard contamination. The clothing, which included a hood, cloth gloves, and rubber boots, when used in conjunction with a full-face-piece gas mask provided full protection to the worker. The standard gas mask used was the M9. MSA full-facepiece, all-purpose canister masks were available in the plant for use.

## 8. DISCUSSION.

a. Analytical Results - Air Samples. Analytical results of air samples revealed significant concentrations of gaseous by-products, consisting of sulfur dioxide, total sulfates measured as  $H_2SO_4$ , and hydrogen chloride. Work area concentrations were measured with wind direction from the ESE which gave concentrations of  $SO_2$ -10 ppm and  $H_2SO_4$  - 13  $mg/m^3$ . The recommended threshold limit values for 1960 according to reference 2d are:  $SO_2$  - 5 ppm; HCl - 5 ppm and  $H_2SO_4$  - 1  $mg/m^3$ . These values are based on a time-weighted average concentration for a normal workday and repeated exposure day after day without adverse effect upon the worker. It is known that these values may be exceeded for a short period, without harmful effects depending on the contaminant, concentration, frequency of high exposure, and duration of such exposures.

(1) According to references 2b and 2c, sulfur dioxide is an irritant gas that produces immediate irritant effects upon nose and throat in the concentration range 6 to 12 ppm. Approximately 20 ppm is considered the lowest concentration that will cause eye irritation. The accepted maximum permissible concentration is considered to be 10 ppm. Exposure to concentrations between 50 and 100 ppm for 30 to 60 minutes is considered maximum. With a threshold odor limit of approximately 3 ppm and a low irritation point, intentional exposure to  $SO_2$  concentrations high enough to be immediately harmful is not considered to be likely.

(2) In the work area, the measurement of  $H_2SO_4$  at 13  $mg/m^3$  may be attributed in part to sulfur trioxide ( $SO_3$ ), the anhydride of sulfuric acid. Dr. Willard, Consulting Chemist to the Ordnance Depot, indicated that  $SO_3$  was present, in addition to  $SO_2$ , in the exhaust gases. Sulfur trioxide is a strong irritant, and inhalation of concentrations approximating 1 ppm may cause a choking sensation. Sulfur trioxide is irritating and corrosive to all mucous membranes, causing inflammation of the upper respiratory tract, as well as possible lung injury. The maximum permissible limit has been stated variously from 2 to 10 ppm. As with  $SO_2$ , if the concentration is maintained below the point of discomfort, no injury is expected. Sulfuric acid is corrosive and further may cause damage to the enamel of the teeth in concentrations above 1  $mg/m^3$ . Since  $SO_3$  combines readily with water to form  $H_2SO_4$ , it is expected that mists or fumes derived from the open recycle pond #1 previously noted, will be lacking in  $SO_3$ , and irritation will be due to  $H_2SO_4$ . Exposure to the stack discharge would give rise to significant concentrations of both  $SO_3$  and  $H_2SO_4$ .

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(3) Significant concentrations of HCl were measured in the exhaust gases, up to 273 ppm as indicated in Table 1. Reference 2f indicates that HCl is primarily an irritant of the upper respiratory passages, and concentrations above 5 ppm for 8-hour exposures may cause eye irritation. Reference 2c further indicates that prolonged exposure to low concentrations of HCl may cause erosion of teeth. With the threshold limit value of 5 ppm, the maximum allowable concentration is 10 ppm. A concentration three and a half times as great (35 ppm) cannot be detected by taste or odor.

(4) Mustard is also a possible constituent of the exhaust gas, but none was detected by standard detection methods. However, this does not eliminate the possibility that subdetectable concentrations do exist or that significantly greater concentrations exist but are not detectable due to inadequacies of the determination. In addition to the potential existence of mustard in the exhaust gases, bringing "leakers" into the storage shed for loading onto the conveyor would give rise to additional mustard contamination.

b. Water Samples. Analytical results of water samples shown in Table 2 indicate a highly saline water, because of the solution of HCl, SO<sub>2</sub>, SO<sub>3</sub> and other gaseous discharges. Because of the high concentrations of dissolved solids (37,445 mg/l maximum) sulfates (2,726 mg/l maximum), chlorides (14,920 mg/l maximum), sulfuric acid (2,783 mg/l), hydrochloric acid (15,341 mg/l), and low pH (3.8) of the recycle water and the scrubber effluent, the liquid waste is definitely not suitable for domestic purposes. It would be detrimental to fish and other aquatic life in any receiving stream and also would be detrimental to stock and wildlife. It would exhibit definite phytotoxic effects and could not be used for irrigation purposes.

(1) Scrubber Efficiency. From the concentrations of elements found on analysis, it would appear that maximum scrubber efficiency was not achieved. Reduction of gas solubility in water may occur as a result of reduction in solubility constants because of increased common-ion effect. With repeated recycling of the liquid and subsequent increase in concentration through evaporation and repeated exposure to the exhaust gases, gas solubility may further decrease with time. A greater proportion of relatively dilute well water would materially increase the efficiency.

(2) Mustard. The presence of mustard in samples 2 and 4 taken from the bomb discharge water seal indicates that there may be incomplete combustion of the mustard contained in the bombs. Since the bombs have holes punched only in one side, it is possible that a small volume of mustard gas is trapped in an occasional bomb, and goes into solution in the water seal, through which each bomb must pass. The presence of mustard in the discharge seal adds to the potential presence of mustard in exhaust gases and the work area. However, the water seal is not considered an important source of atmospheric mustard with recirculation of seal water and periodic dosing with slaked lime.

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(3) Surface Disposal. The release of any excess recycle water to any surface stream that may be tributary to the Cheyenne River is considered inadvisable because of the detrimental or deleterious effects it may produce. According to the laws of South Dakota, 1955, Ch 430, Sec. 1 (Sec. 61.0145), the public waters of the state are classed as A or B. Class A waters must have pollution controlled so that the receiving water will not be rendered unfit for use whether for domestic use, public water supply, fish, or recreational use and will not be a public nuisance. Class B waters are those which are more important to the welfare of the state as carriers of wastes, if such wastes are not detrimental to the public health. Discharge of these wastes from the Depot, which would ultimately flow to the Cheyenne River, would be in opposition to the conditions of both Class A and Class B waters.

(4) Land Disposal. The subterranean formations under the plant have considerable bentonite. The sealing or impervious properties offer some degree of isolation to the shallowest ground water. The deep well at the plant intercepts this formation below the 1300-foot level. The ground water quality as indicated by the analysis of sample 7, Table 2, is poor when considered for domestic purposes. With the intervening strata shale, shale bentonite, and bentonite, there should be little danger of ground water contamination due to existing recycle ponds or other ponds created for evaporative disposal.

c. Theoretical Air Concentrations. It is realized that atmospheric conditions as found during the survey period are quite variable and will change with time. The changes will affect the concentrations of air pollutants,  $SO_2$ ,  $SO_3$ ,  $H_2SO_4$ ,  $HCl$ . When the concentrations of stack emissions are known, concentrations in the plant vicinity may be estimated under varying climatic conditions using the Bosanquet and Pearson equation (Reference 2a 5-24) for atmospheric diffusion

$$C = \frac{Q \cdot 10^6}{\sqrt{2\pi} p q u x^2} e^{-\frac{H}{px} - \frac{y^2}{2(qx)^2}}$$

C = Ground-level concentration in ppm downwind x (feet) and crosswind y (feet) from the source of contamination.

H = Effective stack height (feet) of the source above ground-level.

Q = Rate of contaminant emission in cubic feet per second (cfs) at atmospheric temperature.

p, q = Turbulence parameters or diffusion coefficients (dimensionless).

u = Mean wind speed in feet per second (fps).

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The maximum ground-level concentration ( $C_{max}$ ) will occur directly downwind which gives according to the Bosanquet and Pearson formula:

$$C_{max} = \frac{4.0 \cdot 10^6}{\sqrt{2\pi} \cdot e^2 \cdot uH^2} \cdot \frac{P}{q} = 2.15 \cdot \frac{9 \cdot 10^5}{uH^2} \cdot \frac{P}{q}$$

The maximum ground-level concentration will occur at a distance

$$x_{max} = \frac{H}{2p}$$

from the source of contamination. The effective stack height is obtained by the relationship

$$H = h + 0.6 (h_t + H_v)$$

where

$h$  = physical stack height in feet

$h_t$  = rise in feet caused by temperature difference between the stack gas and the atmosphere

$H_v$  = rise in feet caused by the vertical velocity of emission imparted by the exhaust blower

From these formulations, Figures 2 through 4 were prepared to demonstrate the effects of wind velocities, turbulence, and distance. For purposes of assessing the variable effects of weather, contaminant stack discharge of 1.0 cfs was assumed which is approximately 0.5 percent by volume of total stack discharge. Figure 2 on maximum ground-level concentrations shows the effects of wind velocity with assumed effective stack heights. Since the physical stack height is 32 feet, the minimum possible effective height is 32 feet. Under conditions of strong temperature inversion and wind velocities below 10 fps, the effective height is reduced to a minimum. With increased wind velocity, increased atmospheric mixing tends to overcome inversion effects. Figure 3 gives the atmospheric dilution effect of the stack plume with distance for varying wind velocities and  $p$ ,  $q$  values (diffusion coefficients). This becomes an important consideration where the plume comes in contact with the ground or buildings in which workers may be exposed. Where there is a super-adiabatic condition, turbulence may return the plume to the ground close to the stack. With an assumed  $Q = 0.01$  cfs of contaminant discharge through evolution of volatile gases and  $CO_2$ , in the case of the open recycle pond number 1 where a significant quantity of  $SO_2$  was noted, a minimum distance required to reduce the concentration to 5 ppm by dilution would be 25 feet for  $u = 30$  fps under turbulent atmospheric conditions and 450 feet for  $u = 2$  fps under low turbulence.

centration is maintained below the point at which Sulfuric acid is corrosive and further may cause damage to teeth in concentrations above 1 mg/ml. Since SO<sub>2</sub> tends to form H<sub>2</sub>SO<sub>4</sub>, it is expected that mists or fumes derived from cycle pond #1 previously noted, will be lacking in SO<sub>2</sub> and be due to H<sub>2</sub>SO<sub>4</sub>. Exposure to the stack discharge would have significant concentrations of both SO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub>.

Figure 2  
THEORETICAL MAXIMUM  
GROUND - LEVEL CONCENTRATIONS

Formulae:

$$C_{max} = 2.15 \frac{Q \cdot 10^3}{u \cdot H^2} \cdot P/q$$

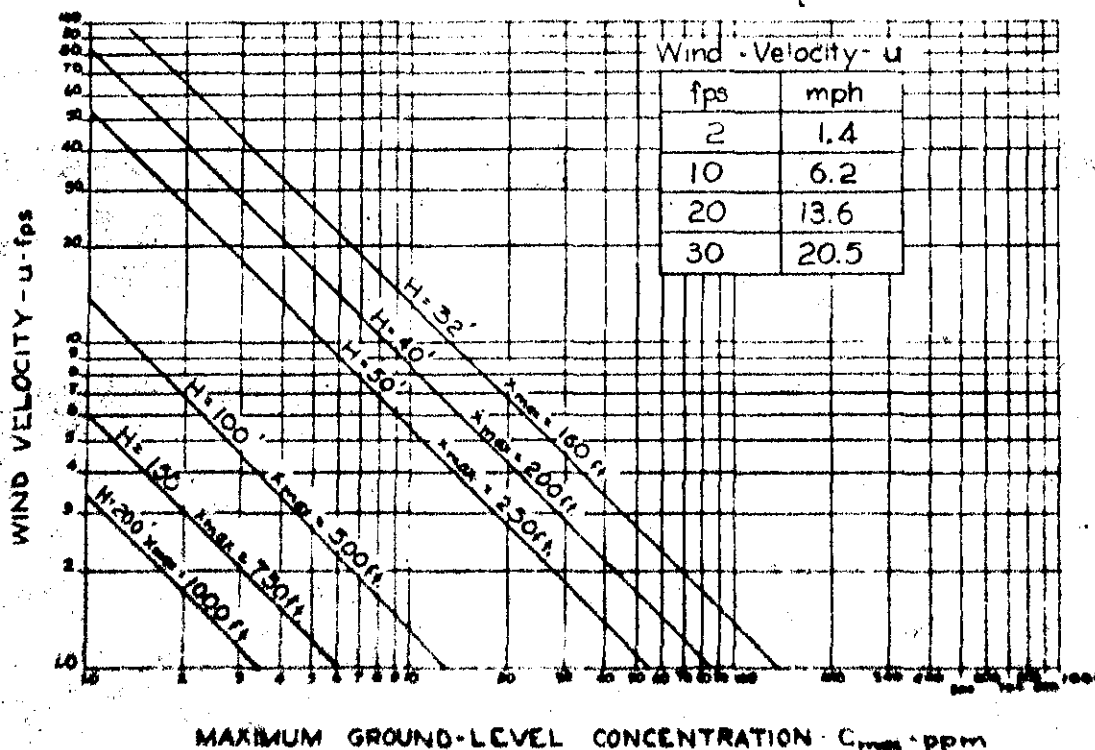
$$x_{max} = H/2p$$

Assumptions:

$$Q = 1.0 \text{ cfs}$$

$$p = 0.10$$

$$q = 0.16$$



Environmental Hygiene Survey, US Army Ordnance Depot,  
Black Hills, Project No. 367209-60/61

