Permit

STATE OF NEW MEXICO
BEFORE THE SECRETARY OF ENVIRONMENT

IN THE MATTER OF:

ENTERED

APPLICATION OF THE UNITED STATES	)	
DEPARTMENT OF ENERGY AND	)	
LOS ALAMOS NATIONAL SECURITY, LLC	)	**No. HWB 09-37(P)**
FOR A HAZARDOUS WASTE FACILITY	)	**HWB 10-04(P)**
PERMIT FOR LOS ALAMOS NATIONAL	)	
LABORATORY	)	

TESTIMONY OF LUCIANA VIGIL-HOLTERMAN

QUALIFICATIONS

My name is Luciana Vigil-Holterman and I have worked on the Los Alamos National Laboratory (LANL) Hazardous Waste Permit for approximately eight years. I have been involved in environmental compliance in some form since 1997. For additional information on my job tasks, please see the attached resume.

INTRODUCTION

Since 1980, Los Alamos National Security (LANS), LLC and the Department of Energy (DOE), collectively known as the Applicants, have been seeking to permit two open burning treatment units at the Los Alamos National Laboratory (LANL). These two units, classified as hazardous waste management units, which are currently operating under interim status, were included in the August, 2007 and July, 2009 drafts of the LANL Hazardous Waste Facility Permit. The units are:

- Technical Area (TA) 16, Structure 388 (Flash Pad); and
- TA-16, Structure 399 (Burn Tray).

On February 2, 2010, the New Mexico Environment Department (NMED) issued a notice that it intends to deny the application for the open burn units. The accompanying Fact Sheet identified the following as the basis for denying the permit application:

- the need to fully characterize the low to moderate risk associated with the ecological risk assessment conducted by the Applicants,
- public opposition to open burning, and
- the need to evaluate alternatives to open burning.

The goal of my testimony is to establish that operations at the open burning (OB) treatment units at LANL have been, are currently and will be in accordance with Resource Conservation and Recovery Act (RCRA) regulations, are protective of human health and the environment, and that these units should be included in the final LANL Hazardous Waste Facility Permit. Exhibit 1 to my testimony, attached hereto, sets forth the permit provisions that the Applicants are proposing for inclusion in the final Permit.

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REQUEST FOR SECTIONS TO BE INCLUDED WITHIN PERMIT

The following is a summary of the permit provisions that the Applicants are requesting to be included in the final Permit. The Applicants request that the following sections, with the modifications indicated, from the July 6, 2009 Revised Draft Permit be included in the LANL Hazardous Waste Facility Permit. These are discussed below and were included with the September 3, 2009 LANL comments on the Revised Draft LANL Hazardous Waste Facility Permit. Excerpts from the September 3, 2009 comments have been included with my testimony as Exhibit 2. The modifications to the July 6, 2009 language add compliance assurance and consistency with all environment, safety and health requirements at the open burning treatment units. In addition, on line 18, page 81 of the July 6, 2009 draft permit, the waste volume would be changed from 12,500 pounds to 6,000 pounds. Sections with the changes requested have been included at Exhibit 1.

Section 2.4.6. Thermal Treatment

Inclusion of this section within the Permit is requested with no additional changes.

Part 6: Treatment by Open Burning

The Applicants request the inclusion of this Part within the Permit with the requested changes as outlined in the September 3, 2009 LANL comment numbers 21, 22, 23, 24, 25, 26, 27, and 28. Additional justification to suggested language change for comment number 23, Section 6.2(9) can be found in information below on the section titled *Air Model Screening*. Also, more information on the soil sampling methodology referenced in comment number 27 can be found in closure plan comments below (Section 6.1 of each of the plans). The comments are summarized from the comments to the Revised Draft Permit in Exhibit 2 and displayed in Exhibit 1.

Additional comments for Part 6 based on this testimony include:

<u>Section 6.1.2 Maximum Quantity of Waste to be Treated</u>

Change "12,500' to "6,000" for the pounds of waste per year that can be treated at both OB treatment units combined.

<u>Section 6.1.3 Specific Requirements for the TA-16-388 Flash Pad, Bullet (5) :</u>

Remove the requirement for a minimum temperature of 400 degrees Celsius (^{0}C) during open burning at TA-16-388. Current documentation as discussed in the section titled *Air Model Screening* within this document verifies that the propane burners operate well above this temperature.

Section 9.4.7.1.ii.b. Outdoor Treatment Units

Inclusion of this section within the Permit is requested with no additional changes.

Attachment A. Technical Area (TA) – Unit Descriptions

Inclusion of Section A.2 within the Permit is requested with the additional requested changes as outlined in the September 3, 2009 LANL comment numbers 174, 175, 176, & 177. The comments are summarized in Exhibit 2 and displayed in Exhibit 1.

Attachment C. Waste Analysis Plan

The Applicants request the inclusion of this Part within the Permit with the requested changes as outlined in the September 3, 2009 LANL comment numbers 65, 232, 233, and 234. The comments are summarized in Exhibit 2 and displayed in Exhibit 1.

Attachment D. Contingency Plan

Inclusion of information associated with the open burning treatment units at TA-16 is requested with no additional changes.

Attachment E. Inspection Plan

Inclusion of information associated with the open burning treatment units at TA-16 is requested with no additional changes.

Attachments G.2 and G.3. Closure Plans

The Applicants request that the closure plans for these units, noticed by NMED on February 2, 2010, be modified as indicated in the attached exhibit and be included in the final LANL Hazardous Waste Facility Permit as Attachment G.2 and G.3. Included herein are comments to these closure plans. Changes are displayed within Exhibit 1.

Interim Status Closure Plan Open Burning Treatment Unit Technical Area 16-388 Flash Pad

Section 5.2. Decontamination and Removal of Structures and Equipment

"Recycle" should be changed to "reuse" in the second sentence of the paragraph. The sentence should state, "All surfaces and related equipment that are removed and not intended for reuse, will not require decontamination, will be considered solid and potentially hazardous waste when removed, and will be disposed of in accordance with Section 7.0." Items that are removed from the unit (such as scrap metal) may be sent offsite for recycle as included in Table 2 of the closure plan.

Section 5.2.1. Removal of Structures and Related Equipment.

The phrase "and will not be recycled" should be removed. The metal cover, trays, and propane burners will meet the requirements for metal recycling and will not be radioactive, and will therefore be recycled as scrap metal as indicated in Table 2 of the closure plan.

Section 6.1- Sampling activities and Figures 5 and 6.

The Applicants request that a multi-incremental sampling approach be taken to assess contamination within the area affected by operations at the open burning treatment unit. Six multi-increment samples would be collected from distinct areas surrounding the unit. Each of the samples will be a composite of at least 30 samples collected from zero to two inches on the surface of the soil in accordance with the technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods".

Under bullet "c." of the section, the Applicants request a change of the requirement to collect a soil sample under the asphalt directly in front of the unit. Because the unit is an open burning treatment unit, pathways for exposure include runoff, air dispersion, and particulate deposition from air. There is no subsurface aspect to the treatment unit that would cause concern for migration beneath an asphalt pad in front of the unit. The Applicants recommend that a wipe sample be collected from the surface of the asphalt and analyzed for high explosives (HE) compounds to determine whether contamination from the operations at the unit have occurred.

Table 1. Closure Schedule for the Technical Area 16-388 Open Burn Treatment Unit

The following table, submitted by the Applicants for the closure plan on April 23, 2009, should be included in the final Permit:

Closure Schedule for the Permitted Unit

Activity	Maximum Time Required [a]
Notify the Department of intent to close.	-45 Days
Conduct records review and structural assessment.	-25 Days
Final receipt/treatment of waste.	Day 0
Begin closure activities after removal of waste.	Day 5
Decontaminate surfaces and equipment.	Day 20
Sample excess decontamination materials for disposal.	Day 20
Perform verification sampling.	Day 30
Evaluate analytical data from verification sampling.	Day 50
Perform additional decontamination, if necessary.	Day 55
Perform additional sampling, if necessary.	Day 60
Evaluate additional analytical data.	Day 75
Perform final cleanup and disposal (i.e., removal of decontaminated equipment and decontamination waste).	Day 140
Prepare closure certification report.	Day 150
Certify closure.	Day 175
Submit final report to the Department.	Day 180

[a] The schedule above indicates calendar days from the beginning by which activities will be completed. Some activities may be conducted simultaneously and/or may not require the maximum time listed. Extensions to this schedule may be requested, as needed.

Interim Status Closure Plan Open Burning Treatment Unit Technical Area 16-399 Burn Tray

Section 5.2. Decontamination and Removal of Structures and Equipment

"Recycle" should be changed to "reuse" in the second sentence of the paragraph. The sentence should state, "All surfaces and related equipment that are removed and not intended for reuse, will not require decontamination, will be considered solid and potentially hazardous waste when removed, and will be disposed of in accordance with Section 7.0." Items that are removed from the unit (such as scrap metal) may be sent offsite for recycle as included in Table 2 of the closure plan.

Section 5.2.1. Removal of Structures and Related Equipment.

The phrase "and will not be recycled" should be removed. The metal cover and trays will meet the requirements for metal recycling and will not be radioactive, and will therefore be recycled as scrap metal as indicated in Table 3 of the closure plan.

Section 6.1- Sampling activities and Figures 4 and 5.

The Applicants request that a multi-incremental sampling approach be taken to assess contamination within the area affected by operations at the open burning treatment unit. Five multi-increment samples

would be collected from distinct areas surrounding the unit. Each of the samples will be a composite of at least 30 samples collected from zero to two inches on the surface of the soil in accordance with the technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods".

Table 1. Closure Schedule for the Technical Area 16-399 Outdoor Treatment Unit

The following table, submitted by the Applicants for the closure plan on April 23, 2009, should be included in the final Permit:

Closure Schedule for the Permitted Unit

Activity	Maximum Time Required [a]
Notify the Department of intent to close.	-45 Days
Conduct records review and structural assessment.	-25 Days
Final receipt/treatment of waste.	Day 0
Begin closure activities after removal of waste.	Day 5
Decontaminate surfaces and equipment.	Day 20
Sample excess decontamination materials for disposal.	Day 20
Perform verification sampling.	Day 30
Evaluate analytical data from verification sampling.	Day 50
Perform additional decontamination, if necessary.	Day 55
Perform additional sampling, if necessary.	Day 60
Evaluate additional analytical data.	Day 75
Perform final cleanup and disposal (i.e., removal of decontaminated equipment and decontamination waste).	Day 140
Prepare closure certification report.	Day 150
Certify closure.	Day 175
Submit final report to the Department.	Day 180

[a] The schedule above indicates calendar days from the beginning by which activities will be completed. Some activities may be conducted simultaneously and/or may not require the maximum time listed. Extensions to this schedule may be requested, as needed.

Attachment J. Hazardous Waste Management Units

Inclusion of the open burning treatment units within Table J-1 as active permitted units rather than "Interim Status Unit not authorized to treat hazardous waste and undergoing closure."

Attachment N. Figures

The Applicants request the inclusion of this Part within the Permit with the requested changes as outlined in the September 3, 2009 LANL comment numbers 132, 142, and 143. The comments are summarized in Exhibit 2.

OPEN BURNING TREATMENT UNITS

Open burning is defined as the burning of any material that produces air contaminants that are directly emitted into the air without first passing through a stack or chimney from an enclosed chamber. All

waste streams treated at the OB units originate at LANL. The two OB treatment units at LANL treat high explosive processing waste; discarded and off-specification HE; and to a limited degree, waste contaminated with HE. This waste is treated within a raised steel pan or tray designed to withstand extremely high temperatures, and often with the use of propane as additional fuel. The purpose of treatment is to destroy the explosive component of the waste in a safe and compliant manner.