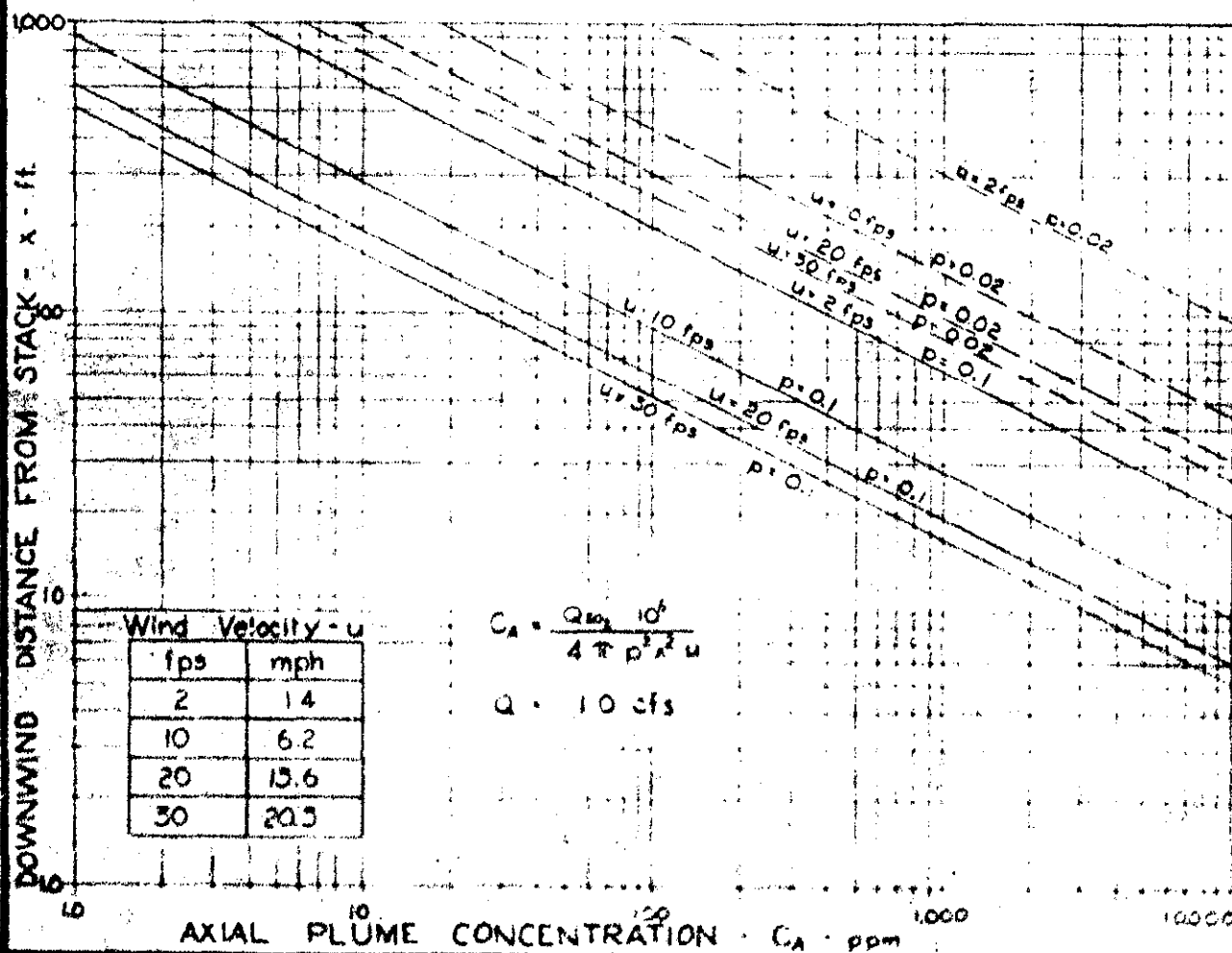
U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY  
UNITED STATES ARMY MEDICAL SERVICE

DATE Feb 61  
DRAWN D.C.L.  
APPROVED R.T.G.  
SCALE  
DATE

in the discharge seal adds to the potential presence of mustard in various cases and the work area. However, the water seal is not considered an important source of atmospheric mustard with recirculation of seal water and periodic dosing with slaked lime.

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Figure 3  
ATMOSPHERIC DILUTION OF PLUME



Environmental Hygiene Survey, US Army Ordnance Depot  
Nack Hills, Project No. 367203-60/61

U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY

UNITED STATES ARMY MEDICAL SERVICE

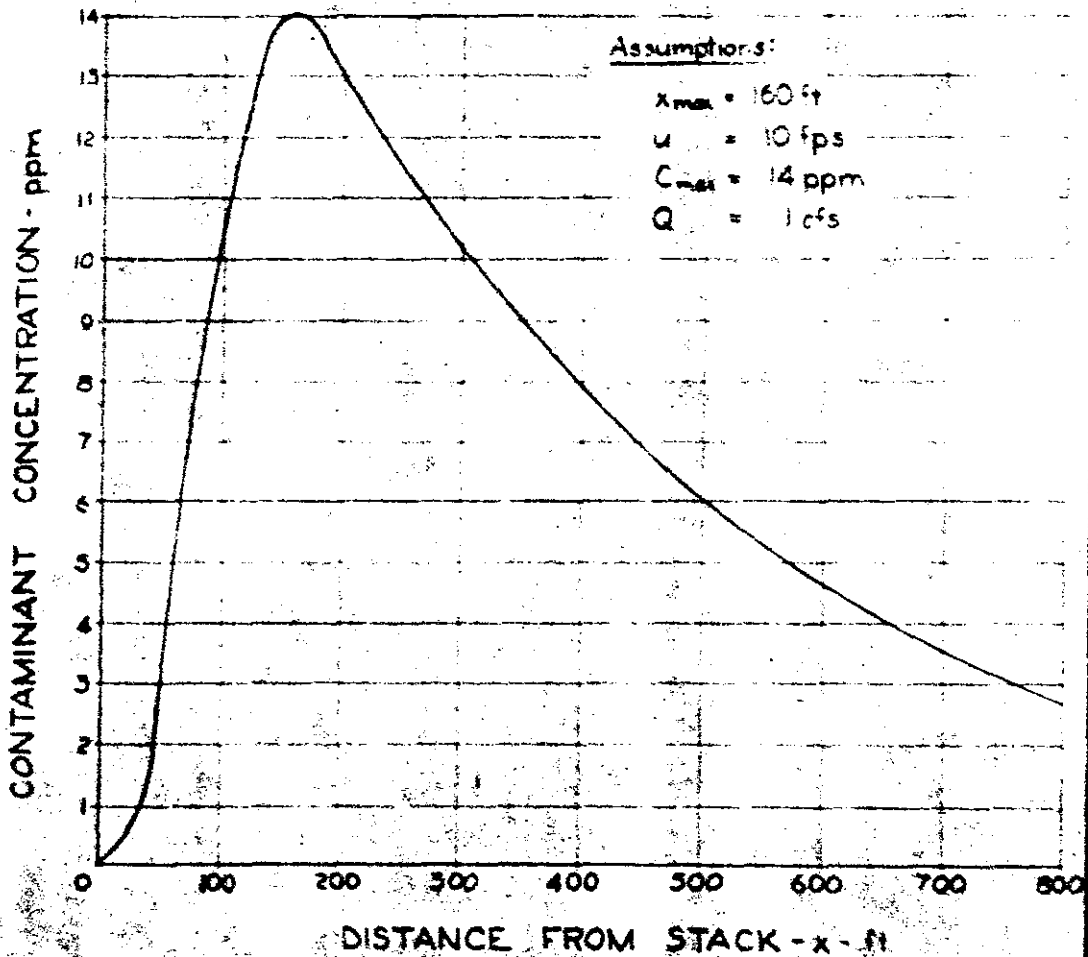
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RATE

are in exhaust  
 and are in  
 water and

$p, q$  = Turbulence parameters or diffusion coefficients  
 (dimensionless).

$u$  = Mean wind speed in feet per second (fps).

**Figure 4**  
**GROUND CONCENTRATIONS**  
**FROM STACK EMISSION**



Environmental Hygiene Survey, US Army Ordnance Depot  
 Black Hills, Project No. 367209-60/61

**U.S. ARMY ENVIRONMENTAL HYGIENE AGENCY**  
 UNITED STATES ARMY MEDICAL SERVICE

DATE Feb 61

DRAWN D.C.K.

APPROVED H.F.G.

SCALE

PLATE

MEDEI-E, Env Hyg Sur #3672M39-60/61, USA Ord Dpt, Black Hills, 23-25 Jan 61

9. Medical Implications. In the concentrations found,  $\text{SO}_2$ ,  $\text{SO}_3$ ,  $\text{HCl}$  and  $\text{H}_2\text{SO}_4$  are irritating to the mucous membranes and cause transient inflammatory reaction on occasional short exposure. Repeated insults to the delicate mucous membranes, if sufficiently prolonged, may produce irreversible changes which interfere with the function of the respiratory system. However, the most severe offender is mustard, not only because of the type and degree of tissue damage produced following exposure, but also because workers may be exposed to low, yet harmful, concentrations with few, if any, immediate symptoms. Characteristically, such exposures are often followed by conjunctivitis and laryngitis. Although detectable concentrations of mustard were not found during the survey, in view of the foregoing and the potential possessed by mustard for producing disabling tissue damage, it would be advisable to consider the occurrence of "red eye" and/or hoarseness as strong presumptive evidence that exposure to mustard is occurring, and that appropriate action be taken to investigate the cause of the exposure and institute corrective action.

#### 10. CONCLUSIONS.

a. Potential air pollutants derived from the burning of mustard in the presence of fuel oil include sulfur dioxide, sulfur trioxide, sulfuric acid, hydrogen chloride, and mustard. Of these, mustard is the most toxic as regards the production of injury and disability.

b. In mustard demilitarization operations the existence of conjunctivitis and laryngitis is considered presumptive evidence of the presence of mustard in sufficient concentrations to warrant investigation of the cause of the exposure and the institution of corrective action.

c. Sources of mustard will normally be from the exhaust stack or "leakers" brought into the storage-loading shed.

d. Concentrations of  $\text{SO}_2$  and  $\text{H}_2\text{SO}_4$  above the recommended threshold limits were found in the plant work area because of vapor emission from recycle pond number 1. Similar or higher concentrations of  $\text{SO}_2$ ,  $\text{H}_2\text{SO}_4$  and  $\text{HCl}$  may occur in the area under different weather conditions due to stack emissions.

e. Since contaminants will occur together, the low threshold concentrations of  $\text{SO}_2$  and  $\text{SO}_3$  may serve as contaminant detectors.

f. Winds of low velocity (15 fps or less) varying in direction from northeast to south will in all probability give rise to increased ground concentrations within the plant work area directly attributable to the stack discharge. Winds varying from the northeast to southeast will carry vapors from recycle pond number 1 into the work area.



MEDEI-E, Env Hyg Sur #3672M39-60/61, USA Ord Dpt, Black Hills, 23-25 Jan 61

g. Recycled scrubber water is a strong acidic, highly mineralized water of questionable value as an efficient gas scrubber, because of possible reduction of gas solubility.

h. Disposal of excess scrubber water by discharge to any surface stream is not feasible.

i. With the shallowest ground water below 1300 feet at the plant and with relatively impermeable strata (primarily bentonite) intervening, surface disposal by shallow evaporation beds should not present a ground water contamination problem.

j. The impregnated protective clothing should provide adequate protection to workers under normal operating conditions.

k. The M9 gas mask will provide adequate protection against mustard.

#### 11. RECOMMENDATIONS.

a. With winds from the direction varying between northeast and south, or under quiescent atmospheric conditions, the area is assumed to receive potentially injurious concentrations of all contaminants and the wearing of the M9 gas mask is recommended.

b. Protective clothing should be worn by all personnel in the plant area at all times.

c. Positive determination of mustard by the "Blue-dot method" in the plant area should require the donning of gas masks by personnel regardless of location in the plant area or wind conditions.

d. Where brief exposures to concentrated stack emissions is required self-contained breathing apparatus in accordance with reference 2g should be worn.

e. The occurrence of conjunctivitis or laryngitis should be used as a presumptive indicator of exposure to mustard. Such occurrences should receive immediate medical attention and supervision to assure proper use of personal protective clothing and equipment.

f. Excess liquid wastes should not be disposed of by discharging to any surface water course.

g. Liquid disposal should be by evaporation in prepared shallow ponds. The ponds should have well compacted sides and bottoms, with sufficient bentonite or other clay material to create an impervious seal.

h. Fresh make-up water should be used in the scrubber liquid to obtain a more dilute solution insofar as the existing well facilities permit.

MEDEI-E, Env Hyg Sur #3672M39-60/61, USA Ord Dpt, Black Hills, 23-25 Jan 61

i. The open recycle pond located immediately adjacent to the plant should be separated from the plant by at least 100 yards, preferably being moved to the south. This will provide maximum atmospheric dilution of the evolved vapors before being returned to the area by winds.

j. Future designs or modifications of the mustard-burning plant should consider the prevailing winds to the maximum extent. With an in-line layout and the exhaust stack located on the opposite end of the plant from the prevailing wind, minimum exposure to exhaust stack contaminants by operating personnel would be achieved.

*Donald J. Hernandez*

DONALD J. HERNANDEZ  
Captain, MSC  
Chief, Sanitary Engineering Division

*William F. Gilley*

WILLIAM F. GILLEY  
Captain, MSG  
Sanitary Engineer

APPROVED

*Adam J. Rafalski*  
ADAM J. RAFALSKI  
Colonel MC  
Commanding

MEDPS-PO (26 Apr 61) 1st Ind  
SUBJECT: Environmental Hygiene Survey

LCM/elh

Hq, DA, OTSG, Washington 25, D. C., 1 May 1961

THRU: Commanding General, Fifth United States Army, ATTN: Surgeon,  
1660 East Hyde Park Boulevard, Chicago 15, Illinois

TO: Commanding Officer, Black Hills Ordnance Depot, ATTN: Surgeon,  
Igloo, South Dakota

Concur in recommendations contained in paragraph 11 of subject survey. Request report of final action taken be submitted through this office.

FOR THE SURGEON GENERAL:

1 Incl  
no

*Charles W. Kraus*  
CHARLES W. KRAUS  
Lt Colonel, MC  
Preventive Medicine Division

Copies furnished:  
OCO  
CO, Grd Field Saf Off

ALFMD-PM (26 Apr 61)

2d Ind

S-9 Jun 61

HEADQUARTERS FIFTH U.S. ARMY, 1660 East Hyde Park Boulevard, Chicago 15,  
Illinois

4 MAY 1961

TO: Commanding Officer, ATTN: Surgeon, Black Hills Ordnance Depot,  
Igloo, South Dakota

For action indicated in paragraph 11, basic, and return to this headquarters by 9 June 1961.

FOR THE COMMANDER:

1 Incl  
wd 1 cy

*Vivian A. Estabrook*  
VIVIAN A. ESTABROOK  
CWO 3-2, USA  
Asst AG

ground concentrations within the plant work area directly attributable to the stack discharge. Winds varying from the northeast to southeast will carry vapors from recycle pond number 1 into the work area.

15

ORDKC-S 3rd Ind  
SUBJECT: Environmental Hygiene Survey

U. S. Army Ord Depot, Black Hills, Igloo, South Dakota, 22 May 1961

TO: CG, Fifth U. S. Army, ATTN: ALFMD-PM, Chicago 15, Illinois

Proposed action by this depot to comply with recommendations in paragraph 11 of basic communication.

a. Gas masks will be worn when winds are from directions varying between northeast and south, or under quiescent atmospheric conditions.

b. Impregnated clothing will be worn by all personnel inside the plant area. Impermeable (rubber) suits will be worn by personnel handling contaminated materials.

c. When a positive determination is made by the "Blue-dot method" that mustard contamination is present in the plant area, personnel will don gas masks regardless of location in the plant area or wind conditions.

d. Where brief exposures to concentrated stack emissions <sup>are</sup> required, a self-contained breathing apparatus in accordance with reference 2g will be worn.

e. The occurrence of conjunctivitis or laryngitis will receive immediate medical attention and supervision to assure proper use of personal protective clothing and equipment. In addition, all maintenance personnel who are exposed to maximum hazards during performance of maintenance work will be checked at least bi-monthly at the U. S. Army Hospital. All personnel working in the mustard plant area will be given complete physical examinations and pulmonary function testing every six months.

f. No liquid wastes are disposed of by discharging to a surface water course.

g. Liquid waste from the plant is being recycled. At the end of the project steps will be taken for disposal of wastes by evaporation.

h. Fresh make-up water is being used in the scrubber liquid to the maximum output of the wall. An additional pond was constructed to make a larger volume of water available for recycling.

i. Since the January survey the recycle pond No. 1 (reference Figure 1, Page 4, basic letter) has been enlarged, lined with coarse limestone aggregate and provided with a permanent cover. Slurry is metered into the scrubber effluent, as before, neutralizing the acid while under the covered portion. The acidic droplets generated in the reaction are condensed when they contact the inclosure. The acidic gases are apparently neutralized when they come in contact with the wet limestone aggregate. Little, if any, odor from this source has been noticed in the plant area.

g. Liquid disposal should be by evaporation in prepared shallow ponds. The ponds should have well compacted sides and bottoms, with sufficient bentonite or other clay material to create an impervious seal.

h. Fresh make-up water should be used in the scrubber liquid to obtain a more dilute solution insofar as the existing well facilities permit.

16

ORDKC-S

22 May 1961

SUBJECT: Environmental Hygiene Survey

j. Wind data for a three year period, 1958, 1959 and 1960, was reviewed to determine the prevailing wind. The present stack site was determined to be the most advantageous spot considering year around prevailing winds.

FOR THE COMMANDER:

1 Incl  
nc

*Nadine Veren*  
NADINE VEREN  
Adjutant

**APPENDIX G**

**PRELIMINARY STATEMENT OF DECONTAMINATION**

BHAD 0053

UTILIZATION AND DISPOSAL SERVICE  
1500 East Bannister Road

July 22, 1965

6111.

District Engineer  
U. S. Army Engineer District, Omaha  
Corps of Engineers  
6612 U. S. Post Office and Court House  
Omaha, Nebraska 68102

Your Ref: M10RM

Dear Sir:

Reference is made to your letter of June 23, 1965, enclosing preliminary decontamination report for the Sioux Army Depot, Nebraska, and your letter of July 2, 1965, enclosing preliminary decontamination report covering Black Hills Army Depot, South Dakota.

Your attention is invited to paragraph 101-47.202-7 of the Federal Property Management Regulations which provides that any report of excess covering property which is contaminated shall state the extent of such contamination, plans for decontamination, etc.

The preliminary reports set out the extent of decontamination to be performed and the restrictions as to future use. It is noted that in some cases the area will be released for surface use only and that certain areas will be fenced for non-use. While we would prefer a certificate of complete decontamination with no use restrictions we realize that this cannot be accomplished in all cases. We will therefore be willing to accept your final decontamination reports when the decontamination has been accomplished provided the restricted areas are sufficiently described.

It is understood that no expense pertaining to this decontamination will be incurred by GSA.

Sincerely yours,

J. Wayne Harrop  
Chief, Real Property Division

JWHarrop:sw

*DALE KENT*  
DALE KENT  
Chief, Real Estate Division



D

DECONTAMINATION WITH RESTRICTIVE COVENANTS

C

EACH WERE AND REPORT  
1000, SOUTH BRONX

The following observations were made as they relate to decontamination necessary to deactivate and/or dispose of the facility with restrictive covenants.

1. AREAS AND BUILDINGS TO BE DECONTAMINATED.

- A. 3000 Area.
- B. 3000 Area.
- C. 3000 Area.
- D. Leaching Beds.
- E. Deactivation Furnace.
- F. Disassembly Plant (TV).
- G. 6000 Area.
- H. Burning Ground #1 Area.
- J. Burning Ground #3 Area.
- K. Burning Ground #2 Area.
- L. Site where M.P. Bomb casings are buried.
- M. Leaching beds for acids.

2. DESCRIPTION, PROBLEM, RECOMMENDATION AND COST ESTIMATE OF AREAS AND BUILDINGS TO BE DECONTAMINATED:

A. 8000 AREA.

(1) Decontamination of area: Consists of 7.8 acres and one operating building, one vacuum building and six service magazines.

(2) Extent of Contamination: This area was used for the Normal Maintenance, Modification, Restoration and Demilitarization of the following types of ammunition and ammunition components.

- a. Conventional ammunition ranging in size from 20MM thru 240MM with H.E. filler.
- b. Rockets ranging in size from 2.75 inch to 4.5 inch with H.E. and M.P. filler.
- c. Grenades, hand and rifle with H.E. filler.
- d. Ammunition components (I.E. Fuses, Primers, Boosters and Propellants).

(3) Decontamination Procedures:

- a. Police the area within a 50 foot radius of all buildings. Visually inspect and surface clean the area of any ammunition, ammunition components and/or any resemblance of ammunition

items or scrap. Any hazardous items found will be removed by trained personnel, transferred to the destruction area and destroyed in accordance with section 27 of AMOR 385-224.

- b. Remove all ammunition and equipment from buildings.
- c. Sweep and wash down all buildings with steam or water as required.

(4) Recommendations as to Future Use: Release area and buildings without any restrictions.

(5) Cost Estimate for Decontamination:

- a. Wash down and clean one operating building, one vacuum building and six service magazines, 100 manhours @ 4.30 = \$430.00.

B. 3000 AREA.

(1) Description of area: Consists of 48.1 acres and four operating buildings, one vacuum building, and eight service magazines.

(2) Extent of Contamination: This area was used for the normal maintenance, modification, renovation and demilitarization of the following types of ammunition and ammunition components:

- a. Conventional ammunition ranging in size from 20MM thru 240MM with H.E., W.P. and E Gas filler.
- b. Rockets ranging in size from 2.75 inch to 4.5 inch with H.E. and W.P. filler.
- c. Grenades, hand and rifle, with H.E. filler.
- d. Ammunition components (I.E., Fuzes, Primers, Boosters and propellants).

(3) Decontamination Procedures:

- a. Police the area within a 50 foot radius of all buildings. Visually inspect and surface clean the area of any ammunition, ammunition components and/or any resemblance of ammunition items or scrap. Any hazardous items found will be removed by trained personnel, transferred to the destruction area and destroyed in accordance with section 27 of AMOR 385-224.
- b. Remove all ammunition and equipment from buildings.
- c. Sweep and wash down all buildings with steam or water as required.

(4) Recommendations as to Future Use: Release area and buildings without any restrictions.

(5) Cost Estimate for Decontamination:

a. Wash down and clean four operating buildings, one vacuum building and eight service magazines, 200 manhours @ \$4.30 = \$860.00.

c. 3046 AREA.

(1) Description of area: Consists of two buildings Mrs. 3046 and 3048.

(2) Extent of Contamination: This area was used for the wash out of the following types of ammunition:

- a. Conventional ammunition, 75MM and 76MM with H.E. filler.
- b. Mines, A.T. and A.P. with H.E. filler.
- c. Bombs, 250 lbs thru 1000 lbs with H.E. filler.

(3) Decontamination Procedures:

- a. Remove all equipment, drains and sumps.
- b. Burn buildings Mrs. 3046 and 3048 and ground within 50 feet of building and remove all scrap material.

(4) Recommendations as to Future Use: Release area for surface use only.

(5) COST ESTIMATE FOR DECONTAMINATION:

a. Burn building Mrs. 3046 and 3048 = \$1,000.00.

d. LEACHING BEDS.

(1) Description of area: Consists of four leaching beds.

(2) Extent of Contamination: Leaching beds were used for the settlings of H.E. filler from the washout plant.

(3) Decontamination Procedures:

- a. Burn all leaching beds.
- b. Cover all beds with earth.

(4) Recommendations as to Future Use: Release area for surface use only.

(5) Cost Estimate for Decontamination:

a. Burn four leaching beds, 70 manhours @ \$4.30 = \$301.00.

E. DEACTIVATION FURNACE.

(1) Description of area: Consists of 11.2 acres and two buildings.

(2) Extent of Contamination: Area was used for the destruction by burning in a furnace of the following types of ammunition and ammunition components:

- a. Small arms, all types.
- b. Fuzes, boosters, primers and tracers.

(3) Decontamination Procedures:

a. Police the area within a 400 foot radius of buildings. Visually inspect and surface clean area for any ammunition, ammunition components and/or any resemblance of ammunition items or scrap. Any hazardous items found will be destroyed in place by trained personnel in accordance with section 27 of AMCR 385-224.

b. Remove all equipment.

c. Wash down buildings with steam or water as required.

(4) Recommendations as to Future Use: Release area and buildings without any restrictions.