LANL is prohibited by the Department of Transportation from shipping certain types of high explosive contaminated waste offsite due to the potential for the waste to ignite or react. For example, there are no DOT complaint shipping containers to safely transport HE-contaminated equipment to offsite facilities. Therefore, these materials have to be flashed onsite. Requirements exist in New Mexico statutes and regulations for treatment of these wastes onsite if conducted in accordance with a RCRA hazardous waste facility permit or interim status regulations (Title 40 of the Code of Federal Regulations [CFR], Part 265). The OB treatment units at TA-16 are operated in accordance with these requirements as detailed in the most recent permit application *Los Alamos National Laboratory Technical Area 16 Part B Permit Application, Revision 4.0* (LANL, 2003).

Exhibits 3 and 4 of my testimony show photographs of each of the units. These units do not burn waste directly on the ground, are protected from the elements with a cover when not in use, are cleaned of any ash or residue 24 hours after treatment activities, and often produce no visible plume during open burning activities. Ash/residue is stored, as applicable, in a New Mexico Special Waste accumulation area in accordance with the requirements at Title 20 of the New Mexico Administrative Code (NMAC), Part 8 or a hazardous waste accumulation area in compliance with the requirements at 40 CFR §262.34. All of the residue and ash generated by the OB treatment units is sampled and analyzed for characterization and disposed of at an offsite facility in accordance with appropriate waste management regulations.

Required Permits for Operation

National Pollutant Discharge Elimination System (NPDES) Multi-Sector General Permit (MSGP) regulates stormwater discharges from industrial activities in New Mexico identified by Sectors based on Standard Industrial Classification codes. The OB treatment units are identified as an industrial activity in Sector K (Hazardous Waste Treatment, Storage, or Disposal Facilities) of the MSGP. MSGP permits are typically in effect for 5 years. A new MSGP permit became effective on September 29, 2008. The permit and the authorization to discharge expire at midnight, September 29, 2013. An NPDES Stormwater Individual Permit covers stormwater requirements for designated solid waste management units and was issued in February of 2009. Several solid waste management units surround the OB treatment units. Citizens groups appealed the individual permit in March 2009 and settlement negotiations are ongoing.

For air quality, the OB treatment units at TA-16 were governed under the New Mexico Air Quality Control Regulations until 2005. The regulations were changed in December 2003 to defer the open burning treatment of hazardous waste to hazardous waste regulations rather than air quality regulations. The non-RCRA regulated flashing activities at the TA-16-388 were still permitted under the New Mexico Air Quality Control Regulations from the end of 2003 through January 10, 2006. On March 29, 2005 the Department's Air Quality Bureau issued a New Source Review (NSR) Construction Permit for the non-RCRA open burning activities at TA-16-388. This included the flashing of equipment removed from buildings containing HE. The NSR Air Quality Permit authorized the use of an open flame generated from propane burners on a concrete pad to ignite or burn residual high explosive material (flashing) from equipment used at LANL. On January 10, 2006, while the permit was under appeal, the

Applicants informed the Department that they would no longer be conducting the types of activities at TA-16-388 authorized by the permit and requested cancellation of the permit. Therefore, flashing of material that did not have the potential to detonate as required by 40 CFR §265.382, was prohibited at TA-16-388. All other treatment activities at TA-16-388 had been previously authorized and were covered by RCRA interim status regulations.

In the RCRA rules, OB units are considered miscellaneous units, which are regulated by 40 CFR Part 264, Subpart X. However, there are no specific rules that apply to thermal treatment units like OB treatment units and these types of units are subject to federal miscellaneous requirements (40 CFR §§ 264.600-603). The requirements instead give general performance standards that require permits for miscellaneous units to have provisions preventing releases of waste constituents that may have adverse effects. These include any additional requirements for monitoring, testing, analytical data, inspections, response and reporting as necessary to protect human health and the environment.

RCRA History for the Open Burn Treatment Unit Operations at TA-16

At LANL, interim status was established for its RCRA treatment, storage and disposal units in November 1980. A permit modification for the open burning treatment units at TA-16 drafted and submitted at the request of the NMED asked for the inclusion of these units in the LANL Hazardous Waste Facility Permit. In 1997, the Applicants requested and the NMED approved a change in the review status of the permit modification for the units at TA-16. The units were included in the permit renewal process, which began in early 1999, to have the units on the same review cycle. In January 2000, an additional application reformatted and updated the information for the TA-16 OB units. Technical notices of deficiency and requests for supplemental information were received and responded to from June 1998 through August 2002. Topics within the notices of deficiency and requests for supplemental information ranged from further description of the units and waste streams to requests for particulate deposition modeling. In June 2003, the Applicants transmitted what was anticipated to be the final permit application to the NMED.

During that time, four of the six OB treatment units were closed for consolidation and waste minimization (Exhibit 5). In 1996, the decision was made to close two of the six open burning treatment units at TA-16 and upgrade the treatment unit at TA-16-388. The installation of a concrete pad, propane burners and a weather cover to TA-16-388 enabled the closure of open burn units at TA-16-387 Flash Pad and TA-16-394 Oil/Solvent Burn Tray. The additions to TA-16-388 were approved as a change during interim status as outlined in 40 CFR §270.72(a)(2)(ii) in 1999. The use of cleaner fuel and the consolidation of activities was a step forward to the goal of minimizing the emissions from open burning treatment operations and decreasing the extent of potential contamination from the operations. Before this change, TA-16-387, TA-16-388 and TA-16-394 all used wood fuel to heat up HE-contaminated equipment or waste. The use of wood fuel was outdated technology and not as effective as the newer technology so the change was requested and approved. With propane, the temperature of the burn can be better controlled than when using wood. Also, propane is an approved, alternative clean fuel listed in the 1990 Clean Air Act as well as the National Energy Policy Act of 1992. TA-16-387 was closed with Material Disposal Area (MDA) P (approved May 2007) and TA-16-394 was approved for closure in November 2002. In 2003, LANL began closure on two of the remaining four open burning treatment units (TA-16-401 & 406) which were approved for closure in 2005. The table below condenses the RCRA permit history for these units.

Exhibit 5 shows an aerial photograph of the TA-16 Burn Ground area today and close-up photos of the open burning units present in 1998 and presented in the LANL General Part A Permit Application,

Revision 0.0 (LANL, 1998). The aerial displays the changes made to TA-16-388 and the cleared areas that exist now where TA-16-387 and TA-16-394 were located. TA-16-401 and TA-16-406 were closed but kept in place for use as part of the wastewater treatment facility at TA-16-1508. Therefore, out of the six original OB treatment units at TA-16, only the units at TA-16-388 and TA-16-399 remain (Exhibits 3 and 4). Additionally, an industrial waste incinerator at TA-16 was closed in 2001 due to waste stream consolidation and minimization efforts at LANL.

General RCRA TA-16 Open Burning History

Date	Event/Document
November 1980	Interim status obtained.
June 1995	Permit modification request.
April 1996	Revision of modification request.
December 1996 - January 1997	Information request and response on permit modification and payment of permit fees.
May - August 1997	Request for change in review from modification to inclusion into permit renewal.
December 1998 – January 1999	Requests for information and responses on open burning treatment units.
March– May 1999	Changes during interim status for Technical Area (TA) 16, 338 request and approval.
January 2000	Permit application submittal.
September 2000[a]	Subject matter clarification and response.
January - February 2002	Notice of deficiency and response to notice.
August 2002	Second notice of deficiency and response to notice.
November 2002	Approval of closure of TA-16-394 Oil/Solvent Burn Tray
June 2003	Permit application submittal that incorporated all appropriate information from requests for information and notices of deficiency.
September 2005	Approval for closure of TA-16-401 and -406.
November 2005	Approval of closure of Material Disposal Area P which included the TA-16-387 (Flash Pad 387).

[a] The SMC issued by the New Mexico Environment Department Hazardous Waste Bureau was never finalized. However, the issues contained therein were addressed, as appropriate, in subsequent revisions to the TA-16 Part B permit application.

Draft LANL Hazardous Waste Facility Permit

Parts 6 and 12 of the August 27, 2007 draft Permit set forth the specific open burning treatment conditions for the two units at TA-16. In comments on this draft, the Applicants opposed certain conditions, suggested revisions to certain conditions, and asked for clarification of other conditions. Draft permit negotiations were held between LANL personnel, NMED personnel, tribal members from two local Pueblos, and representatives from local environmental groups. As a result of the negotiations, NMED prepared a revised draft permit that was issued for public comment on July 6, 2009. At the end of these negotiations, a Stipulation was entered into by the negotiation participants, including the

Applicants. The Applicants agreed with the permit provisions in the revised draft permit, with a few specific exceptions. This revised draft included the OB treatment units at TA-16 and contained conditions for open burning treatment unit operations that would allow for the operations of the units compliant with RCRA regulations and within a manner protective of human health and the environment. The Fact Sheet for the July 6, 2009 Revised Draft Permit stated that the units would be authorized for waste management "to treat by open burning and otherwise safely manage high explosive hazardous wastes." (Fact Sheet at 31). The Applicants made comments to the revised draft permit requesting removal of certain conditions and revisions of other conditions based on consistency with other safety and security requirements at the OB treatment units and requirements within the rest of the draft permit.

THE OB PERMIT IS CRITICAL FOR ONGOING OPERATIONS AT LANL

Although waste consolidation/minimization efforts have been conducted throughout the operations that generate HE waste streams, there are certain waste streams that are best treated by open burning. These waste streams include wastes generated from explosives production and processing that generally consists of HE which has been machined with water and occasionally the cloth filters from these processes. Other waste streams include those that cannot be shipped offsite, such as equipment and ductwork generated from the decommissioning of old explosive processing/manufacture/research buildings in support of footprint reduction at LANL. Additionally, alternatives and consolidation efforts continue at LANL as is evidenced in the section on *Alternatives to Open Burning* in this document. Waste streams will be shipped off-site where contracts can be procured. HE operations, including decisions for waste management options, take human safety (both the public and employees) as the most important priority. Although decommissioning of facilities within the HE area has not generated HE-contaminated waste in recent years, buildings used for production and processing have high potential of generating these wastes in the near future. Denial of the permit for open burning treatment units has an additional unintended consequence of LANL not having a safe mechanism to handle ductwork and piping that may have explosives build up within them. Steam cleaning and dissolution processes are used whenever possible and can remove HE from most surfaces; however, they do not work in all cases. The only current technology for safe treatment of deposited HE on equipment is through open burning.

The potential denial of the permit to continue operations at the TA-16 Burn Ground could also have a significant impact on the global war on terror. Please see testimony by William S. Rees Jr. and John Tegtmeir for further information on this topic.

HISTORIC OPEN BURNING OPERATIONS VS. CURRENT OPERATIONS

Beginning in 1951, scrap burning of HE was conducted at TA-16-388, TA-16-394, and TA-16-399, which were used to burn dry HE from breakage, tray rejects, sprues, machining rejects, emptied boxes, and excess melt. TA-16-401 and 406 were sand filters that filtered solid explosives out of waste water. The explosives were then dried and burned at each of the filters. TA-16-392 was used to burn HE-contaminated material suspected of uranium contamination. TA-16-387 was used to flash HE-contaminated unburnable material prior to disposal. TA-16-394 was later converted to an oil/solvent burn tray that was approved for RCRA clean closure in 2002. TA-16-401 and 406 were closed under RCRA in 2005. TA-16-387 was approved for closure with MDA-P in 2007. Attachment A of this document contains pictures of these units as photographed in 1998 and included in the 1998 LANL General Part A Permit Application, Revision 0.0 (LANL, 1998).

Originally, TA-16-388, TA-16-399, and TA-16-394 used an electronic match to ignite dry HE and added combustible material and kerosene to aid in the perpetuation of burning. Padding is placed on the tray and the explosives are removed from the boxes and set on the padding. The padding is then dampened with kerosene, electric matches (squibs) are connected to the firing cables, and a train of excelsior saturated with kerosene is run from the squibs to the padding. Both TA-16-388 and TA-16-394 were converted for other treatment use. TA-16-399 still operates in this manner and only treats HE powders.

At TA-16-387, wood and scrap lumber were added to the explosives contaminated unburnable material to facilitate the destruction of the HE by keeping the temperature high enough to remove the explosives in holes, threads, and crevices. The same was true of the converted TA-16-394 oil/solvent burn tray. Wood, scrap lumber, and kerosene were added under the tray and ignited to burn off the oil/solvent within the tray.

TA-16-388 was later converted to use propane as an alternative fuel so as to significantly reduce air pollutant emissions by burning at higher temperatures; significantly reduce the generation of ash resulting from the burning of wood; render flashed materials non-hazardous, which enabled reuse or recycling of flashed materials, as appropriate; and allow closure of the old wood-burning flash pad as part of the MDA-P closure. An installed kettle for oil or solvent treatment at TA-16-388 was never used for treatment activities because during testing it was determined to be a less efficient treatment than the propane burners. The expansion of capabilities at the TA-16-388 OB treatment unit included the ability to treat:

- Inert-mock explosives that may contain oxidizers;
- Solid/Sludge HE with sand from the filtration of HE-contaminated water;
- Solid chunk HE that include consolidated turnings, reject parts, and excess explosives;
- High explosive sludge that settles out of wastewater from high explosive processing facilities;
- Waste oil/solvents that are assumed to be contaminated with HE; and
- Scrap HE including any machinery, equipment, or furniture used in the explosive processing area that is potentially explosives contaminated.

Since the approval for the change during interim status for TA-16-388, waste stream segregation, consolidation, and minimization efforts have much decreased the amount and types of waste that are treated at the OB treatment unit. For example, inert explosives are now shipped offsite for treatment/disposal as are most waste oils and solvents that are contaminated with HE. Additionally, most solid chunk explosives are used for sanitization purposes at open detonation areas, rather than treated as waste; therefore, use of TA-16-399 and TA-16-388 for this purpose has greatly decreased. Generation of the waste streams that are still regularly treated has decreased significantly due to advances in HE manufacturing and processing. Please see the section on *Alternatives to Open Burning* in this document for further discussion. For the last several years, less than 6,000 lbs/year have been treated.

Exhibit 6 to my testimony shows a OB treatment operation at TA-16-388. It is an approximately 4 minute clip of an OB treatment activity from two different angles at TA-16-388. The waste treated is a HE and water sludge from processing activities that was treated in January 12, 2006. The video has been included to scale the OB treatment operations compared to the images that mention of open burning conjures.

AIR MODEL SCREENING

All of the TA-16 RCRA permit applications stated that compliance with the OB treatment units' air quality permits demonstrated compliance with air quality regulations and met the requirements in 40 CFR §264.601(c) to assess impacts to the air from waste treatment operations. A deposition model was conducted in response to a notice of deficiency for the permit application (LANL, 2002) and was included in the 2003 TA-16 permit application (LANL, 2003). In 2007, because of the cancellation of the air quality permit, NMED requested that the Applicants conduct air modeling to fulfill the air pathway assessment requirements and the Applicants submitted a protocol document (LANL, 2007a). The protocol was developed with guidance from NMED and use of the *Draft Final Open Burning/Open Detonation Permitting Guidelines* (EPA, 2002). The NMED issued a notice of deficiency on that document and air modeling was conducted based on the revised protocol (LANL, 2007b) that was drafted in response to the notice.

The air pathway analysis was submitted to the NMED in September 2007 (LANL, 2007b)..The NMED also procured an air pathway screening assessment that was drafted by TechLaw Inc. (TechLaw Inc., 2007). A notice of deficiency was issued on the LANL air pathway assessment and a revision of the assessment was submitted in 2008 with the response (LANL, 2008). The draft permit as issued on August 27, 2007 was based on modeling conducted by TechLaw Inc. and contained a prohibition on the treatment of 11 waste constituents. This model assessment was not provided to the Applicants until after permit negotiations began in August 2008; therefore, it was unclear how the constituents were chosen. During permit negotiations it was discovered that the air modeling referenced by NMED did not take into account the use of propane as fuel for treatment activities at TA-16-388 and was therefore not representative of operations at the open burning treatment unit. The 11 prohibited constituents came from modeling conducted solely on TA-16-388. It was determined that TA-16-399 did not pose an unacceptable risk to human health and the environment. The NMED agreed that the model should be run again assessing the impact of propane fuel use in treatment operations. Propane increases the temperature of combustion so it minimizes the production of hazardous emissions.

Addendum 2 to the TechLaw Inc. model was drafted to present the results of modeling OB treatment operations at TA-16-388 taking into account the use of propane fuel. These model runs determined that all operations at the TA-16 OB treatment units were protective of human health and the environment with the exception of one scenario. The burning of 20,000 pounds per year (lbs/yr) of HE-contaminated waste at TA-16-388 was determined to exceed a dioxin/furan toxicity equivalency quotient (TEQ) Ecological Screen Level (ESL) for small mammals within the area. The assessments that NMED based the first two revisions of the draft permit on are flawed for two reasons: 1) the emission factor chosen by the NMED and contested by the Applicants is not representative of current operations at the open burning treatment units and should not have been used; and 2) modeled parameters are not representative of waste treatment activities at the TA-16 OB treatment units.

Use of Inappropriate Emission Factors

Based on the limited availability of emission factors for dioxins and furans for open burning activities, LANL originally chose factors from the emission factors available from the Open Burn/Open Detonation Dispersion Model (OBODM) User's Guide (EPA, 1998) for burning of an ammonium perchlorate (AP) propellant. This waste consisted of 25.87 percent (%) chlorine and is based on trial burns conducted at the Dugway Proving Ground (DPG) (Mitchell & Suggs, 1998). AP is not treated at the TA-16 OB treatment units and the amount of chlorine in AP is at least 5 times higher than wastes that are treated at the units. As requested by the NMED in the notice of deficiency on Revision 0 of the

protocol document (NMED, 2007), the dioxin/furan emission factors were changed to those for aluminized AP propellant manufacturing waste because they were "more conservative and may be more applicable to burning solids contaminated by HE at TA-16-388". These emission factors are not representative of the wastes treated at the OB units and the development of the emission factors was flawed in its execution.

The aluminized AP propellant manufacturing waste surrogate was designed to simulate the mix of plastic gloves, cotton rags, kimwipes, wood towel rods and similar materials that result from the clean-up of the vessels used to manufacture propellants. LANL does not manufacture propellants or treat propellants through open burning. The HE-contaminated combustible waste stream treated at TA-16-388 differs significantly from the surrogate waste used to develop the dioxin/furan emission factors and the surrogate was modified in the middle of the burn trial. From Mitchell & Suggs (1998):

> *This surrogate waste was supposed to simulate the mix of AP-contaminated plastic gloves, cotton rags, Kimwipes, wood towel rods and similar materials that result from the clean-up of the vessels used to manufacture AP-based propellants. These materials are usually disposed of by open burning in pans or by incineration. The original plan was to bring an actual AP-based manufacturing waste to DPG for the experiment, however, this was prohibited because DPG did not have a permit for destroying this type of waste. In hindsight, the surrogate waste burned was not truly representative of a real manufacturing waste. The chemical composition was appropriate, i.e., 65% aluminized AP (69% AP, 19% aluminum), 20% plastic material (polyethylene gloves), 11% paper/wood/cloth and 4% diesel fuel; the problem lies with the manner in which the propellant was placed in contact with the combustible materials. That is, 1-in. cubes randomly dispersed on top of the combustible materials. In an actual waste, the propellant would be dispersed on the combustible materials as a fine powder*
>
> *Also, because the first burn resulted in a hole in the bottom of the pan, the second and third burns were done with the surrogate waste sitting on top of a 7.6 cm layer of pea gravel. At the completion of each of these last two burns, holes were found in the side of the burn pan, and melted plastic was found in the pea gravel. Approximately 110g of ash remained in the burn pan after the first burn, 40g of ash after the second burn and 65g of ash after the third burn. It was difficult to determine the weight of ash remaining when the pea gravel was used. The weight of waste surrogate burned in the three trials was 1,139g, including the 4g of Hercules Unique Smokeless Powder used to initiate each burn.*
>
> *The unique mix of emission products, the melted plastic and the 17% conversion of N to NOx observed for the surrogate AP-manufacturing waste demonstrates that this burn was very different from all other burns which involved energetic materials. Most of the emission factors for chlorinated VOC's, those for the five furans, and two of those for the SVOCs are associated only with this material. There were also notable quantities of diesel-fuel-related VOCs in the emissions.*

The explosives contaminated waste stream treated at the TA-16-388 Flash Pad consists of HE (pieces or powder), cloth, cardboard, kimwipes, limited plastic bags, possible small amounts of solvent or oil on kimwipes or filters, small glass pieces, and small metal pieces. This waste stream does not contain a high percentage of plastics, wood, or paper. The presence of these items would lead to the higher production of furans. Also, the additions of the use of propane (with a consistent, high temperature) as

an additive fuel and the contamination of the combustible material with a high explosive (rather than a propellant) further distance the likeness between the surrogate and the actual waste stream treated at TA-16-388.

Validation of the dioxin and furan data in Mitchell & Suggs (1998) used to develop the emission factors was difficult because the minimum quantitation limit emission factors for dioxin and furan data were very low for burn trials (2.6E-11 kg of analyte/kg of energetic material) and these compounds are constantly encountered in environmental media. Therefore, only dioxin and furan data that was detected in multiple burns and above the minimum quantitation limit emission factors were included with the validated data. Five furan isomers were detected in the aluminized AP propellant manufacturing waste and were included within the validated data because they occurred in all trials and at 100 to 1,000 times larger than the minimum quantitation limit emission factors. Mitchell & Suggs (1998) failed to validate an emission factor for a dioxin isomer that was detected during one trial of the diesel fuel and dunnage surrogate waste that contained no energetic materials and was used for other emission factors within the air pathway assessment. Finally, despite the extremely sensitive quantitation limit for dioxins and furans, they were not detected in the any of the other organic-based and AP-based propellants burns in the BangBoxes.

The results for the aluminized AP propellant manufacturing waste trial burns were considered consistent with "combination deflagration (AP) and incineration type burn (melting of polyvinyl gloves and charring of the wood dowel sticks by the heat released from the deflagration)." Mitchell and Suggs (1998) also acknowledged that additional work should be done on this type of material and that the trial burns would have provided conditions favoring dioxin and furan production. These conditions are low temperature (250-400 °C), long residence time (seconds), presence of chlorine and organic materials and a metal that could serve as a catalyst. Those conditions are in contrast with operations at the OB treatment units at TA-16-388 because the temperature of the propane burners is in excess of 1400 degrees Fahrenheit (°F) or 760 °C within 10 second of starting the system according to recent measurements taken at TA-16-388 (Exhibit 7 to my testimony). The temperature of the burn area stays consistently above 1800 °F (approximately 982 °C). The types of HE burned most often range in burn temperature from approximately 1070-2030 °C. Combustion studies indicate that dioxin and furan compounds are readily created at temperatures from 400-1000 °F (approximately 204-538 °C) and are destroyed when gas temperatures exceeds approximately 1400 °F or 760 °C (EPA, 2010). Therefore, it is unlikely that dioxins and furans could be formed during the burn operations at TA-16-388. Additionally, the presence of metals and chlorine in HE waste is less than the 19% aluminum and the ~11.5% chlorine within the surrogate waste. These emission factors lead to the assessment of an unreasonably high potential for air concentration and deposition and are not appropriate for use in the TA-16 air pathway assessment. When the emission factors for furan that were originally selected within the LANL protocol document (LANL, 2007) are used to calculate new air concentration and deposition values, all screening levels are met, even after 10 years of use at the units.