(5) Cost Estimate for Decontamination:

a. Wash down two buildings, 16 manhours @ \$4.30 = \$68.80.

F. DISASSEMBLY PLANT (TW).

(1) Description of Area: Consists of approximately 2 acres and two buildings.

(2) Extent of Contamination: Area was used for the disassembly of the following ammunition:

a. Bombs ranging in size from 100 lbs thru 4000lbs with H.E. filler.

(3) Decontamination Procedures:

a. Police the area within a 50 foot radius of all buildings. Visually inspect and surface clean area for any ammunition, ammunition components and/or any resemblance of ammunition items or scrap. Any hazardous items found will be removed by trained personnel and transferred to the destruction area and destroyed in accordance with section 27 of AMCR 385-224.

b. Remove all equipment.

c. Wash down buildings with steam or water as required.

(4) Recommendation as to Future Use: Release area and buildings without any restrictions.

(5) Cost Estimate for Decontamination:

a. Wash down two buildings, 16 manhours @ \$4.30 = \$68.80.

G. 6000 AREA (CHEMICAL PLANT).

(1) Description of area: Consists of 114 acres, one burning pit and chemical plant area.

(2) Extent of Contamination: Area was used for the disposal by burning of the following types of ammunition:

- a. Chemical bombs ranging in size from 100 lbs thru 1000 lbs with H Gas and OH Gas fillers.
- b. An underground drain approximately 250 feet long is known to be contaminated with mustard. This drain is located 5 to 8 feet underground and passes under a reinforced concrete slab.

(3) Decontamination Procedures:

- a. Close up the burning pits.
- b. Wash down Bldg. No. 6005 with steam or water as required and relocate the building.
- c. Fence the plant area and burning pit with barbed wire.

(4) Recommendation as to Future Use: Release the fenced area for non-use. Release the building without any restrictions.

(5) Cost Estimate for Decontamination:

- a. Burn burning pit and close up, 40 manhours @ \$4.30 = \$129.00.
- b. Fence burning pit with barbed wire ( $\frac{1}{2}$  mile) \$552.00.
- c. Fence plant area with barbed wire ( $\frac{1}{2}$  mile) \$552.00.
- d. Wash down one building, 8 manhours @ \$4.30 = \$34.40.

H. BURNING GROUND #1 AREA:

(1) Description of area: Consists of 438 acres with two burning pits.

(2) Extent of Contamination: Area was used for the destruction by burning and detonation of the following types of ammunition.

- a. Bombs, chemical (WP and H Gas).
- b. Conventional ammunition ranging in size from 20MM thru 240MM with HE filler.

(3) Decontamination Procedures:

- a. Police the area within a 2400 foot radius of the TV station for any resemblance of ammunition items. Any hazardous items found will be destroyed in place by trained personnel in accordance with section 27 of AMCR 385-224.
- b. Fence area with barbed wire.

(4) Recommendations as to Future Use: Release fenced area for non-use.

(5) Cost Estimate for Decontamination:

- a. Police 438 acres, 800 manhours @ \$4.30 = \$3,440.00.
- b. Fence area with barbed wire (7200 lin feet) = \$1,512.00.

✓ J. BURNING GROUND #3 AREA.

(1) Description of area: Consists of 675 acres and burning area.

(2) Extent of Contamination: Area was used for the burning of the following types of ammunition and ammunition components:

- a. Small arms, .30 cal., ball and tracer.
- b. Conventional ammunition ranging in size from 20MM thru 240MM with H.E. filler.
- c. Bombs, fragmentation, 20 lbs and 220 lbs with H.E. filler.
- d. Ammunition components (I.E. Fuzes, Primers, Boosters and Propellants).
- e. Guided missiles fuel and oxidizer (UDMH, Fuel M3 and Nitric acid).

(3) Decontamination Procedures:

- a. Police the area within a 2400 foot radius of the burning sites. Visually inspect and surface clean the area of any ammunition, ammunition components and/or any resemblance of ammunition items or scrap. Any hazardous items found will be destroyed in place by trained personnel in accordance with section 27 of AMCR 385-224.
- b. Burn the area where the burning sites were located.
- c. Fence area with barbed wire.

(4) RECOMMENDATION AS TO FUTURE USE: Release fenced area for surface use only.

(5) COST Estimate for Decontamination:

- a. Police 675 acres, 1200 manhours @ \$4.30 = \$5,160.00.
- b. Burn and police burning area, 80 manhours @ \$4.30 = \$344.00.
- c. Fence area with barbed wire (1½ mile) \$1,360.00.

k. BURNING GROUND #2 AREA.

(1) Description of Area: Consists of 965 acres, two service magazines and twelve burning sites.

(2) Extent of Contamination: Area was used for the destruction by burning and detonation of the following types of ammunition and ammunition components.

- a. Small arms, .30 and .50 cal., all types.
- b. Conventional ammunition ranging in size from 20MM thru 240MM with H.E., incendiary and chemical (W.P., H Gas, and CN Gas).
- c. Conventional bombs ranging in size from 4 lbs thru 12,000 lbs with H.E., incendiary, Pyrotechnics and chemical (W.P., H Gas, L Gas, CX Gas, CG Gas and AC Gas).
- d. Ammunition components (I.E. Fuzes, Primers, Boosters, Bursters, activators and Propellant).
- e. Rockets ranging in size from 2.75 inch to 4.5 inch with H.E. and W.P. filler.
- f. Mines, A.T. and A.P. with H.E. filler.
- g. Grenades, hand and rifle with H.E. filler.

(3) Decontamination Procedures:

- a. Police the area within a 2400 foot radius of the demolition pits. Visually inspect and surface clean the area of any ammunition, ammunition components and/or any resemblance of ammunition items or scrap. Any hazardous items found will be destroyed in place by trained personnel in accordance with section 27 of AR 335-224.
- b. Pit areas will be inspected the same as the above and when completed pits will be closed up.
- c. Fence area with barbed wire.

(4) Recommendations as to Future Use: Release fenced area for non-use.

(5) Cost Estimate of Decontamination:

- a. Police 965 acres, 1600 manhours @ \$4.30 = \$6880.00.
- b. Inspect and clean 12 sites and level off 600 manhours @ \$4.30 = \$2,580.00.
- c. Wash down two service magazines, 8 manhours @ \$4.30 = \$34.40.
- d. Fence area with barbed wire (1 1/4 mile)... \$1,360.00.

L. Site of Buried W.P. Bomb Casings:

(1) Description of Area: Consists of approximately 4 acres.

(2) Extent of Contamination: Area of two pits where 100 lb W.P. bomb casings, which had been drained, are buried.

(3) Decontamination Procedures:

a. Stake area containing the two pits.

(4) Recommendations as to Future Use: Release area for surface use only.

(5) Cost Estimate for Decontamination: No cost.

M. LEACHING BEDS FOR ACID.

(1) Description of Area: Consists of two leaching beds.

(2) Extent of Contamination: The beds were used for the drain off of Sulphuric acid water from the chemical cleaning of cartridge cases.

(3) Decontamination Procedures:

a. Test the beds for contamination. If any is present cover area with lime stone and close up the beds.

(4) Recommendations as to Future Use: Release the area without any restrictions.

(5) Cost Estimate for Decontamination: 16 hrs @ \$4.30 = \$68.80.




**APPENDIX H**  
**DECONTAMINATION SOPs**

Statement of Clearance

31 January 1967

All lands within the Black Hills Army Depot, Igloo, South Dakota, located approximately 8 miles south west of Edgemont, South Dakota, have been given a careful search and have been cleared of all dangerous and/or explosive materials reasonably possible to detect. Six areas depicted on the inclosed drawing PE 1004-1, dated 27 Jan 67, are designated as restricted. Area No's 1, 2, 4, 5, and 6 are entirely restricted from any use. Area No. 3 is restricted to surface use only. All other tracts are recommended for any use for which the land is suited.

  
WALTER C. GARTHWAITE  
Major, Ord C  
Commanding

Attached PE 1004-1

Copy furnished:  
AMC

*Done*

AMXSBH

6 February 1967

SUBJECT: Neutralization (Decontamination) of Black Hills Army Depot

TO: District Engineer  
U.S. Army Engineer District, Omaha  
ATTN: Real Estate  
215 North 17th St.  
Omaha, Nebraska 68101

1. Reference Para 11, AR 405-90.
2. Statement of clearance with drawing no. PE 1004 attached and Standing Operating Procedure No. SSMBH 5-66 with drawing no. PE 1003 attached, are submitted as inclosures 1 and 2.
3. Neutralization of the contaminated and hazardous areas designated on drawing no. PE 1003 was performed in accordance with SOP SSMBH 5-66 with completion date 15 Dec 66.
4. The following technicians supervised the work performed:  
Francis R. Salvo, Chief Surveillance  
Herbert A. Geffre, Ammunition Inspector (Surveillance)  
Francis F. Finkle, Maintenance General Foreman  
Robert C. Schmidt, Foreman

2 Incl  
as

Copy furnished:  
AMC

WALTER C. GARTHWAITE  
Major OrdC  
Commanding

BLACK HILLS ARMY DEPOT  
Igloo, South Dakota

STANDING OPERATING PROCEDURE FOR:

SUBJECT: DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

ACTIVITY: DECONTAMINATION

USASMC CONTROL NUMBER:

DEPOT ORGANIZATIONAL SYMBOL: SSMBE

SOP NO: SSMBE 5-66 DATE: 13 Jul 66

PREPARED BY:

*James C. Casper*

TITLE:

*Production Control*

PHONE EXTENSION:

*2425*

CONCURRENCES:

SURVEILLANCE OFFICE

*Francis R. Salvo*

CHIEF, SURVEILLANCE OFFICE

SAFETY OFFICE

*Francis R. Salvo*

SAFETY DIRECTOR

T

*Thomas W. Hipsley*

DST

APPROVED BY:

*Jack Carstensen*

1LT. CARSTENSEN  
1LT. Col., Col. Corps  
Commanding

## OPERATIONAL INDEX

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  - Operation II - SOP For Decontamination of Operating Buildings and Grounds Around Buildings
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  - Operation VI - SOP For Decontamination of Wastout Plant and Area at Black Hills Army Depot
  - Operation VII - SOP For Decontamination of Chemical Plant and Plant Area
-

SECTION I

GENERAL NOTES FOR DECONTAMINATION

SOP NO: SSMBH 5-66

DATE: 13 July 1966

## SECTION I

### GENERAL INFORMATION

1. Purpose: To provide a safe and effective procedure for the complete decontamination of all explosives storage locations, operating buildings and areas, loading aprons at Black Hills Army Depot.
2. Scope: This S.O.P. affects all phases of required operations.
3. Objectives: To assure that all buildings, equipment and grounds are properly decontaminated in a safe manner and to assure that the equipment can be utilized at another installation, and the buildings and grounds for other purposes.
4. Responsibilities:
  - A. Chief, Surveillance is responsible for:
    - (1) Adequacy of S.O.P. to conduct decontamination.
    - (2) Final inspection, certification, and signing of certificate that all buildings and equipment were decontaminated in accordance with these procedures.
    - (3) Furnish the technical advice and instructions for decontamination that may not be fully covered in this S.O.P.
    - (4) Preparation and signature of the statement of clearance required by references, para. 7D.
    - (5) Furnishing the necessary supporting records to the statement of clearance as required by references, para. 7D.
  - B. D.S.T. is responsible for:
    - (1) The accomplishment of decontamination in accordance with approved S.O.P.
    - (2) Prepare addenda as necessary, to incorporate additional decontamination procedures for problem areas, if any, that may not be covered in this S.O.P.
    - (3) Assist the Chief of Surveillance Division as required by him in discharging the responsibility of para. 4A5.
  - C. Chief, Depot Facilities Division is responsible for:
    - (1) Furnishing the necessary engineer tools and equipment that may be required for decontamination operations.
    - (2) Furnishing necessary skilled personnel such as electricians, plumbers, etc., to operate such tools and equipment and/or to perform dismantling operations falling within the category.
5. Marking of Buildings and Equipment:
  - A. To prevent contaminated equipment or buildings from being erroneously destroyed or mistaken as decontaminated, buildings and equipment will be marked with yellow paint (see "Definitions" para. 6) to indicate the degree of decontamination which has been performed. Tags shall be used in addition to indicate the extent and progress of treatment of treatment given. Tags are used and are to be signed by the inspector and supervisor and the extent of decontamination performed (such as cleaned with hot water, steam, or approved solvent) will be stated on the tag under their signatures.
6. Definition:
  - A. "Decontamination" means the complete removal of explosives contamination, from all buildings and structures, equipment, and ground areas which are contaminated with explosive elements. This includes doors, vents, walls, ledges, ceilings, cracks, and joints in concrete floors, exterior water, steam and air lines, sumps and other places exposed to explosives. Contamination will be removed by use of vacuum, steam, water, and approved solvents, swabbing, scraping or flashing; whichever is appropriate for the material or item involved. Only approved

3. Objectives: To assure that all buildings, equipment and grounds are properly decontaminated in a safe manner and to assure that the equipment can be utilized at another installation, and the buildings and grounds for other purposes.