Furthermore, although dioxins and furans have been detected in several materials during combustions, fuel and air mixing processes and temperatures in most combustion systems are sufficient to destroy most of the dioxins and furans that may be in the original material. The exceptions to this statement are structure fires and small contained fires like wood stoves or fire places because combustion conditions within these may not be ideal (EPA, 1997). Estimations for residential wood combustion are equal to 6.76E-02 lbs/year whereas even the estimations using the air pathway assessment used by the NMED are only 8.6E-08 lbs/year.

Comparison of Actual Waste Treatment Activities at TA-16 and Modeled Parameters

The total volume of waste that is treated through open burning has decreased significantly in the last ten years. As part of the assessment conducted for the NMED, TechLaw, Inc. modeled 20,000 pounds (lbs) for each waste scenario: HE waste at TA-16-399, HE waste at TA-16-388, and HE-contaminated waste at TA-16-388 (TechLaw, 2007). Both OB units combined have treated less than 6,000 lbs/year for the last five years. Most of the waste treated through open burning at LANL (approximately 90%) is bulk HE with water (and occasionally the filter cloths) from the machining of HE components used for testing, research and development projects within the DOE Complex. This waste consists of scraps and chips of explosives from machining mixed with water and the fiber filter socks used to strain the larger chunks of explosives from the recycled water used for cooling. All waste treated at the TA-16-399 Burn Tray is bulk HE and most of the waste treated at the TA-16-388 Flash Pad is bulk HE, water, and filters. The treatment of the HE-contaminated combustible debris waste makes up a small percentage of the waste treated at the open burning treatment units and in recent years has been less than 2% of the total waste treated in recent years.

MONITORING

Air

On March 2, 3, 4, and 9, 2010, air particulate monitoring was conducted for TA-16-399. The waste treated was HE powders on each monitoring event. Two samplers were placed downwind of the burn tray in the predominant wind direction of the pathway of the treatment of the waste. Sampler number 1 was placed approximately 150 feet from the burn tray and Sampler number 2 was placed approximately 165 feet from the burn tray. The beginning air flow on both samplers was set at 40 cubic feet per minute (cfm). After the samplers had run a sufficient time to collect data before, during, and after the burn; the samples were collected and prepared for shipment to the sample management office. Sampler number 2 was then fitted with a blank sample for comparison and was allowed to run for a little over 20 hours. The above process was repeated for the remaining sampling events. The burn times were approximately the same length (4 minutes) each time. The run time for the samplers and blanks varied according to each burn. A total of 10 samples were collected (including blanks) and analyzed. Preliminary results from analysis for dioxin and furans indicate that the burns at TA-16-399 do not generate amounts of dioxins and furans above levels detected within the method blank. Samples collected were also to be analyzed for RCRA metals; however, results have not been received as of the date of this written testimony.

This air particulate monitoring was conducted in order to verify the hypothesis that the OB treatment units at TA-16 produce nondetectable air particulate contaminant concentrations. Every effort was made to ensure that particulate samples were collected from the correct wind direction and within any plume that could be present from the waste treatment. Particulate air sampling was chosen rather than ambient air monitoring as dioxins and furans are more likely to be found in the soil or condensed on particulate matter than as gaseous pollutants in the air (EPA, 1997).

Soil and Water

The February 2, 2010 fact sheet on the intent to deny a hazardous waste facility permit for the open burning of hazardous waste at the TA-16 OB units states that based on the findings of the human health and ecological screening assessment that the area required a "more refined site-specific assessment" that incorporated the lowest concentration of a substance, found by experiment or observation, which causes an adverse alteration. Both of the previous drafts of the Permit contained requirements to conduct soil

and storm water sampling at the OB treatment units. This monitoring would have been conducted on a periodic basis throughout the life of the permit to demonstrate that current operations at the units do not have an adverse impact to the area surrounding the units. Additionally, the soil monitoring program within the previous drafts will allow for trending associated with any contamination that current operations may be adding to soil concentrations. This monitoring also gave a pathway to assess the additional risk associated with any waste constituent concentrations that may be added by current operations. Actions tied to statistically significant changes in those concentrations would have been determined as outlined in the soil monitoring section within Part 6 of the July 6, 2009 Revised Draft Permit that allowed for corrective action for the situation.

Soil sampling would have been conducted surrounding both units and storm water runoff sampling would have been collected from immediately off of the TA-16-388 Flash Pad. This distinction was born out of the difficulty of isolating runoff from just the TA-16-399 Burn Tray and ensuring that collection water did not represent contamination from solid waste management units within the area that are destined for corrective action activities.

Concentrations currently found within the soil in the area (discussed within the section *Human Health and Ecological Risk Assessment*) show levels below human health screening levels but above a few ecological screening levels (ESLs) for small mammals like deer mice, plants, and earthworms. This level of contamination can most likely be attributed to historic open burning practices from closed hazardous waste management units within the area. The practice of using wood as burning fuel that occurred at previous units, namely TA-16-394 and TA-16-387 for over 40 years would have contributed dioxins and furans found within surface soils. Current OB treatment unit operations are unlikely to produce dioxin and furan concentrations because of the type of waste treated and temperature at which they are treated. Dioxin and furan isomers were seen in the seven samples collected during this closure; however, their presence was below the detection limit for the analysis conducted. Current screening levels are below those past detection limits. Concentrations of dioxins and furan onsite seem also to be comparable to concentrations detected at the TA-16 OB units, when assessed using RACER (www.racernm.com) and as referenced in the LANL Human Health and Ecological Screening Risk Assessment (LANL, 2010). The concentrations of barium are comparable to concentrations measured at other locations around the TA-16 Burn Ground site, including those measured within the biological zone (that surrounded the disposal site) during the closure of MDA-P (LANL, 2005).

HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

Soil sampling conducted at the TA-16 OB treatment units was conducted at the request of NMED in June 2009 and August 2009. Thirty-seven surface samples (0-1 ft) were collected from 37 locations across the TA-16 Burn Ground (Exhibit 8 to my testimony) where the two OB units are located. These samples were analyzed for RCRA metals and/or dioxin and furan congeners. The data was used in the evaluation of risk to human and ecological receptors. This information was provided in a revised Human Health and Ecological Risk Screening Assessment to the NMED on January 11, 2010.

The human health aspect of the risk assessment concluded that for the residential scenario, the hazard index (HI) of 0.06 is less than NMED's target level of 1.0 and the cancer risk (2E-06) is less than the NMED target level of 1E-05. Therefore, the assessment indicated that there is no potential unacceptable risk to human health at the TA-16 Burn Ground. Adjusted hazard quotients (HQs) for the ecological receptors resulted in HQs of 0.8, 1.9, 2, and 6 for Montane Shrews, deer mice, earthworms and plants, respectively. These HQs are attributed to concentrations of dioxin and furans and barium within the soil

at the site. The assessment concluded that there are no potential unacceptable risks to human and ecological receptors present at the TA-16 Burn Ground when taking into account the following considerations.

- The calculated risk for each species is based on literature derived ESLs that are conservative and overestimate the potential risk to receptors.
- Field observations and published studies within the greater area indicate that the low to moderate risk levels for small mammals do not reflect actual adverse ecological impacts to receptors at the site because studies conducted indicate that populations within the area are healthy.
- Elevated concentrations are likely to be due to historic operations at the site rather than current operations and current operations should not increase the concentration of dioxin, furans, or barium within the soil.
- Previous studies have found no effects on small mammal populations at similar dioxin/furan concentrations in the canyons.

Adding to these considerations, it is important to mention the consolidation and risk reduction activities that have taken place at the OB treatment units over their lifetime. Operational changes have reduced the risk to human and ecological receptors at the TA-16 Burn Ground by:

- closing units that treated waste using wood and kerosene as fuel for the OB treatment activities and reducing emissions and increasing the burn efficiency by installing propane burners at TA-16-388;
- continuing to decrease the volume of HE waste generation which have significantly decreased from past operations due to strong efforts in total waste minimization, careful waste segregation, and the substitution of nonhazardous materials for high explosive research and processing operations; and
- continuing to decrease the toxicity of the waste by including limited amounts of wood or paper products, plastics, metal pieces, and solvents.

All of these efforts decrease the likelihood that current OB treatment activities adversely impact the concentration of contaminants in the soil surrounding the units.

Risks to Small Mammals in the Area

LANL biologists conducted small mammal trapping in Cañon de Valle during 1992 (Raymer and Biggs 1994) and again during 2001 (Bennett et al. 2002). During these trapping efforts in Cañon de Valle, no shrews were captured. This was likely due to the stream flows being intermittent throughout the year and thus not providing suitable shrew habitat. Since the TA-16 burning grounds themselves do not provide suitable habitat for shrews, and there are no recorded occurrences of shrews in the Cañon de Valle drainage near the facility, operation of the burn units at the TA-16 burning grounds is not anticipated to cause harm to any shrew species.

Deer mice are capable of living in almost any habitat in New Mexico. This species is decidedly the most common in ponderosa, mixed coniferous, and spruce-fir forests, next most common in northern sage-grassland, and much less common in woodland, grassland, and desert communities (Findley, et al. 1975).

Small mammal trapping in upper Cañon de Valle in 2001 was performed and population densities were compared to a reference site in Pajarito Canyon and used for the *Ecological Risk Assessment for Canon de Valle* (LANL, 2004). This study was initiated as a means for assessing potential adverse effects in

the canyon that could be attributed to the chemicals of potential ecological concern in the terrestrial and riparian systems. Small mammal trapping arrays were established in Cañon de Valle and Pajarito Canyon and trapping was conducted during May 2001 and again in September to October 2001. Pajarito Canyon was selected as the reference canyon based on its similarity to Cañon de Valle with respect to topography, elevation, water presence and quantity, vegetation, and burn severity from the Cerro Grande fire in 2000. The risk assessment looked at the number of small mammal species, population density estimates, reproductive status classes for each species, body weights, and contaminant body burdens. The most abundant small mammal trapped was the deer mouse and the species did not show adverse population characteristics when compared to the reference site, Pajarito Canyon (Bennett et al. 2002). Also, Cañon de Valle had six of seven reproductive classes in the spring and seven of seven classes in the fall. This evidence suggests that the contaminant inventories in Cañon de Valle are not adversely affecting the small mammal community. The analysis of contaminant body burdens for small mammals also showed that the concentrations within mice are below the ESLs for the Mexican spotted owl. However, this study did not include dioxin and furan analysis. Overall, as evidenced in the Cañon de Valle ecological risk assessment past operations at the TA-16 Burn Ground have not had any negative effects on deer mice populations within the greater site area and future operations are not anticipated to harm the species.

PROTECTIVE OPERATIONAL REQUIREMENTS

The NMED model report (TechLaw Inc., 2008) recommended that the treatment of high explosive contaminated wastes at TA-16-388 required "performance of a more refined analysis of ecological risk, restrictions on the types of HE-contaminated wastes treated, and/or implementation of controls or procedures to prevent exposure of small mammals." The above sections contain information on the ecological risk assessments conducted as well as the willingness of the Applicants to conduct further investigation. The July 6, 2009 draft permit included restrictions on the amount of waste treated as well as the types of waste at the open burning treatment units to address the two other requirements.

The amount of waste that can be treated at the open burning treatment units was decreased from the volume of waste that was modeled. The model volume of waste was 20,000 lbs and the revised draft Permit condition required that the Applicants treat no more than 12,500 lbs/year. The Applicants agree to a further reduction to 6,000 pounds per year (Exhibit 1). A list of prohibited wastes was included within the July 6, 2009 revised draft Permit that included many known dioxin and furan producers: chlorinated solvents and ammonium perchlorate, polyvinyl chloride, and structural components of demolition and decommissioning wastes. The prohibition of those types of waste would cover much of the concern for dioxin and furan producers. Additionally, compliance with these specific waste bans is much less complicated for the Applicants and would simplify enforcement for the NMED compliance inspectors.

Operational controls were also conditions within the former drafts of the permit for protection of human health and the environment. OB treatment operations would have had restrictions on the fuel used, the time of day a burn is conducted, the amount of liquids that could be treated, the temperature of the burn, vegetation growth restrictions, specific barricade requirements, treatment prohibitions during electrical storms or precipitation events, and restrictions on wind speeds and fire danger levels. Requirements for the staging of waste, disassembly of equipment to the practicable prior to treatment, and covering of the treatment units when not in use, and notifying the fire department at the beginning and end of each treatment event. Additional maintenance requirements included inspection and testing of equipment to

ensure proper working order and patrolling area around treatment unit prior to treatment. All of the operational controls listed above have been in place at the open burning treatment units for many years as part of safety and security requirements as well as compliance with RCRA interim status regulations and are protective to human health and the environment.

ALTERNATIVES TO OPEN BURNING

Throughout the permitting process, it has been a LANL goal to reduce the quantity and types of waste that are treated through open burning onsite. Continual assessment of alternatives to open burning has occurred at LANL and a report was transmitted to NMED in 2007 (LANL, 2007a). In 2010, LANL has updated the alternatives analysis submitted in 2007. Alternatives to open burning are chosen according to the following ranking:

1. Avoid production of waste streams requiring OB treatment.
2. Reclaim/reuse waste materials rather than OB treatment.
3. Treat the waste using a method other than OB treatment onsite.

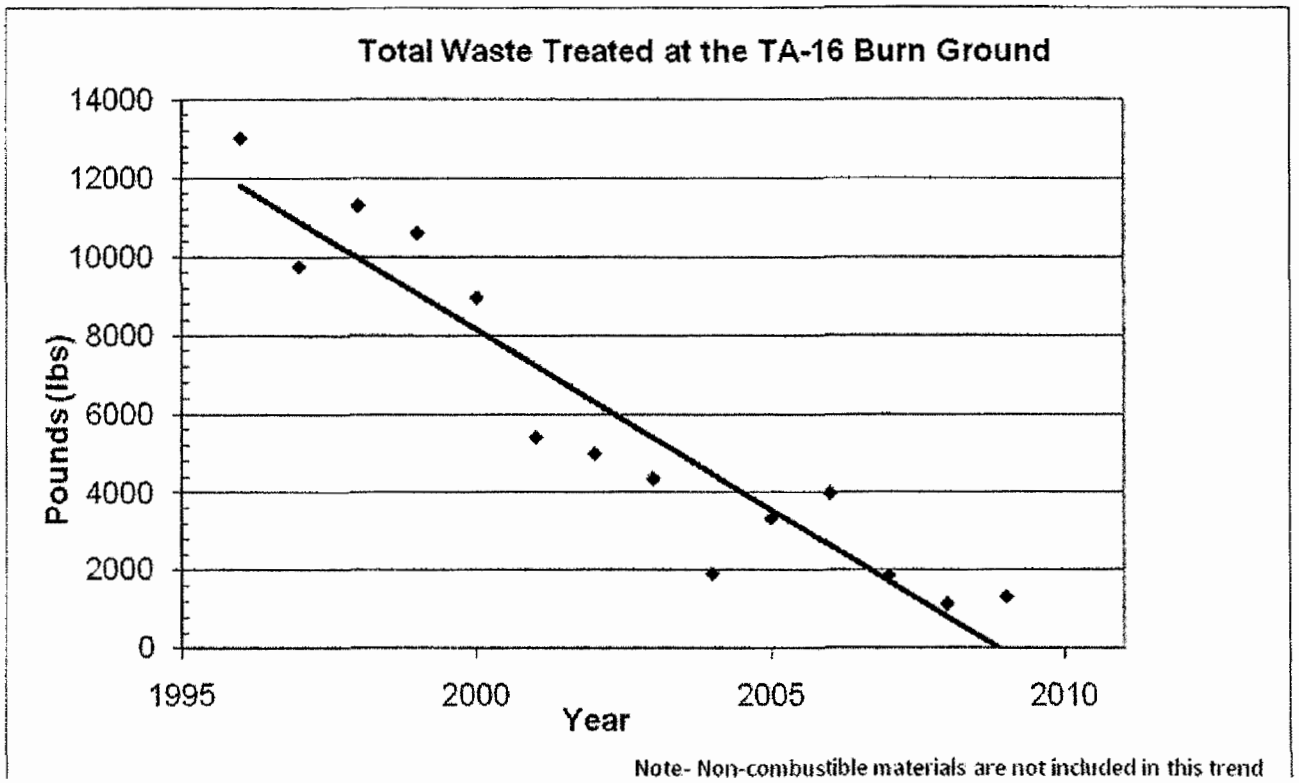
Waste Minimization

Significant progress has been made over the past decade in reducing the amount of waste treated onsite through the methods listed above. Below is a table the specific results of these efforts for the past seven years and a chart illustrating the overall decline of waste treatment totals since 1996.

TA-16 Waste Treatment Facility Waste Streams for Open Burning

Year	HE sludge (lbs)	HE-Contaminated Combustibles (lbs)	HE-Contaminated Solvents (lbs)	HE-Contaminated Non-Combustibles (lbs)	HE-Contaminated Metals (lbs)	Wetted HE (lbs)	Solid or Scrap HE (lbs)
2004	1542	270	12	0	12,580	0	0
2005	1889	528	0	908	0	0	0
2006	3260	470	258	0	0	0	0.8
2007	1199	596	13	375	0	0	53
2008	837	302	3	0	0	0	1.5
2009	1299.3	8432 *	0	0	0	0	27.6
2010*	76	48	0	0	0	0	766.8

HE = high explosives
Lbs = pounds
* Quantities for 2010 are current through March 15, 2010.
*- Luciana corrected on cross from Don



Wide varieties of operations generate the wastes outlined in the table. The HE sludge waste stream is generated from machining explosives at TA-16. The composition is about 50% HE and 50% water by volume. The HE-contaminated combustibles include mostly filter socks mixed with the HE sludge waste stream because they are used to filter explosives from recirculating coolant water in the machining process at TA-16. A much smaller portion of this waste stream is laboratory testing waste which would include contaminated bags, gloves, and kimwipes used in research operations. This waste stream may also contain small pieces of metal that cannot be safely separated from the rest of the waste. This waste stream is rarely generated due, in large part, to waste segregation practices. HE solvents include solvents (mostly one non-hazardous type of solvent) oils or chemical products that are spilled and come into contact with explosives, and hydraulic fluid from processing equipment. Almost all of these liquids are sent offsite for treatment. HE non-combustible waste is primarily sand that has been contaminated through water filtration. Explosives contaminated metals is HE processing equipment, ductwork or pipes from decommissioning of HE processing buildings that have or are suspected. Oil is drained from equipment and it is disassembled and/or steam cleaned if it can be done safely. After treatment, metal equipment is recycled. The weight in the table above indicates the weight of the equipment, not the explosives content. Wetted HE are pure explosives that are stored in a water/alcohol solution for safety purposes. Solid or scrap HE come from parts that do not meet specification, parts that are not needed, x-ray rejects, and research experiments.

Pollution Prevention Practices Implemented

In many cases, process improvements were made to production and research activities that resulted in the reduction in the overall volume and types of waste generated. Additionally, waste handling processes were improved to ensure that wastes treated at the OB treatment units were minimized. These include:

- Segregating detonable explosives-contaminated debris from non-detonable contaminated debris which is sent offsite for disposal.
    - Generators of high explosive contaminated debris carefully assess whether wastes generated from production and research activities have the potential to detonate.
- Pressing explosive parts to near-net shape, using isostatic presses, thereby reducing the amount of high explosive machining waste created and saving time and raw material.
    - For example, cylinders were pressed when a cone shape was needed, so the cylinders would be machined down to cones producing approximately a 1/3 of the volume of cylinder as waste. New technology allows for pressing of a cone and only having to refine the shape through machining.

- Replacing disposable plastic bags with reusable containers for transporting HE-contaminated debris to the open burning treatment units.
- Shipping high explosive contaminated oils and solvents offsite for treatment/disposal.
- Segregating and burning HE waste by type, which improves waste treatment effectiveness by reducing the burn time and saves on the amount of fuel used.
- Steam cleaning equipment instead of flashing equipment, when possible, to meet DOE Explosives Safety Manual release requirements.
- Consolidating all HE machining and most HE pressing operations into one building, thereby reducing the potential for HE contamination at many locations.
- Consolidating all open burning waste treatment activities at TA16-388 and eliminating the use of the TA-14 Q-site burn cage.
- Steam cleaning plastics when possible and disposing of the resultant material as non-hazardous waste offsite.
- Treating heavily contaminated plastic molds that could not be steam cleaned by open detonation instead of open burning.
- Using scrap and excess HE when possible as fuel for waste treatment by open detonation rather than pure or virgin HE material. This process gets rid of the HE excess and treats the waste at the same time for a more efficient process.

Additionally, the use of recovered/recycled cyclotetramethylenetetranitramine (HMX) in munitions could reduce approximately half of virgin use of HMX. However, prior to its use in munitions, its safety and sensitivity must be determined along with its ability to be processed in selected formulation. Tracking the progress of this study is ongoing.

Other Treatment Technologies

Research on alternatives to open burning and open detonation is funded on a national scale by the Joint Demilitarization Technology Program. It is an interagency effort (including both Department of Defense (DoD) and the DOE) dedicated to the development of safe, efficient, and environmentally acceptable processes for the treatment of munitions. Projects to date have focused on large-scale waste treatment, mainly at DoD munitions facilities that treat millions of pounds a year of HE waste. These alternative treatment technologies are not completely replacing OB and open detonation (OD) treatment activities. Rather, they are targeted at specific high throughput waste streams with high environmental risk. For example, Crane Army Ammunition Facility is using an incinerator for ammunition with high

lead content that causes environmental risk. But the most of HE treatment is still taking place in OB or OD treatment units. LANL tracks the development of these alternatives.

Some technologies (e.g., ultraviolet treatment, biotreatment, photocatalysis) are targeted at wastewater, a waste stream not treated at the LANL OB treatment units. Improvements in bioremediation technologies (e.g., composting and vitrification) are appropriate to environmental restoration activities. They are not discussed as alternatives to open burning because environmental restoration wastes are not significant waste streams treated at the LANL OB treatment units. Other technologies are specific to DoD ammunition wastes. For example, a number of the projects involve removal of shells (e.g., by metal acid dissolution) or extraction of explosives (e.g., trinitrotoluene melting) from shells so that the separated ammunition components can be sent to different treatment facilities. These are not technologies applicable to wastes at the Applicants.

Another important consideration is that the technology should not create a waste more difficult to treat than the original waste stream or more toxic to the environment or employees. LANL reviewed the available technologies and identified as potential technologies: conversion of HE to fertilizer, detonation chambers, thermal treatment (incinerators and confined burn facilities), and molten salt. The table below summarizes which waste streams the technology can and cannot treat and the possible limitations of the technology.

Technology Evaluations

Technology	Treatable Waste Streams	Untreatable Waste Streams	Limitations
Actodemil ® Fertilizer Technology	Wet high explosives	Bulk dry high explosives Combustibles Non-Combustibles Solvents	Binders may result in product being too sticky to use as fertilizer. Plus, this would lead to the applications of plastic components of binders on to the ground.
Detonation Chamber	Dry high explosives	Wet high explosives Combustibles Non-combustibles Solvents	Cannot treat any of the currently significant waste streams Requires additional high explosives for fuel
Incineration	Combustibles Solvents Wet high explosives Small bulk explosives	Large bulk high explosives Non-combustibles	Cannot treat all waste streams Public opposition to incineration
Contained Burn Technology	Bulk high explosives	Combustibles Non-combustibles Solvents Wet high explosives Small bulk explosives	Cannot treat any of the currently significant waste streams and cannot treat the waste stream that cannot be transported offsite.
Molten Salt	Wet high explosives	Bulk high explosives Combustibles Non-combustibles	Interference of chlorine in binders (converts salt to (NaCl).