4. Responsibilities:

A. Chief, Surveillance is responsible for:

- (1) Adequacy of S.O.P. to conduct decontamination.
- (2) Final inspection, certification, and signing of certificate that all buildings and equipment were decontaminated in accordance with these procedures.
- (3) Furnish the technical advice and instructions for decontamination that may not be fully covered in this S.O.P.
- (4) Preparation and signature of the statement of clearance required by references, para. 7D.
- (5) Furnishing the necessary supporting records to the statement of clearance as required by references, para. 7D.

B. D.S.T. is responsible for:

- (1) The accomplishment of decontamination in accordance with approved S.O.P.
- (2) Prepare addenda as necessary, to incorporate additional decontamination procedures for problem areas, if any, not may not be covered in this S.O.P.
- (3) Assist the Chief of Surveillance Division as required by him in discharging the responsibility of para. 4A5.

C. Chief, Depot Facilities Division is responsible for:

- (1) Furnishing the necessary engineer tools and equipment that may be required for decontamination operations.
- (2) Furnishing necessary skilled personnel such as electricians, plumbers, etc., to operate such tools and equipment and/or to perform dismantling operations falling within the category.

5. Marking of Buildings and Equipment:

A. To prevent contaminated equipment or buildings from being erroneously designed or mistaken as decontaminated, buildings and equipment will be marked with yellow paint (see "Definitions" para. 6) to indicate the degree of decontamination which has been performed. Tags shall be used in addition to indicate the extent and progress of treatment of treatment given. Tags are used and are to be signed by the inspector and supervisor and the extent of decontamination performed (such as cleaned with hot water, steam, or approved solvent) will be stated on the tag under their signatures.

6. Definitions:

A. "Decontamination" means the complete removal of explosives contamination, from all buildings and structures, equipment, and ground areas which are contaminated with explosive elements. This includes doors, vents, walls, ledges, ceilings, cracks, and joints in concrete floors, exterior water, steam and air lines, sumps and other places exposed to explosives. Contamination will be removed by use of vacuum, steam, water, and approved solvents, swabbing, scraping or flashing; whichever is appropriate for the material or item involved. Only approved type solvents compatible with the specific explosives will be used.

B. Markings:

- (1) Single "X" indicates only partial decontamination. This marking is temporary and subsequent decontamination must be done.
- (2) Three (3) "X's" indicate that the equipment or building has been examined and approved after decontamination, but still should not be treated with open flame or high temperature heating devices, and is not to be considered toxically safe.

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(3) Five (5) "X's" indicate that the equipment or building has been inspected after decontamination, and is entirely safe, and may be released for general use.

NOTE: The procedures described in this S.O.P. cover, in most cases, complete decontamination as designated by a five (5) "X" (XXXXX) marking. In those instances where local decision or specific instruction from higher authority specifies that a lesser degree of processing is required, only the specified decontamination will be accomplished, i.e., as described above for one X (X) or three X's (XXX).

(4) Red car seals will be used on igloos that are free of contamination.

7. References:

- A. AMCR 385-224, dated 4 September 1951 and all changes.
- B. S.E. 5-52, dated July 1945 (WD Supply Bulletin).
- C. Paragraph M1106 of OACI, dated 26 February 1959, concerning decontamination.
- D. AR 405-90, Disposal of Real Estate, dated 9 June 1959, para. 5B.

PROCEDURE AND MAINTENANCE OF DAILY LOG AND WORK ORDER FILE

1. The DST office will maintain the master file for all reports and work orders required for decontamination of the Ammunition storage area at Black Hills Army Depot.
2. Daily reports will be submitted by the foreman in charge of decontamination to the DST office.
3. Format of report is as follows:

DAILY LOG

DATE: \_\_\_\_\_

- A. Building/Area Decontamination
- B. Procedure Used.
- C. Number Personnel.
- D. Certificate from Surveillance Inspector.
- E. Comment.

SIGNATURE: \_\_\_\_\_

(Foreman in Charge)

The foreman in charge will secure a certificate of decontamination (see below) for each storage location, building and/or area facility.

CERTIFICATE OF DECONTAMINATION

DATE: \_\_\_\_\_

I certify that the following building site (cross out word not applicable), has been decontaminated to a \_\_\_\_\_ category. The following procedure was used: \_\_\_\_\_

Webster's reagent was used to determine that decontamination was complete. Car seal number was used to secure magazine or building.

SIGNATURE: \_\_\_\_\_

(Ammunition Inspector)

- Foreman in charge of decontamination will coordinate with the DST office on submission of work orders to the Depot Facilities Division.

## I. General:

1. Steam used to heat water for decontaminating shall have a maximum pressure of five (5) lbs. PSI (228° F).
2. Protective equipment, such as showers, goggles, uniforms, gloves, rubber boots, rubber aprons, respirators and laundry facilities must be available for the use of the workers.
3. Hot water is recommended for the removal of black powder and Explosive D.
4. Steam is recommended for TNT and mixtures of TNT with other explosives.
5. Acetone is recommended for the removal of tetryl contamination. In this connection, when acetone is used, special care should be taken to provide adequate ventilation to prevent high concentration of vapors which might cause asphyxiation. Working supply of acetone must be kept in safety type container.
6. Safety solvent with a flash point above 100° F, may also be employed for swabbing, however, such solvents do not ordinarily dissolve explosives, but merely act to loosen or float explosive particles.
7. Where disassembling or dismantling are required for decontamination, all nuts, bolts, screws, studs, cotter pins, etc., will be removed while wet. When a sensitive explosive is present and undue force is required, penetrating oil will be used and a stream of water played on items being removed.
8. Contaminated equipment or material and waste explosives will not be disposed of by burying.
9. Personnel shall be held to a minimum to assure a safe and efficient operation.
10. Explosive waste, contaminated acetone or solvent and contaminated rags shall be transported to burning ground in approved container before accumulation at the operation creates a hazardous condition. This should be done at least once each shift, or more often, when required.
11. Operators employed in steam cleaning operations shall wear goggles, gloves and rubber boots or overshoes.
12. Portable steam cleaning equipment (Steam Jenny) will be stationed outside of building being cleaned.
13. Oily or greasy rags will be placed in a self-closing container partially filled with water.
14. Metal scrapers will not be used at any time to clean floors.
15. Restricted area fences will remain intact until all decontamination operations have been completed. Contaminated buildings will be kept locked except while decontamination operations are in progress.
16. Fire protection equipment and personnel are to be readily available at all times.
17. During all phases of decontamination high temperatures and rough handling will be avoided to prevent explosive accidents.
18. Striking explosive material with hammers will be prohibited. Frictional heat will also be avoided.
19. Smoking will be permitted only in the existing designated locations.
20. Personnel engaged in decontamination operations will wear protective clothing and equipment as required.
21. If pipe lines have to be cut, this can be approved after explosive material has been flushed out, using high pressure water through both ends and all branches. The pipe filled with water, using a roller type cutter with the pipe full of water and playing a water hose over the outside pipe. Such a pipe should not be hammered or subjected to heat of a torch.

OPERATION: DECONTAMINATION OF IGLOO STORAGE MAGAZINES AND CROULDS AROUND MAGAZINES

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: Minimum required for a safe and efficient operation.

STEP NO.	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	Unlock igloo and open door, remove all surveillance inspection cards, placards, etc., place them into a trash container.	1. (O) Transfer to BHEI via stake truck as required for burning.
2.	Inspect all ventilators, screens, doors, gutters, floors, walls, etc., in the interior of the magazine for any foreign material, such as ammunition components, etc., and accumulation of explosive dust.	2. (S) Only safety approved flash lamps and hand lamps will be used.
3.	With the aid of a non-sparking hook, remove the plates from the drains on each side of igloo and inspect for any explosive contamination and foreign material.	3. (S) Hook non-sparking will be made of brass or copper.
4.	In the event any ammunition or ammunition components are found, immediately notify the foreman in charge who will determine a safe method of handling in accordance with existing regulations for the specific item.	4. (S) Ammunition and/or ammunition components will be transferred to BHEI and destroyed by detonation in accordance with Section 27 of AR 385-224 for the specific item.
5.	In the inspection, any accumulation of dust found, bulk of the dust will be removed, sprinkle a sufficient amount of water on floor to prevent the circulation of dust. Sweep floor and remove sweepings by use of a dust pan or shovel non-sparking	5. (S) Sweepings will be placed in a container with a sufficient amount of water to completely submerge the sweepings, transferred to BHEI and destroyed by burning.
6.	Apply Webster reagent indicator to any location in the interior of the magazine where there is any suspicion of explosive contamination. To identify contamination when using Webster reagent, the reagent turns from light orange to a bright red when applied to surface which is contaminated.	6. (O) Webster reagent indicator only reacts with TNT, or a mixture of TNT with other explosives such as ammatol, ammatol, comp B and B <sup>2</sup> , peroxide, tetryol, etc. Black powder, Black powder and explosive "D" will not show evidence of contamination when reagent is applied.
7.	The presence of explosive contamination which cannot be detected	7. (S) Surveillance Inspector or qualified personnel will make

- |  |  |
|--|--|
| 1. Unlock igloo and open door, remove all surveillance inspection cards, placards, etc., place them into a trash container.  | 1. (O) Transfer to B&H via stake truck as required for burning.  |
| 2. Inspect all ventilators, screens, doors, gutters, floors, walls, etc., in the interior of the magazine for any foreign material, such as ammunition components, etc., and accumulation of explosive dust.   | 2. (S) Only safety approved flash lamps and hand lamps will be used.   |
| 3. With the aid of a non-sparking hook, remove the plates from the drains on each side of igloo and inspect for any explosive contamination and foreign material.  | 3. (S) Hook non-sparking will be made of brass or copper.  |
| 4. In the event any ammunition or ammunition components are found, immediately notify the foreman in charge who will determine a safe method of handling in accordance with existing regulations for the specific item.  | 4. (S) Ammunition and/or ammunition components will be transferred to B&H and destroyed by detonation in accordance with Section 27 of ASMR 363-224 for the specific item.   |
| 5. In the inspection, any accumulation of dust found, bulk of the dust will be removed, sprinkle a sufficient amount of water on floor to prevent the circulation of dust. Sweep floor and remove sweepings by use of a dust pan or shovel non-sparking.   | 5. (S) Sweepings will be placed in a container with a sufficient amount of water to completely submerge the sweepings, transferred to B&H and destroyed by burning.  |
| 6. Apply Webster reagent indicator to any location in the interior of the magazine where there is any suspicion of explosive contamination. To identify contamination when using Webster reagent, the reagent turns from light orange to a bright red when applied to surface which is contaminated. | 6. (O) Webster reagent indicator only reacts with TNT, or a mixture of TNT with other explosives such as amatol, ammonal, comp B and B <sup>2</sup> , pentolite, tetryol, etc. Smokeless powder, Black powder and explosive "D" will not show evidence of contamination when reagent is applied. |
| 7. The presence of explosive contamination which cannot be detected by use of the reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.   | 7. (S) Surveillance Inspector or qualified personnel will make visual inspection.  |
| 8. In the event reagent or inspection does not indicate contamination, the entire magazine will be washed down with water and magazine swept out. Magazine will be considered decontaminated.  | 8. (S) Magazine will be closed and marked in accordance with step No. 11 and No. 14 of this S.O.P.   |

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STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
9.	<p>In the event reagent or the visual inspection indicates contamination, the following material will be used for swabbing.</p> <p>A. Use water in magazine contaminated with black powder.</p> <p>B. Use steam and hot water in magazine contaminated with explosive D, TNT, and mixtures of TNT with other explosives such as Amatol, ammonal, comp B and B<sup>2</sup>, pentolite, terrytol, etc.</p> <p>C. Use acetone in magazines contaminated with terrytol.</p> <p>D. Use a 20% solution of hot sodium sulphite for cleaning floor cracks and rinse copiously with water.</p>	<p>9.</p> <p>B. (S) Steam Jenny used for steam and hot water will be positioned outside magazine 25 feet from door of igloo.</p> <p>(S) Operators using steam will be required to wear flameproof coveralls, goggles, rubber gloves, rubber boots, or overshoes.</p> <p>C. (S) When using acetone in magazine, adequate ventilation will be provided to prevent high concentration of vapors. (See Safety Requirements, Section II, para.5)</p>
10.	<p>After magazine has been swabbed, the entire magazine will be rinsed with clear water and swept out. Magazine will be considered decontaminated.</p>	
11.	<p>Close and secure magazine, by the use of registered car seal.</p>	
12.	<p>Police and visually inspect grounds within a fifty (50) foot radius of magazine and manually test at various locations to detect any explosive contamination.</p>	<p>12. (I) Webster's reagent indicator will be used to test for contamination.</p>
13.	<p>If test shows that the ground is contaminated, the contaminated area will be burned in the following manner:</p> <p>A. Place adequate scrap material over area to ensure a hot and complete burn.</p> <p>B. Prior to ignition of the burn, a radius of 1200 ft. will be cleared of all personnel. Road blocks will be set up on all roads leading to area.</p> <p>C. Burn will be ignited by aid of safety and fuze lighter. Burn will be burned in the direction from which the wind is blowing.</p> <p>D. When burn is set up and safety fuze is in position, foreman in charge will be assured that all personnel are out of the danger area. When he is assured area is clear, he will ignite the burn by pulling pin or twisting pin and retire to a safe location from burn, 1,200 feet.</p>	<p>13.</p> <p>A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated areas.</p> <p>C. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.</p> <p>D. (S) Depot Fire Department will be on standby during burning operations.</p>

azine contaminated with explosive D. TNT, and mixtures of TNT with other explosives such as ammol, ammonal, comp B and B<sup>2</sup>, pentolite, tetryl, etc.