		Solvents	

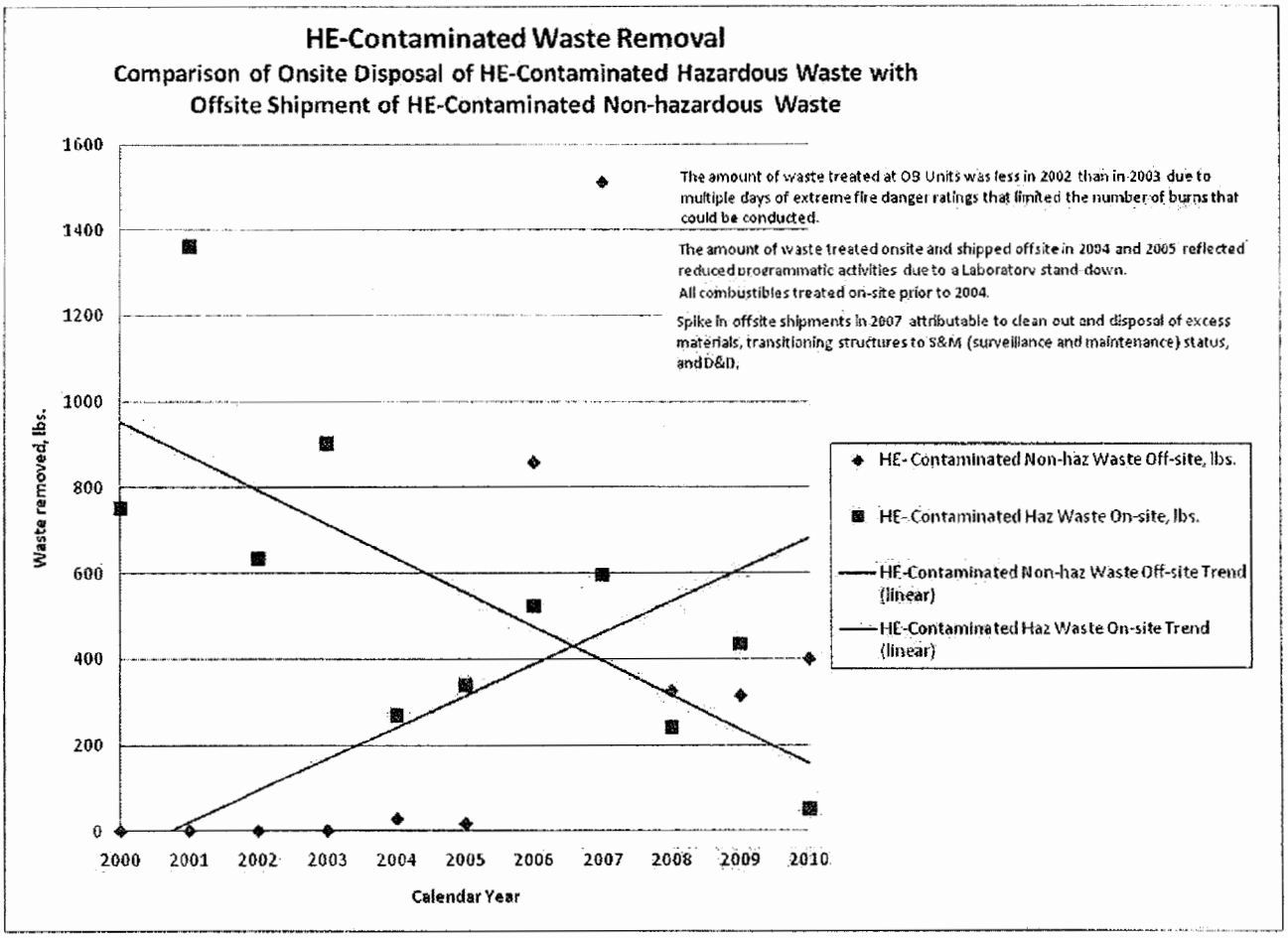
Offsite Shipment of Waste Streams

LANL also ships for offsite disposal any waste stream that is amenable to transport and has an available offsite waste path. There are positive and negative consequences to this pathway. Positive aspects include that waste treatment onsite decreases and therefore emissions from the OB treatment units decrease.

Currently all propellants are treated at an offsite incinerator and disposal options are being explored for HE contaminated combustible debris waste as well as other waste types. Although three facilities have been identified, contracts currently exist with only one of the facilities.

Drawbacks include that detonable waste that is shipped offsite will still be thermally treated, through open burning or in an incinerator and greater overall emissions result because the waste would have to be shipped considerable distances, resulting in air emissions from trucks that would carry the waste to the treatment/disposal facility. The HE would also have to be shipped on public roads thereby posing a safety concern for the public. Furthermore, most treatment/disposal facilities have minimum shipment requirement on volume of waste. Because HE contaminated waste generation has decreased at LANL, accumulation of this waste onsite would have to occur until a volume of waste suitable for shipment could be reached.

Waste segregation practices that have been implemented have also positively impacted offsite shipment of waste. Because of segregation, the amount of non-hazardous HE contaminated waste has had an overall increase while the volume of hazardous HE contaminated waste has decreased. These wastes are minimally contaminated with HE and are shipped offsite as industrial waste. Accumulation of these wastes to meet shipment quantities, however, because they are a non-hazardous waste, storage is less complicated. Below is a graphical representation of these general shipment rates.



CONCLUSIONS

The risk assessment demonstrates that there are no unacceptable risks to either human health or ecological receptors at the TA-16 OB units. Based on the importance of the OB treatment units to national security missions at LANL and the evidence that the OB treatment units currently are and will be operated in a manner that is protective of human health and the environment, there is no basis to deny the permit for the OB treatment units. The Applicants request that the OB provisions set forth in Exhibit ApplicantLRVH 1 be included in the final LANL RCRA permit.

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FURTHER AFFIANT SAYETH NAUGHT

Luciana Vigil-Holterman

Luciana Vigil-Holterman

STATE OF NEW MEXICO)
) ss.
COUNTY OF LOS ALAMOS)

SUBSCRIBED, SWORN TO AND ACKNOWLEDGED before me this 19th day of March, 2010

Lola E. Sandoval

NOTARY PUBLIC

My Commission Expires:

December 24, 2013

Luciana R. Vigil-Holterman

Work Address: PO Box 1663, MS-K490, Los Alamos, NM 87545 Work Phone: 505-665-3435
Email: luciana@lanl.gov

Skills

Computer- Experience with Microsoft Office Suite as well as internet use, electronic mail, and basic programming experience in HTML and C++. Knowledge of most applications in Windows 2000/XP/Vista. Experience with ArcView Geographic Information Systems (GIS), AutoCAD, Visual Sampling Plan, Adobe Photoshop, Adobe Illustrator, and Adobe Reader Professional.

Field of study- Experience and knowledge of environmental federal and state laws including the Clean Water Act (CWA), National Pollutant Discharge Elimination System (NPDES), the Clean Air Act (CAA), the National Environmental Policy Act (NEPA) including the Cultural Resource Compliance Acts, Resource Conservation and Recovery Act (RCRA) including Hazard and Solid Waste Amendments (HWSA), the Endangered Species Act, and the Toxic Substances Control Act (TSCA). Advanced knowledge of RCRA and TSCA compliance activities at Los Alamos National Laboratory. Experience in soil, other solids, oil, and water environmental sampling.

Education

Degree: MS
GPA/Scale: 3.89/4.0
Date: 06/2002
School: New Mexico Highlands University, PO Box 9000, Las Vegas, NM 87701
Major: Life Science-Environmental Science Concentration

Degree: BS
GPA/Scale: 3.59/4.0
Date: 06/2000
School: New Mexico Highlands University, PO Box 9000, Las Vegas, NM 87701
Major: Environmental Science-Environmental Geology Concentration

Work Experience

Environmental Professional 3
June 2006 – Present
Los Alamos National Security, LLC., Los Alamos National Laboratory, Los Alamos, NM

- Assist in RCRA permit activities including the update and development of applications, air risk assessment analysis for the open burning treatment units, closure plans development, and permit modification drafting and submittal.
- Participated in negotiations with the state and public stakeholders for the Los Alamos National Laboratory permit renewal.
- Presented permit modification and renewal information at public information meetings.
- Provided waste acceptance and regulatory compliance assurance at hazardous waste open burning treatment unit from June 2006 through December 2007.
- Provided general environmental compliance assurance at Technical Areas 11, 16, and 37 from June 2006 through December 2007.
- Provide information and guidance to internal and external customers in the RCRA permit and other environmental aspects as necessary.

Technical Staff Member
September 2002 – June 2006
Los Alamos National Laboratory, Los Alamos, NM

- Assisted in RCRA permit activities including application development, permit modification drafting, and participation and oversight of closure activities.
- Provided waste acceptance and regulatory compliance assurance at hazardous waste open burning treatment unit from July 2005 through June 2006.
- Provided general air, water, and waste environmental compliance assurance as well as implementation of the LANL Environmental Management System at Technical Areas 11, 16, and 37 from July 2005 through June 2006.
- Responsible for the maintenance of the polychlorinated biphenyl (PCB) database.
- Aided in the design and implementation of the group records management program.

- Provided information and guidance to internal and external customers in the RCRA permit and other environmental aspects as necessary.

Graduate Research Assistant (Technician)
June 2000 – September 2002
Los Alamos National Laboratory, Los Alamos, NM
- Assisted in aspects of the PCB, Solid Waste, Sampling, and Permitting Programs with the Solid Waste Regulatory Compliance Group.
- Responsible for database management, regulatory guidance research, environmental sample collection, preparation for sampling and sample preparation for shipment to analytical laboratories.
- Aided in the drafting and quality assurance of official documents.

Graduate Student Teacher Assistant
August 2000 – May 2002
New Mexico Highlands University, Natural Resource Management Department, Las Vegas, NM
- Assisted in laboratory preparation and instruction, and graded papers and laboratory reports for Introduction to Geology class.
- Acted as a liaison between undergraduate students and course instructor.
- Topics discussed include minerals; sedimentary, igneous, and metamorphic rocks; earthquakes; plate tectonics; topographic maps; stream processes and groundwater processes.
- This assignment was scholarship related and was only valid during the academic semester.

Undergraduate Student Employee (Technician)
May 1997 – June 2000
Los Alamos National Laboratory, Los Alamos, NM
- Worked with the PCB and Solid Waste Programs within the Hazardous and Solid Waste Group.
- Researched and drafted information in regards to TSCA regulations and other information, including maintenance of the PCB database.
- Conducted walk-through inspections; soil, oil, and swipe sampling; and sample preparation.

Computer Science Lab Assistant (Work study)
September 1997 – May 2000
NMHU, Computer Science Department, Las Vegas, NM
- Maintenance and repair of computer systems. Some networking, troubleshooting, and experience with all installed system applications.
- Customer service and basic tutoring in computer related problems and application familiarity.
- This job was a work-study assignment and was only valid during the academic semester.

Financial Aid Assistant (Work study)
Jan. 1997 – May 1997
UNM-Los Alamos, Los Alamos, NM
- Filed, answered phones, and performed customer service duties.
- Checked students' criteria in qualifying for financial aid.

Gas station attendant
May 1995 – Jan. 1997
Gasamat of Española, Española, NM
- Customer service and basic maintenance.

Supervisor
April 1994 – May 1995
Rio Grande Cinema- Trans-Lux, Española, NM
- Operated and maintained the projector.
- Worked in customer service and sales.
- Supervised other employees.

Misc.
DOE Clearance: Q

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auditable form in the Facility Operating Record. The Permittees shall assign a traceable identifier to this documentation to facilitate both access to this information and its verification by the Permittees and the Department.

2.4.4 Waste Received from Off-Site

If a hazardous waste stream is received at the Facility from an off-site facility identified at Permit Section 2.2.1(1) or (2), the Permittees shall obtain from the facility a detailed characterization of a representative sample of the waste. If acceptable knowledge is used for the waste characterization, the Permittees shall require the facility to provide all acceptable knowledge documentation used to characterize the waste stream (*see* 40 CFR § 270.32(b)(2)). In addition, the Permittees shall ensure that all applicable waste characterization requirements specified in Permit Section 2.4 have been met and documented.

The Permittees shall ensure that the waste matches the identity of the waste designated on the accompanying manifest or shipping paper. If discrepancies between the waste received from an off-site treatment facility and the information on the manifest are found, the Permittees shall comply with the requirements of 40 CFR § 264.72, which is incorporated herein by reference, to resolve the discrepancies.

2.4.5 Treatment-Derived Waste

The Permittees shall characterize treatment-derived wastes generated both on-site and off-site by determining whether the treatment residues meet the applicable treatment standard in accordance with 40 CFR § 268.7(b), which is incorporated herein by reference, unless the Permittees have documented that the purpose of the treatment process is not to attain the applicable treatment standard. The Permittees shall ensure adherence to notification and recordkeeping requirements specified at 40 CFR § 268.7(b)(3)(ii). If the waste remains a hazardous waste, the Permittees shall further characterize it in compliance with the applicable requirements of Permit Section 2.4.1.

2.4.6 Thermal Treatment

The Permittees shall sufficiently characterize any waste stream which has not been previously treated in the thermal process (open burning) to establish appropriate operating conditions (including waste quantity and auxiliary fuel feed) and to determine the type of pollutants which might be emitted (*see* 40 CFR § 270.32(b)). At a minimum, the characterization must determine:

(1) heating value of waste;

(2) waste constituent emission factors;

(3) halogen and sulfur content in the waste; and

(4) concentrations of lead and mercury in the waste, unless the Permittees have written, documented data that show that these elements are not present.

The Permittees may obtain the above-mentioned values from published sources of information.

2.4.7 Waste Characterization Review

The Permittees shall ensure that the initial characterization of any hazardous waste stream managed under this Permit is reviewed or repeated to verify that the characterization is accurate and up to date (*see* 40 CFR § 264.13(b)(4)). The Permittees shall document this review in the Facility Operating Record.

The Permittees shall perform the following:

(1) Annually reëvaluate all hazardous waste streams generated to verify the accuracy of initial and subsequent characterization results. The annual reëvaluation shall be required no later than one year from the date of initial characterization of the hazardous waste stream or one year from the last annual reëvaluation;

(2) Recharacterize hazardous wastes whenever there is a change in the waste-generating processes which includes a change in the status of the waste for purposes of Land Disposal Restrictions or when analytical results indicate a change in the waste stream;

(3) Annually verify the waste characterization of one percent of hazardous waste streams characterized solely by acceptable knowledge (*see* 40 CFR §§ 264.13(b)(4) and 270.32(b)(2)). Such waste characterization verification shall be performed by quantitative chemical analyses appropriate for the waste as specified in Attachment C (*Waste Analysis Plan*). The one percent of wastes whose characterization is to be verified shall be determined in relation to the total number of unique waste streams characterized solely by acceptable knowledge and managed at TA-54 in the previous calendar year. The waste streams whose characterization is to be verified shall be chosen without further bias and the selection procedure shall be documented in the Facility Operating Record. Wastes not required to undergo this annual verification and not to be counted toward the total number of wastes managed in the previous year include mixed transuranic wastes, hazardous debris, and hazardous wastes that are hazardous only because they are listed at 40 CFR Part 261, Subpart D; and

(4) Recharacterize a hazardous waste stream whenever the Permittees are notified by a receiving off-site facility that the characterization of a hazardous waste they obtained from the Permittees' Facility does not match a pre-approved waste analysis certification or accompanying waste manifest or shipping paper. The

PART 6: TREATMENT BY OPEN BURNING

6.1 MANAGEMENT OF OPEN BURNING UNITS

The Permittees shall utilize the two permitted open burning (OB) units at TA-16 only for the treatment of hazardous waste. The Permittees shall treat by open burning only those hazardous wastes that that would result in detonation or deflagration to remove the characteristics of reactivity (D003) and ignitability (D001). The Permittees shall limit open burning treatment activities to the high explosive (HE) waste categories identified in Attachment C (*Waste Analysis Plan*).

The Permittees shall conduct open burning operations in accordance with this Permit Part, Attachment A (*Technical Area (TA) Unit Descriptions*), 40 CFR Part 264, Subpart X, 40 CFR §§ 268.7(b), and 40 CFR Part 270, which are incorporated by reference. The Permittees shall ensure that open burning occurs only at the following two permitted units:

(1) TA-16-388 (Flash Pad); and

(2) TA-16-399 (Burn Tray)

(*see* Figure 16 in Permit Attachment N (*Figures*)).

6.1.2 Maximum Quantity of Waste to be Treated

The Permittees shall treat no more than ~~12,500~~ 6,000 pounds of waste per year cumulatively at the two permitted units.

The Permittees shall not treat at the Flash Pad more than 200 lbs of dry or wet bulk HE per event and no more than 1,000 lbs of HE-contaminated waste per event (see 40 CFR § 270.32(b)(2)).

The Permittees shall not treat at the Burn Tray more than 1,000 lbs of bulk HE per event including 100 lbs of flake trinitrotoluene. No single piece or assembly at the Burn Tray shall exceed 250 pounds (*see* 40 CFR § 270.32(b)(2)).

6.1.3 Specific Requirements for the TA-16-388 Flash Pad

The Permittees shall comply with the following requirements for treatment at the Flash Pad:

(1) Only dry bulk HE, wet bulk HE, and HE-contaminated waste may be treated;

(2) HE-contaminated equipment containing asbestos, unless the asbestos concentrations are in *de minimis* quantities, shall not be treated;

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(3) Liquids (*e.g.*, water, used oils, DMSO) shall have a minimum of 25% by volume of HE (*see* 40 CFR § 270.32(b)(2));

(4) No fuel other than propane shall support open burning (*see* 40 CFR § 270.32(b)(2)). Only two propane burners located on each side of the Flash Pad may be used, except that if HE-contaminated equipment is treated, the Permittees may use the third propane burner. Use of the third burner shall be documented in the Facility Operating Record;

~~(5) A minimum temperature of 400 degrees Celsius shall be attained during open burning to ensure complete thermal degradation of bulk HE and HE contaminated wastes. The Permittees shall measure and record in the Facility Operating Record the temperature achieved for each treatment event, except that for Solid and Scrap HE and HE Process Waste from Water Filtration Waste Categories (*see* Attachment C (*Waste Analysis Plan*) Section C.1.3.2), the Permittees shall instead document in the Facility Operating Record results of burn tests for these two categories, demonstrating that burn temperatures of greater than 400 degrees Celsius are attained during treatment.~~

(6) Wastes shall be placed on the Flash Pad only if treatment is planned within four hours of such placement. However, if oversized equipment requires complex staging, the Permittees may stage the equipment on the Flash Pad for 48 hours; the Department will not consider this staging inappropriate storage. The equipment and the unit must be covered during staging;

(7) All HE-contaminated debris and bulk HE shall be covered with a screen prior to treatment. The Permittees shall place containers holding HE-contaminated liquids (*i.e.*, water, bulk oils, DMSO) in steel trays, or some other form of secondary containment (*e.g.*, additional pan, tray) for the duration of the treatment; and

(8) Equipment to be treated shall be disassembled to the extent practicable.

6.1.4 Specific Requirements for the TA-16-399 Burn Tray

The Permittees shall treat only dry bulk HE at the Burn Tray (*see* 40 CFR § 270.32(b)(2)).

The Permittees shall not treat any HE pieces that contain metal or other materials that could produce shrapnel.

6.2 WASTE PROHIBITIONS AT THE OB UNITS

The Permittees shall not treat by open burning any of the following wastes or materials:

(1) ~~the hazardous component of mixed wastes, and~~ beryllium (*see* 40 CFR § 270.32(b)(2));

(2) chlorinated solvents and ammonium perchlorate (*see* 40 CFR § 270.32(b)(2));

(i) The Permittees shall provide to the Department certification that any listed EPA Hazardous Wastes F003, F004, and F005 treated by open burning contain no chlorinated solvents as defined in 40 CFR §261.31;

(ii) Certification will be included in the Biennial Report;

(3) polyvinyl chloride (PVC);

(4) small control boxes or electronic equipment;

(5) blasting caps, electric detonators, HE units containing electric detonators, or mild detonating fuse arrays;

(6) solvents in bulk quantity except for dimethyl sulfoxide (DMSO) and water. The Permittees shall otherwise treat non-chlorinated solvents, including F003, F004, and F005, only in *de minimis* quantities;

(7) soils contaminated with HE, except that the Permittees may treat filter sands contaminated with HE from the TA-16 HE Waste Water Treatment Facility;

(8) wastes generated during demolition and decommissioning of structures or structural components; and

~~(9) wastes capable of generating dioxins and furans.~~

~~(i) The Permittees shall provide to the Department, prior to each treatment event, a certification that wastes being treated are not capable of generating dioxins and furans.~~

~~(ii) To remove this prohibition, the Permittees must submit to the Department a Class 3 permit modification request that includes a demonstration that the treatment of waste capable of generating dioxins or furans will be conducted in a manner that will ensure protection of human health and the environment.~~

The Permittees are authorized to treat only those wastes identified by EPA Hazardous Waste Numbers (waste codes) listed in Attachment B (*Part A Application*) associated with TA-16 and identified as utilizing waste process code X01.

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6.3 DESIGN, CONSTRUCTION, OPERATION, AND ROUTINE MAINTENANCE REQUIREMENTS

The Permittees shall document in the Facility Operating Record all inspections and activities associated with open burning treatment identified in the subsequent sections of this Permit Part.

~~6.1.1~~6.3.1 Restrictions on Operations

~~6.1.1.1~~6.3.1.1 General

The Permittees shall comply with the following general requirements and restrictions concerning operations at the OB units:

(1) Grasses and shrubs~~Vegetation~~ within a 200 ft radius of the Flash Pad and the Burn Tray shall be trimmed to less than or equal to six inches above the ground surface and the area will be kept free of other combustible material, before treatment. The Permittees shall document compliance with this provision in the Operating Record;

(2) The barricade at TA-16-389 shall be closed for the duration of treatment. Safety barricade will be used during~~ and for~~ the ten-hour cool-down period after treatment to prevent the entry of unauthorized personnel into TA-16-388 or TA-16-399~~the area~~, except as provided in Permit Section 6.3.3.2;

(3) A minimum of 2 people and no more than 5 people shall be present in the TA-16-389 control building for the duration of a treatment event at 1 of the OB units.

(4) The Permittees shall observe in the control building, using a computer or video display, each treatment event for the duration of treatment via the camera located in between the OB units;

(5) A minimum of 24 hours shall elapse between open burning treatment events before reuse of the Flash Pad or the Burn Tray to allow the surface to cool;

(6) The OB units' containment devices (*e.g.,* pans, trays, pads) shall be covered when not in use to prevent precipitation collection and runoff; and

(7) Only non-sparking tools shall be utilized at the OB units when waste is present at 1 of the 2 permitted units.

~~6.1.1.2~~6.3.1.2 Hours of Operation

The Permittees shall comply with the following requirements and restrictions concerning the hours of operation at the OB units:

(1) Open burning treatments shall be conducted only during the time period beginning 1 hour after sunrise and ending 1 hour before sunset; and

(2) Open burning treatments at the Flash Pad and the Burn Tray shall not be conducted concurrently (*see* 40 CFR § 270.32(b)(2)).