C. Use acetone in magazines contaminated with tetryl.

D. Use a 20% solution of hot sodium sulphite for cleaning floor cracks and rinse copiously with water.

10. After magazine has been swabbed, the entire magazine will be rinsed with clear water and swept out. Magazine will be considered decontaminated.

11. Close and secure magazine, by the use of registered car seal.

12. Police and visually inspect grounds within a fifty (50) foot radius of magazine and manually test at various locations to detect any explosive contamination.

13. If test shows that the ground is contaminated, the contaminated area will be burned in the following manner:

A. Place adequate scrap material over area to ensure a hot and complete burn.

B. Prior to ignition of the burn, a radius of 1200 ft. will be cleared of all personnel. Road blocks will be set up on all roads leading to area.

C. Burn will be ignited by aid of safety and fuze lighter. Burn will be burned in the direction from which the wind is blowing.

D. When burn is set up and safety fuze is in position, foreman in charge will be assured that all personnel are out of the danger area. When he is assured area is clear, he will ignite the burn by pulling pin or twisting pin and retire to a safe location from burn, 1,200 feet.

14. After burn is completed and area has cooled, crew will return to magazine and paint required "X's" on the door of magazine to indicate the degree of contamination.

15. Release the magazine and area without any restrictions.

and hot water will be positioned outside magazine 25 feet from door of igloo.

(S) Operators using steam will be required to wear flameproof coveralls, goggles, rubber gloves, rubber boots, or overshoes.

C. (S) When using acetone in magazine, adequate ventilation will be provided to prevent high concentration of vapors. (See Safety Requirements, Section II, para.5)

12. (I) Webster's reagent indicator will be used to test for contamination.

13.

A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated areas.

C. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.

D. (S) Depot Fire Department will be on standby during burning operations.

14. (I) A log will be maintained and shall include location of magazine, degree of decontamination, method of decontamination, date and car seal number.

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1 REQUIREMENTS GENERAL: See Section II

SECTION OF COMPONENTS AND PACKING MATERIAL:

ammunition and/or ammunition components to Burning Ground #2.  
crap material to Burning Ground #2 such as picarats, etc.  
weepings to Burning Ground #2.

MENT, TOOLS, GAGES, SUPPLIES:

, rubber boots, gloves, squeegees  
closing containers, safety containers for acetone  
a Jerry, trucks - dump or stake  
as, dust pans, shovel (non-sparking)  
2-proof coveralls, goggles  
ty fuse, fuse lighters, fuel oil #2  
lights, hooks (non-sparking) respirators  
trucks (fire), Webster reagent indicator  
s, paint-yellow, paint brush  
p lumber  
y can w/yellow paint and stencils

AS REQUIRED



SECTION III - OPERATION II

DECONTAMINATION OF OPERATING BUILDINGS AND GROUNDS AROUND BUILDINGS

SOP: SSMBH 5-66

DATE: 13 July 1966

STANDING OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

OPERATION NO: II  
SOP NO: SSMBH 5-66 DATE: 13 Jul 66

OPERATION: DECONTAMINATION OF OPERATING BUILDINGS AND GROUNDS AROUND BUILDINGS

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	Coordinate all work requiring the service of the Depot Facilities Division by submission of proper work orders.	
2.	All main incoming electrical power will be switched off and switches will be locked in the off position.	
3.	Completely cover all exposed outlets inside and outside to protect against water seepage.	3. (S) Water-proof tape will be used.
4.	Remove and turn in all equipment and/or other extraneous material not listed as part of building, in accordance with supply regulations.	4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.
5.	Apply Webster reagent indicator to any location in the interior of the building where there is any suspicion of explosive contamination. To identify contamination when using reagent, the reagent turns from a light orange to a bright red when applied to a surface that is contaminated.	5. (S) Webster reagent indicator reacts only with TNT, or a mixture of TNT and other explosives, such as amatol, ammonal, Comp B and E <sup>2</sup> , pentolite, etc. Smokeless powder, black powder and explosive "D" will not show evidence of contamination when reagent is applied.
6.	The presence of explosive contamination which cannot be detected by the use of reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.	6. (S) Surveillance inspectors or qualified personnel will make the visual inspections.
7.	In the event reagent or the visual inspection does not indicate contamination the building will be washed down with water and mopped, cleaned building will be considered decontaminated.	7. (O) Building will be closed and marked in accordance with steps of this S.O.P. (Steps #13 & #14).
8.	In the event reagent or visual inspection indicates contamination, the following materials will be used for scrubbing. A. Use water in buildings contaminated with black powder. B. Use steam and hot water in build-	8. (S) Scrubbing material will be such as rags, mops, brooms, appropriate fiber brushes.

1. Coordinate all work requiring the service of the Depot Facilities Division by submission of proper work orders.
  2. All main incoming electrical power will be switched off and switches will be locked in the off position.
  3. Completely cover all exposed outlets inside and outside to protect against water seepage.
  4. Remove and turn in all equipment and/or other extraneous material not listed as part of building, in accordance with supply regulations.
  5. Apply Webster reagent indicator to any location in the interior of the building where there is any suspicion of explosive contamination. To identify contamination when using reagent, the reagent turns from a light orange to a bright red when applied to a surface that is contaminated.
  6. The presence of explosive contamination which cannot be detected by the use of reagent will be made by a visual inspection by personnel who can identify and are familiar with all types of explosives.
  7. In the event reagent or the visual inspection does not indicate contamination the building will be washed down with water and mopped, cleaned building will be considered decontaminated.
  8. In the event reagent or visual inspection indicates contamination, the following materials will be used for swabbing.
    - A. Use water in buildings contaminated with black powder.
    - B. Use steam and hot water in building contaminated with explosive D, TNT, and mixtures of TNT with other explosives.
    - C. Use acetone in buildings contaminated with tetrytol.
    - D. Use a 20% solution of hot sodium ascorbate for cleaning floor cracks and rinse copiously with water.
3. (S) Water-proof tape will be used.
  4. (S) Equipment will be decontaminated to a 3X (XXX) degree for inter-depot transfer.
  5. (S) Webster reagent indicator reacts only with T&T, or a mixture of TNT and other explosives, such as amatol, ammonal, Comp B and E<sup>2</sup>, pentolite, etc. Smokeless powder, black powder and explosive "D" will not show evidence of contamination when reagent is applied.
  6. (S) Surveillance inspectors or qualified personnel will make the visual inspections.
  7. (O) Building will be closed and marked in accordance with steps of this S.O.P. (Steps #13 & #14).
  8. (S) Swabbing material will be such as rags, mops, brooms, appropriate fiber brushes.
    - B. (S) Steam Jenny used for steam and hot water will be positioned outside 25 feet from building.
    - C. (S) See Safety Requirements Section 12, (para. 5).

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STEP NO	DESCRIPTION	(SAFETY, OPERATIONAL, INSPECTION) SPECIFIC INSTRUCTIONS
9.	After building has been swabbed down, the entire building will be washed with clean water and mopped out. Building will be considered decontaminated.	
10.	Close and secure building by the use of registered car seals.	
11.	Police and visually inspect grounds within a fifty (50) foot radius of building and manually test ground at various locations to detect any explosive decontamination:	11. (I) Webster reagent indicator will be used to test for contamination.
12.	<p>If the test shows that the ground is contaminated, the contaminated area will be burned off in the following manner.</p> <p>A. Position adequate scrap material over area to ensure a hot and complete burn.</p> <p>B. Burn will be ignited by the aid of safety fuze and fuze lighter. The burn will be burned in the direction from which wind is blowing.</p> <p>C. Prior to ignition of the burn, the area, for a radius of 1200 feet will be cleared of all personnel. Road blocks will be set up on all roads leading to area.</p> <p>D. When foreman is assured that all personnel are outside of the danger area, he will ignite the burn by pulling or twisting the pin of the fuze lighter. Foreman will return to a safe location from burn 1200 feet.</p>	<p>A. (S) Trucks transferring scrap material will not be permitted to drive over contaminated area.</p> <p>B. (S) Safety fuze will be tested for burning rate prior to using and when a new coil is used. Under no circumstance will the fuze length be under three feet, having a minimum burning time of 120 seconds.</p> <p>D. (S) Depot Fire Department will have a tank truck on standby during burning operations.</p>
13.	After burn is completed and area has cooled, crew will return to building and paint required "X's" on building to indicate the degree of decontamination.	13. (I) A log will be maintained and shall include location of building, degree of decontamination, method of decontamination, date and car seal number.
14.	Release the building and area without any restrictions.	

## SECTION III - OPERATION III

## DECONTAMINATION OF VACUUM COLLECTION SYSTEMS AND VACUUMS BUILDINGS

SOP: SSMBH 5-66

DATE: 13 July 1966

- of explosive contamination.
- D. Wet type vacuum collecting system.
1. Drain all water from tank and transfer to Burning Ground #2 for burning.
  2. Clean interior of tank and the piping in the manner prescribed for dry type collectors and piping.
  3. Sludge tanks and pumps forming a part of the wet collecting system will be cleaned of explosive deposits using approved material.
  4. Joints in the equipment that were in contact with explosive, where they were secured by screws, bolts, or other type of fastening, are to be carefully separated after lubricating threads.
  5. Wash or clean all parts with approved material.
  6. After cleaning this equipment will be coated with oil for rust prevention; it will then be reassembled.
  7. Paint the required "X's" on equipment as to degree of decontamination. Transfer to shipping building for inter-depot shipment.
  8. Wash the interior of building in accordance with Section III, Operation II, S.O.P. for the Decontamination of Operating Buildings and Grounds around Buildings.

D.

3. (S) Operators cleaning tank and pumps will wear the required protective equipment for cleaning material being used.

5. (S) See Section II, (Part. #5 and #7).

SAFETY REQUIREMENTS GENERAL: See Safety Requirements Section III.

DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

1. Explosives to Burning Ground #2 for burning.
2. Equipment to shipping building.

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Locks, tape, hand tools, (non-sparking)  
Steam Jersey, (safety type can for acetone)  
Containers for explosive, rags, mops, brooms  
Oil, paint, paint brushes, flame-proof  
Coveralls, rubber gloves, rubber boots or overshoes  
Goggles, trucks - stake, acetone

AS REQUIRED

Page 17 of 29 pages

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY-OPERATIONAL-INSPECTION)
4. C. 2.	<p>Steam will be used for TNT and explosive D.</p> <p>3. Use acetone for the removal of tetrytol.</p> <p>4. The interior of the tank and the connecting pipe outlets from the tank shall be likewise cleaned of explosive contamination.</p> <p>D. <u>Wet type vacuum collecting systems.</u></p> <p>1. Drain all water from tank and transfer to Burning Ground #2 for burning.</p> <p>2. Clean interior of tank and the piping in the manner prescribed for dry type collectors and piping.</p> <p>3. Sludge tanks and pumps forming a part of the wet collecting system will be cleaned of explosive deposits using approved material.</p> <p>4. Joints in the equipment that were in contact with explosive, where they were secured by screws, bolts, or other type of fastening, are to be carefully separated after lubricating threads.</p> <p>5. Wash or clean all parts with approved material.</p> <p>6. After cleaning this equipment will be coated with oil for rust prevention; it will then be reassembled.</p> <p>7. Paint the required "X's" on equipment as to degree of decontamination. Transfer to shipping building for inter-depot shipment.</p> <p>8. Wash the interior of building in accordance with Section III, Operation II, S.O.P. for the Decontamination of Operating Buildings and Grounds around Buildings.</p>	<p>4. C. 2. (S) Operators using steam will be required to wear flame-proof coveralls, goggles, rubber boots, and rubber gloves.</p> <p>3. (S) See Safety Requirements Section II, (Para. 5).</p> <p>D.</p> <p>3. (S) Operators cleaning tanks and pumps will wear the required protective equipment for cleaning material being used.</p> <p>5. (S) See Section II, (Para. #5 and #7).</p>

SAFETY REQUIREMENTS GENERAL: See Safety Requirements Section III.

DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

1. Explosives to Burning Ground #2 for burning.
2. Equipment to shipping building.

EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Locks, tape, hand tools, (non-sparking)  
 Steam Jenny, (safety type can for acetone)  
 Containers for explosive, rags, mops, brooms

AS REQUIRED

SECTION III - OPERATION IV

DECONTAMINATION OF LEACHING BEDS FOR EXPLOSIVES AND ACIDS

SOP: SSMBH 5-66

DATE: 13 July 1986



STANDING OPERATING PROCEDURE FOR  
DECONTAMINATION OF BLACK HILLS  
ARMY DEPOT

OPERATION NO: IV  
SOP: SECT 5-66 DATE: 13 July 1966

OPERATION: Decontamination of Leaching Beds for Explosives and Acids

EXPLOSIVE LIMITS: None

PERSONNEL LIMITS: OPERATORS: Minimum Required for a Safe and Efficient Operation.

STEP NO	DESCRIPTION	SPECIAL INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	<p>The following procedures and recommendations are made as they relate to the decontamination with the most reasonable degree of 3 X (XX) necessary to deactivate and/or dispose of the leaching beds at Black Hills Army Depot with restricted covenants.</p> <p>A. Receive scrap material from storage sites, damage will via van trailer and/or dump trucks.</p> <p>B. Position adequate scrap material over leaching beds contaminated with explosive to ensure a hot and complete burn.</p> <p>C. Obtain required number of safety fuses and fuze lighters from storage. Proceed to burn site. Safety fuze will be tested for burning rate prior to using and when a new coil of fuze is used. Safety fuze will be cut to required length so as to allow personnel time to clear the area.</p> <p>D. Activate fuze lighters by pulling or twisting pin. Make sure lighter starts safety fuze. Retire to the safe distance of 1,200 feet from the burn. Prior to activating safety fuze, foreman in charge will be assured that area around the burn is free of all personnel and equipment.</p> <p>E. Black Hills Fire Department will be on standby at time of burning.</p> <p>F. After fire is out and the bed cooled, tests will be made at different locations to be sure beds are cleaned of contamination.</p> <p>G. If test shows that no contamination is present, bed will be considered decontaminated. With the aid of a bulldozer, close bed with earth.</p>	<p>1.</p> <p>H. (S) Trucks transferring scrap material will not be allowed to drive over contaminated area.</p> <p>C. (S) Under no circumstances will the fuze length be under three feet, having a minimum burning time of 120 seconds.</p> <p>D. (O) A small amount of pyrophorant may be used to ignite the fire.</p> <p>(S) The area around the leaching bed for a radius of 1,200 ft. will be cleared of all personnel, and road blocks will be set up on roads leading into area.</p> <p>F. (O) Webster reagent indicator will be used for testing for contamination.</p>
2.	<p>Decontamination of leaching beds used for acids.</p> <p>A. Receive limestone from supply point via dump trucks.</p> <p>B. Position limestone over leaching</p>	

1. The following procedures and recommendations are made as they relate to the decontamination with the most reasonable degree of 3 X (XX) necessary to deactivate and/or dispose of the leaching beds at Black Hills Army Depot with restricted coverments.
  - A. Receive scrap material from storage sites, damage will via van trailer and/or dump trucks.
  - B. Position adequate scrap material over leaching beds contaminated with explosive to ensure a hot and complete burn.
  - C. Obtain required number of safety fuses and fuse lighters from storage. Proceed to burn site. Safety fuse will be tested for burning rate prior to using and when a new coil of fuse is used. Safety fuse will be cut to required length so as to allow personnel time to clear the area.
  - D. Activate fuse lighters by pulling or twisting pin. Make sure lighter starts safety fuse. Retire to the safe distance of 1,200 feet from the burn. Prior to activating safety fuse, foreman in charge will be assured that area around the burn is free of all personnel and equipment.
  - E. Black Hills Pike Department will be on standby at time of burning.
  - F. After fire is out and the bed cooled, tests will be made at different locations to be sure beds are cleaned of contamination.
  - G. If test shows that no contamination is present, bed will be considered decontaminated. With the aid of a bulldozer, close bed with earth.
2. Decontamination of leaching beds used for acids.
  - a. Receive limestone from supply point via dump trucks.
  - b. Position limestone over contaminated area to a depth approximately 1 inch deep.
  - c. With the aid of a bulldozer, close bed with earth.
3. Recommendations for future work.
  - a. Release area with no restrictions.

B. (S) Trucks transferring scrap material will not be allowed to drive over contaminated area.

C. (S) Under no circumstances will the fuse length be under three feet, having a minimum burning time of 120 seconds.

D. (O) A small amount of pro-fellant may be used to ignite the fire.

(S) The area around the leaching bed for a radius of 1,200 ft. will be cleared of all personnel, and road blocks will be set up on roads leading into area.

F. (O) Webster resurvey indicator will be used for testing for contamination.

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DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

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## EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP

Scrap Material

Safety Fuze

Fuze Lighters

Truck - Dump

Fire tank truck

Road blocks

Bulldozers

Limestone

AS REQUIRED

OPERATION: DECONTAMINATION OF DEMOLITION AND BURNING GROUNDS

EXPLOSIVE LIMITS: NONE

PERSONNEL LIMITS: OPERATORS: MINIMUM REQUIRED FOR A SAFE AND EFFICIENT OPERATION

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
1.	The following procedures and recommendations are made as they relate to the decontamination, with the most reasonable degree of 3X (XXX) necessary to deactivate and/or dispose of the demolition and/or burning ground area facility of Black Hills Army Depot, with restricted covenants.	
2.	<p><u>Demolition Grounds and Area.</u></p> <p>A. Police the area within a radius of 2,400 feet of demolition site</p> <p>B. Surface clean all exposed and passable areas of all ammunition items or scrap in the following manner.</p> <p>C. 1. Unexploded lumps of explosives and unfuzed ammunition may be picked up and prepared for the next shot. Position unexploded lumps of explosive or unfuzed items of ammunition in groups not to exceed 500 lbs. of explosive.</p> <p>2. When all groups are set up, and prior to capping sites, all personnel will retire to the barricade control station.</p> <p>3. One team of two qualified operators will obtain a sufficient amount of electric blasting caps (two (2) per group) from storage and proceed to demolition area.</p> <p>4. Remove shunts from the lead wires of the blasting cap. Test cap for continuity using a galvanometer. When test is completed short the lead wires of the cap. Position the blasting cap into the demolition material on items to be destroyed.</p> <p>5. Check the firing line for stray currents and continuity using a dummy test circuit and radio pilot lamp #47 or equal and a galvanometer. If test checks out satisfactorily, unshort the cap wires and connect them to the</p>	<p>2. Blasting machine shall be kept locked at all times when not in use. Foreman or his assistant will be personally charged with the sole custody of all ignition devices. Keys to fire control panel will be in the hands of foreman and not loaned to anyone.</p> <p>2. When foreman is assured that all personnel are in the control station, sites may be capped. (S)</p> <p>3. (S) Blasting caps must be carried in a closed container. Under no circumstances will caps be carried in operator's pockets.</p> <p>4. (S) When uncoiling the lead wires of the blasting cap, cap will not be held directly in the hand but by the wire, approximately six inches from cap. Lead wires should be straightened out as far as required by hand.</p> <p>5. (S) Test for stray current will be made at point where cap wires are connected to the firing circuit. Connection between the blasting cap and the circuit firing line will not be made unless the power end of the firing wire is shorted and</p>

STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
3.	<p>B. Move dial handle to the number of the firing site that is being used. Insert Mallory Plug No. 55 into Mallory Jacks, and test circuit for continuity using a galvanometer. A reading of 10-25 ohms indicates a satisfactory circuit.</p> <p>C. Connect the wires from the Mallory Plug to the blasting machine and fire shot by twisting or plugging handle, depending on type of blasting machine used.</p> <p>D. Disconnect the lead wires from the blasting machine. Repeat steps 3. A, B, and C before firing subsequent shots.</p>	<p>3. B. (S) If circuit continuity is not obtained, a search will be made after all other shots have been fired for a break in the firing line, repairs made and demolition completed.</p> <p>C. (S) If firing wires are energized and shot fails to fire (misfire), 30 min. or more before investigating cause of misfire. Investigation is to be made by no more than two people, i.e., foreman and his assistant or ammunition inspector. All other personnel will remain in shelter until cause of misfire is determined, repairs made, and demolition completed.</p>
4.	<p>A. Fuzed ammunition or items which may have internally damaged components will be treated as duds and destroyed in the following manner.</p> <p>B. When duds are found in the search, they will be marked with a rod placed in the earth by the side of the item, and marked with a red or yellow tag. A number tag also will be used.</p> <p>C. Duds will be destroyed in place by placing a charge next to but not in contact with the dud.</p> <p>D. Prepare the shot in accordance with Step #2, C-3, 4, 5, and 6.</p> <p>E. Shoot the shot in accordance with Step #3, A, B, C and D.</p>	<p>4. B. (S) Tags will be used to keep track of all duds and that the ones found will not be missed when preparing shot.</p> <p>C. (S) Duds will be handled carefully at all times.</p> <p>D. Same as Step II.</p> <p>E. Same as Step III.</p>
5.	<p>After demolition ground is cleared of all explosive items and scrap with the aid of a best cover demolition pit will be closed.</p>	
6.	<p>Fence the area with a five strand barb wire fence and post area as to surface cleaned and release for normal use.</p>	
7.	<p><u>Demolition of Burning Bombs at Black Hills Army Depot</u></p> <p>A. Fence the area within a radius of 2,400 feet of sites where burning operations actually took place.</p> <p>B. Surface clean all exposed and passable areas of all ammunition items or scrap in the following manner.</p> <p>C. 1. Unburned lumps of explosives and unfuzed ammunition may be picked up and prepared for the next burn.</p> <p>2. Position adequate scrap material over sites where burning operation actually took place to ensure a hot and complete burn of</p>	<p>7. B. (S) Duds found will be marked with a rod placed in the earth by the side of the item and marked with a red or yellow tag. Numbered tags will also be used.</p> <p>C. 2. (S) Trucks hauling scrap or combustible material will not be allowed to drive over contaminated area.</p>

disconnecting circuit.

C. Connect the wires from the Mal-lory Plug to the blasting machine and fire shot by twisting or placing on handle, depending on type of blasting machine used.

D. Disconnect the lead wires from the blasting machine. Repeat steps 3, A, B, and C before firing subsequent shots.

4. A. Fuzed ammunition or items which may have internally damaged components will be treated as duds and destroyed in the following manner.

B. When duds are found in the search, they will be marked with a rod placed in the earth by the side of the item and marked with a red or yellow tag.

A number tag also will be used.

C. Duds will be destroyed in place by planting a charge next to but not in contact with the dud.

D. Prepare the shot in accordance with Step #1, C-3.4.2, and 5.

E. Shoot the shot in accordance with Step #3, A, B, C and D.

5. After demolition ground is cleared of all explosive items and scrap with the aid of a bull dozer demolition pits will be closed.

6. Fence the area with a five strand barbed wire fence and post area as to surface cleared and release for traffic.

7. Decontamination of Burning Grounds at Black Hills Army Depot

A. Fence the area within a radius of 2,400 feet of sites where burning operations actually took place.

B. Surface clean all exposed and passible areas of all ammunition items or scrap in the following manner.

C. 1. Unburned lamps of explosives and unfuzed ammunition may be picked up and prepared for the next burn.

2. Position adequate scrap material over sites where burning operation actually took place to ensure a hot and complete burn of area.

3. Burns will be ignited with the aid of a safety fuse and fuse lighters.

4. Receive safety fuse and fuse lighters from storage and proceed to the burn area. Prepare safety fuse in the following manner.

C. (S) If firing fires are extinguished and his fails to fire (no fire) 30 min. after the cause of mis-fire investigation is to be made by no more than two people, i.e., foreman and his assistant or ammunition inspector. All other personnel will remain in shelter until cause of mis-fire is determined, repairs made, and demolition completed.

4. B. (S) Tags will be used to keep track of all duds and that the ones found will not be missed when preparing shots.

C. (S) Duds will be handled carefully at all times.

D. Same as Step II.

E. Same as Step III.

3. (S) Duds found will be marked with a rod placed in the earth by the side of the item and marked with a red or yellow tag. Numbered tags will also be used.

C. 2. (S) Trucks hauling scrap or combustible material will not be allowed to drive over contaminated area.

4. (S) Safety fuse will be tested for burning rate prior to burn and when a new coil is used.

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STEP NO	DESCRIPTION	SPECIFIC INSTRUCTIONS (SAFETY, OPERATIONAL, INSPECTION)
7. C.	5. Cut safety fuze to required length and secure fuze lighter to one end of fuze. Position end of safety fuze into wire or combustible material. A small amount of proellant may be used to insure a complete start of combustible material. 6. Burn will be burned in the direction from which the wind is blowing. 7. When foreman is assured that all personnel are out of the danger area, 2,000 feet from burn, he will activate the fuze lighter by twisting or pulling pin and retire to a safe distance from burn area, 2,400 feet.	7. C. 5 (1) Under no circumstances will the fuze length be under three (3) feet, having a minimum burning time of 120 seconds. (S) Fuze length will be adequate to enable foreman to walk to a safe distance.
8.	Duds found will be handled in the same manner as in Step 4, A,B,C and D.	7. (S) Depot fire department will be on standby during burning. 8. (1) Same as Step 4, A,B,C and D.

#### SAFETY REQUIREMENTS GENERAL:

1. Demolition area will have telephone communication available.
2. Chief, Maintenance Branch will be contacted before steps are detonated. He will decide if weather conditions are favorable for detonation.
3. AMCR 385 274, Section 17 will be complied with in its entirety.

#### DISPOSITION OF COMPONENTS AND PACKING MATERIAL:

Duds, undetonated ammunition, ammunition scrap destroyed.

#### EQUIPMENT, TOOLS, GAGES, SUPPLIES:

SOP  
Rags, red or yellow  
Tags, fire control panel  
Radio pilot lamp, galvanometer  
Blasting caps  
Demolition material  
Firing wire  
Blasting machine  
Bulldozer  
Safety fuze  
Fuze lighters

SECTION III - OPERATION VI

DECONTAMINATION OF WASHOUT PLANT AND AREA AT BLACK HILLS ARMY DEPOT

SOP: SSMBE 5-66

DATE: 13 July 1966



OPERATION: DECONTAMINATION OF VARIOUS PLANT AND AREA AT BLACK HILLS ARMY DEPOT

EXECUTIVE SUMMARY: NONE

PERSONNEL COMMENTS: MEMBERS REQUIRED FOR A SAFE AND EFFICIENT OPERATION.

SOP

NO

DESCRIPTION

SPECIFIC INSTRUCTIONS

(SAFETY, OPERATIONAL, ENVIRONMENTAL)

1. The following procedure and recommendations are made as they relate to the decontamination with the most reasonable degree of IX necessary to decontaminate and/or dispose of the wash-out plant and area at Black Hills Army Depot with restricted equipment.
2. Coordinate all work regarding the services of the Depot Facilities Division by submission of proper work orders.
3. Main incoming electrical power will be switched off and all incoming electrical power lines leading into plant will be removed for a distance of at least 100 feet from buildings.
  - A. Remove all equipment and/or extra-large material that is not listed as part of building and turn in, in accordance with supply regulations.
4. Receive scrap combustible material from dumpage mill and/or storage locations. Specific designated material in and around buildings 3043 and 3045 to ensure a hot and complete burn.
  - A. Receive safety fuse and fuse lighters from storage and proceed to the burn area. Prepare the safety fuse in the following manner.
    - B. Cut the required length of safety fuse from coil of fuse and secure fuse in place to one end of safety fuse. Position other end of safety fuse into propellant or combustible material.
    - C. Burn will be burned in the direction from which the wind is blowing.
    - D. When burn is secured that all personnel are out of the danger area (100 feet from building), distance will activate the fuse lighter by striking or pulling pin and moving to a safe distance from burn - 2000 ft.
5. When fire is out and the burn is cooled, area will be tested for contamination. If no contamination is present,

4. (3) Smoke transferring scrap material will not be allowed to drive over contaminated area.
  - A. (3) Safety fuse will be tested for burning rate prior to burn and when a new coil is used.
  - B. (3) Under no circumstances will the fuse length be shorter than (1) feet having a minimum burning time of 120 seconds. (3) Fuse length will be as short as possible and will be a safe distance - not fail.
  - D. (4) Depot Fire Department will be on standby during burning operations.

1. The following precautions and standards are used as they relate to the contamination with the most reasonable degree of SX necessary to facilitate and/or dispose of the clean-out plant and area at Black Hills Army Depot with restricted personnel.
2. Coordinate all work requiring the services of the Depot Facilities Division by submission of proper work orders.
3. Main incoming electrical power will be switched off and all incoming electrical power lines leading into plant will be removed for a distance of at least 300 feet from buildings.
  - A. Remove all equipment and/or extraneous material that is not listed as part of building and turn in, in accordance with supply regulations.
4. Receive scrap combustible material from dumpage with proper storage location. Position adequate material in and around buildings, etc. and back to ensure a hot and complete burn.
  - A. Remove safety fuse and fuse lighters from storage and proceed to the burn area. Prepare the safety fuse in the following manner:
    - i. Cut the required length of safety fuse from coil of fuse and secure fuse lighter to one end of safety fuse. Position other end of safety fuse into propellant or combustible material.
    - C. Fuse will be burned in the direction from which the wind is blowing.
    - D. When burning is assured that all personnel are out of the danger area (200 feet from building), foreman will activate the fuse lighter by striking or pulling pin and retreat to a safe distance from burn - 300 ft.
5. When fire is out and the burn is cooled, area will be tested for contamination. If no contamination is present, area will be released for surface use only. If test shows contamination, area will be reburied.

(3) Trucks transferring scrap material will not be allowed to drive over contaminated area.

A. (3) Safety fuse will be tested for burning rate prior to burn and when a new coil is used.

B. (3) After no circumstances will the fuse length be other than 10 feet maximum; a minimum burn time of 120 seconds. (4) Fuse length will be so that burning can occur in safe distance - see table.

C. (3) Depot Fire Department will be on standby during burning operations.

DISPOSITION OF CONTAMINATED AND BURNING MATERIAL:  
Burn Area.

EQUIPMENT, TOOLS, GEAR, SUPPLIES:  
SOP

Scrap or combustible material, safety fuse, fuse lighters, Propellant, Trucks (dump or stack), trucks, tanks

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SECTION LXXI - OPERATIONS VII

DECOMMISSIONING OF CRITICAL PLANT AND FUEL AREA

SOP: SERIES 5-66

DATE: 13 July 1966



On the same date, approximately 1964, the  
 following, who were in the presence of the  
 the following persons, who were in the presence of the

10. 11. 12. 13. 14. 15. 16. 17. 18. 19. 20. 21. 22. 23. 24. 25. 26. 27. 28. 29. 30. 31. 32. 33. 34. 35. 36. 37. 38. 39. 40. 41. 42. 43. 44. 45. 46. 47. 48. 49. 50. 51. 52. 53. 54. 55. 56. 57. 58. 59. 60. 61. 62. 63. 64. 65. 66. 67. 68. 69. 70. 71. 72. 73. 74. 75. 76. 77. 78. 79. 80. 81. 82. 83. 84. 85. 86. 87. 88. 89. 90. 91. 92. 93. 94. 95. 96. 97. 98. 99. 100. 101. 102. 103. 104. 105. 106. 107. 108. 109. 110. 111. 112. 113. 114. 115. 116. 117. 118. 119. 120. 121. 122. 123. 124. 125. 126. 127. 128. 129. 130. 131. 132. 133. 134. 135. 136. 137. 138. 139. 140. 141. 142. 143. 144. 145. 146. 147. 148. 149. 150. 151. 152. 153. 154. 155. 156. 157. 158. 159. 160. 161. 162. 163. 164. 165. 166. 167. 168. 169. 170. 171. 172. 173. 174. 175. 176. 177. 178. 179. 180. 181. 182. 183. 184. 185. 186. 187. 188. 189. 190. 191. 192. 193. 194. 195. 196. 197. 198. 199. 200. 201. 202. 203. 204. 205. 206. 207. 208. 209. 210. 211. 212. 213. 214. 215. 216. 217. 218. 219. 220. 221. 222. 223. 224. 225. 226. 227. 228. 229. 230. 231. 232. 233. 234. 235. 236. 237. 238. 239. 240. 241. 242. 243. 244. 245. 246. 247. 248. 249. 250. 251. 252. 253. 254. 255. 256. 257. 258. 259. 260. 261. 262. 263. 264. 265. 266. 267. 268. 269. 270. 271. 272. 273. 274. 275. 276. 277. 278. 279. 280. 281. 282. 283. 284. 285. 286. 287. 288. 289. 290. 291. 292. 293. 294. 295. 296. 297. 298. 299. 300. 301. 302. 303. 304. 305. 306. 307. 308. 309. 310. 311. 312. 313. 314. 315. 316. 317. 318. 319. 320. 321. 322. 323. 324. 325. 326. 327. 328. 329. 330. 331. 332. 333. 334. 335. 336. 337. 338. 339. 340. 341. 342. 343. 344. 345. 346. 347. 348. 349. 350. 351. 352. 353. 354. 355. 356. 357. 358. 359. 360. 361. 362. 363. 364. 365. 366. 367. 368. 369. 370. 371. 372. 373. 374. 375. 376. 377. 378. 379. 380. 381. 382. 383. 384. 385. 386. 387. 388. 389. 390. 391. 392. 393. 394. 395. 396. 397. 398. 399. 400. 401. 402. 403. 404. 405. 406. 407. 408. 409. 410. 411. 412. 413. 414. 415. 416. 417. 418. 419. 420. 421. 422. 423. 424. 425. 426. 427. 428. 429. 430. 431. 432. 433. 434. 435. 436. 437. 438. 439. 440. 441. 442. 443. 444. 445. 446. 447. 448. 449. 450. 451. 452. 453. 454. 455. 456. 457. 458. 459. 460. 461. 462. 463. 464. 465. 466. 467. 468. 469. 470. 471. 472. 473. 474. 475. 476. 477. 478. 479. 480. 481. 482. 483. 484. 485. 486. 487. 488. 489. 490. 491. 492. 493. 494. 495. 496. 497. 498. 499. 500. 501. 502. 503. 504. 505. 506. 507. 508. 509. 510. 511. 512. 513. 514. 515. 516. 517. 518. 519. 520. 521. 522. 523. 524. 525. 526. 527. 528. 529. 530. 531. 532. 533. 534. 535. 536. 537. 538. 539. 540. 541. 542. 543. 544. 545. 546. 547. 548. 549. 550. 551. 552. 553. 554. 555. 556. 557. 558. 559. 560. 561. 562. 563. 564. 565. 566. 567. 568. 569. 570. 571. 572. 573. 574. 575. 576. 577. 578. 579. 580. 581. 582. 583. 584. 585. 586. 587. 588. 589. 590. 591. 592. 593. 594. 595. 596. 597. 598. 599. 600. 601. 602. 603. 604. 605. 606. 607. 608. 609. 610. 611. 612. 613. 614. 615. 616. 617. 618. 619. 620. 621. 622. 623. 624. 625. 626. 627. 628. 629. 630. 631. 632. 633. 634. 635. 636. 637. 638. 639. 640. 641. 642. 643. 644. 645. 646. 647. 648. 649. 650. 651. 652. 653. 654. 655. 656. 657. 658. 659. 660. 661. 662. 663. 664. 665. 666. 667. 668. 669. 670. 671. 672. 673. 674. 675. 676. 677. 678. 679. 680. 681. 682. 683. 684. 685. 686. 687. 688. 689. 690. 691. 692. 693. 694. 695. 696. 697. 698. 699. 700. 701. 702. 703. 704. 705. 706. 707. 708. 709. 710. 711. 712. 713. 714. 715. 716. 717. 718. 719. 720. 721. 722. 723. 724. 725. 726. 727. 728. 729. 730. 731. 732. 733. 734. 735. 736. 737. 738. 739. 740. 741. 742. 743. 744. 745. 746. 747. 748. 749. 750. 751. 752. 753. 754. 755. 756. 757. 758. 759. 760. 761. 762. 763. 764. 765. 766. 767. 768. 769. 770. 771. 772. 773. 774. 775. 776. 777. 778. 779. 780. 781. 782. 783. 784. 785. 786. 787. 788. 789. 790. 791. 792. 793. 794. 795. 796. 797. 798. 799. 800. 801. 802. 803. 804. 805. 806. 807. 808. 809. 810. 811. 812. 813. 814. 815. 816. 817. 818. 819. 820. 821. 822. 823. 824. 825. 826. 827. 828. 829. 830. 831. 832. 833. 834. 835. 836. 837. 838. 839. 840. 841. 842. 843. 844. 845. 8

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**APPENDIX I**  
**STATEMENT OF CLEARANCE**