~~6.1.1.3~~6.3.1.3 Weather Conditions

The Permittees shall comply with the following requirements and restrictions with respect to weather conditions:

(1) Open burning treatments shall not be conducted when an electrical storm(s) exists within 3 miles of the OB units;

(2) Open burning treatments shall not be conducted during precipitation or inclement weather, or if storms are forecasted to occur within 4 hours at the location of the OB units;

(3) Open burning treatments shall not be conducted when wind speeds at the TA-16-389 control building exceed 15 mph; and

(4) Open burning treatments shall not be conducted during ~~High,~~ Very High, or Extreme Fire Danger classes as designated by the ~~National Oceanic and Atmospheric Administration's National Weather Service~~United States Forest Service. Treatment during High Fire Danger must only occur at wind speeds less than 10 miles per hour (*see* http://www.wrh.noaa.gov/sew/fire/olm/nfdrs.htm).

~~6.1.2~~6.3.2 Run-On and Run Off Controls

The Permittees shall inspect weekly and on the day of treatment, and maintain as necessary, the surface water run-on and runoff control features (*e.g.*, all associated rock retention structures, retaining walls, covers, berms, ditches) associated with the Flash Pad and the Burn Tray (*see* Figure 17 in Attachment N (*Figures)*) (*see* 40 CFR §§ 264.601(b) and 270.32(b)(2), and the Permittees' TA-16 Storm Water Pollution Prevention Plan, as updated).

~~6.1.3~~6.3.3 Routine Maintenance

The Permittees shall conduct the following maintenance and inspection activities prior to treatment events at the OB units:

~~6.1.3.1~~6.3.3.1 Pre-Burn Maintenance

(1) Notify the Permittees' Emergency Management & Response organization and the Los Alamos Fire Department of the start and end times of the scheduled treatment the day before a scheduled treatment event;

(2) Inspect the Flash Pad and the Burn Tray, and its associated equipment, within 24 hours preceding a treatment event;

(3) Inspect the camera located in the TA-16-389 control building to ensure it is functional before HE waste is staged for treatment;

(4) Test the propane burners at the Flash Pad prior to staging waste. The Permittees shall test the squib (*i.e.,* electric match) firing system prior to staging waste to the Burn Tray. The Permittees shall cancel the planned open burn treatment if the burners or squib firing test fails;

(5) Ensure at least 2 and nor more than 4 people are present at the Flash Pad or Burn Tray during waste staging operations, and at least one person is present in the TA-16-389 control building to monitor the staging operations using a computer or video display of images from the camera located between the OB units; and

(6) Patrol the area in the vicinity of the OB units the morning of the scheduled burn to ensure that no large wildlife or unauthorized personnel are present in or around the OB units.

~~6.1.3.2~~6.3.3.2 Post-Burn Maintenance

The Permittees shall cover the waste containment devices (*e.g.,* pans, trays, pads) and inspect the unit and all associated equipment within 10 hours of the last open burn treatment.

~~6.1.3.3~~6.3.3.3 Treatment Residues

The Permittees shall clean the waste containment devices of any treatment residues within 24 hours of a treatment event. If the Permittees find any untreated HE remaining in the residue during inspection of the unit after treatment, the Permittees shall re-treat the waste on that day subject to the restrictions of this Permit Part. If lightning occurs within 3 miles of the unit during residue collection, the Permittees shall cease collection, and resume no more than 4 hours after the storm passes. The residues shall be managed as a hazardous waste until determined otherwise based on waste characterization conducted in accordance with Attachment C (*Waste Analysis Plan*) Section C.3.

6.4 ALTERNATIVE ASSESSMENT

The Permittees shall submit an open burn alternative treatment assessment report to the Department no later than the 8th anniversary of the effective date of this Permit (*see* Permit Attachment I (*Compliance Schedule*)).

6.5 MONITORING REQUIREMENTS

6.5.1 Soil Monitoring Requirements

The Permittees shall conduct a soil sampling and analysis program to establish baseline soil contaminant levels, to monitor for hazardous constituents released to soils during open burning treatment events, and to ensure that any releases do not have an adverse effect on human health or the environment (*see* 40 CFR § 264.602). All sampling events as described in this section shall commence no later than July 1 of the designated sampling year, beginning the first July 1 after the effective date of this Permit. The Permittees shall provide oral and written notification to the Department of the scheduled sampling activities at least 15 days prior to commencing sampling activity.

The Permittees shall analyze the soil samples collected during each monitoring event for total metals, explosive compounds, ~~volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), perchlorate,~~ and dioxins/furans.

The first sampling event (herein referred to as "baseline") shall include collection of soil samples from intervals of 0 to 2 inches below ground surface (bgs) and 5 to 7 inches bgs ~~at the locations identified in Figure 19 in Attachment N (*Figures*)~~. The 0 to 2 inches bgs samples will be collected in accordance with the technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods". The samples collected from 5 to 7 inches bgs will be collected at the locations identified in Figure 19 in Attachment N (*Figures*). The second, third, and fourth sampling events shall occur one year, two years, and four years, respectively, after the baseline sampling event (*see* Attachment I (*Compliance Schedule*)). Sampling events conducted after the baseline shall include at a minimum the 0 to 2 inch depth interval using the multi-incremental sampling technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods"~~at the same locations identified in Figure 19~~. If no treatment was conducted at the OB units between sampling events, the Permittees may propose an alternative sampling schedule. The Permittees shall certify in writing no later than July 31 of the scheduled sampling year that treatment was not conducted since the preceding sampling event.

The Permittees shall submit to the Department a sampling and analysis report for each sampling event summarizing all sampling activities and the results of sample analyses by October 1 of each sampling year (*see* Attachment I (*Compliance Schedule*)). The Permittees shall identify in the report any sample analytical results that exceed either the baseline sampling event, any soil cleanup levels established in Permit Section 11.4.2.1, and any ecological screening levels established at 11.5, as applicable. The Permittees' report shall include a temporal and spatial trend analysis on sample results, and an evaluation of the appropriateness of the number and location of the sampling sites. The Permittees' report shall also include a human health and ecological risk assessment conducted in accordance with U.S. EPA and/or Department guidance or methodologies that includes an evaluation of the cumulative risks for all measured constituents. The Permittees shall include in the report a plan to address any exceedance(s). Upon review

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of the Permittees' report and plan, the Department will determine if further corrective action is needed.

6.5.2 Surface Water Monitoring Requirements

The Permittees shall collect at least 2 storm water samples annually at the surface water sampling location identified in Figure 19 in Attachment N (*Figures)*. The samples shall be collected annually between the months of May and October and shall not be collected within 30 days of each other. The Permittees shall collect the stormwater samples by taking a minimum of 1 grab sample from a discharge, collected within the first 30 minutes of a measurable storm event. If it is not possible to collect the sample(s) within the first 30 minutes of a measurable storm event, the sample(s) shall be collected as soon as practicable after the first 30 minutes, and documentation shall be provided in the report describing the adverse condition(s) and why it was not possible to take samples within the first 30 minutes. The Permittees shall not substitute snow melt runoff for stormwater water samples.

The samples shall be analyzed for total metals and~~,~~ explosive compounds~~, volatile organic compounds, semi-volatile organic compounds, perchlorate, and dioxins/furans~~. If the precipitation event produces insufficient sample volume to perform all analyses, the Permittees will prioritize the list of analytes based on the sample volume collected as follows: 1) explosive compounds and~~;~~ 2) total metals~~; 3) semi-volatile organic compounds; and 4) perchlorate~~. The Permittees shall submit a sampling and analysis report to the Department within 90 days of each sampling event (*see* Attachment I (*Compliance Schedule*)).

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9.4.7.1.ii Soil Sampling Grid for Outdoor Units

The Permittees shall collect soil samples from the soils below the sub-grade, from the soils beneath the pad at the interface of fill and native soil or tuff, and according to the locations in Section 9.4.7.1.ii.a and b of this Permit Part.

9.4.7.1.ii.a Outdoor Storage Units

The Permittees shall collect soil samples at the following locations at the outdoor storage units:

(1) One sample for every 250 square feet in loading and unloading zones;

(2) One sample for every 900 square feet under the pad;

(3) One sample at each discharge point (stormwater run-off locations);

(4) One sample at the discharge point of any underground piping;

(5) One sample directly beneath all sumps and catch basins;

(6) One sample at all secondary containment areas;

(7) One sample at all joints and intersections of piping; and

(8) One sample every 30 feet beneath the axis of the lowest portions of any open conveyance drainage system in any permitted unit that has sloped flooring.

(*see* 40 CFR § 270.32(b)).

9.4.7.1.ii.b Outdoor Treatment Units

The Permittees shall collect samples at the following locations at the outdoor treatment units, as applicable:

(1) One soil sample for every 250 square feet in unloading zones;

(2) One soil sample at each location identified on Figures G.2-1 and G.3-1 in Attachment G (*Closure Plans*);

(3) One concrete chip sample at each location identified on Figures G.2-1 and G.3-1 in Attachment G (*Closure Plans*); and

(4) One sample at the discharge point (stormwater runoff locations) identified in Figure G.2-3.

(*see* 40 CFR § 270.32(b)(2)).

9.4.8 Amendment of the Closure Plan

The Permittees shall submit a permit modification request (*see* 40 CFR § 264.112(c) and Part 270) to seek authorization of a change in the approved closure plan upon the

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3-29 contains gamma alarms that monitor for the presence of gamma radioactive contamination. Continuous air monitors are utilized throughout TA-3-29 to detect airborne radioactive contamination and, when detected, sound an alarm. The building also has a public address system for announcing fires or evacuations. Telephones with paging capabilities are located throughout TA-3-29. Paging telephones are used to page on-site personnel and may be used in the event of an emergency to communicate the location and nature of hazardous conditions to personnel in the area. The alarm system is interrupted when the paging telephone system is activated to allow personnel to hear the announcement. Personnel working in Rooms 9010, 9020, and 9030 can also use these phones to summons assistance from local emergency response teams in case of emergency. Rooms 9010, 9020, and 9030 are equipped with fire extinguishers and pull stations. Depending on the size of a fire and the fuel source, fire extinguishers may be used by on-site personnel. However, the Facility policy encourages immediate evacuation of the area and notification of appropriate emergency personnel. The fire alarm control panel continuously monitors all fire-suppression and detection systems and transmits signals to the Los Alamos County Fire Department through the Facility's central alarm system.

Fire hydrants installed according to National Fire Protection Association standards are located around the outside of TA-3-29. Water is supplied to the fire hydrants by a municipal water system through 8-in. pipes at an adequate volume and pressure (i.e., 200 gallons per minute and 90 pounds per square inch static pressure) to supply a water hose in the event of a fire. Spill kits, which contain sorbent pillows, safety glasses, and gloves, are located at the south end of Room 9010 in enclosures 9010a and 9010b. Trained personnel may use this equipment to mitigate small containable spills when they are certain their actions will not put themselves or others at risk. Available personnel decontamination equipment includes safety showers and emergency eyewashes in enclosures 9010a and 9010b.

Personnel working in Room 9020 have access to the eyewashes in enclosures 9010a and 9010b and a safety shower and emergency eyewash in Room 9030. The buddy system will always be employed when containers are actively managed in Rooms 9010, 9020, and 9030 to assure that safety showers and eyewashes can be reached in an emergency. Material Safety Data Sheets provide useful exposure information and are available in Rooms 9010, Room 9030, and outside Room 9130.

A.2 TA-16

This Section provides an overview of current facility operations and waste management practices for the permitted open burn (OB) units at TA-16. It includes the locations of the OB treatment units, descriptions of the units, and the current operational and waste management practices associated with them. The waste streams treated at these units are described in Table C-6 of Attachment C (*Waste Analysis Plan*).

TA-16 is located in the southwestern quadrant of the Facility at the west end of the Pajarito Plateau near the foothills of the Jemez Mountains (see Figure ~~15~~16 in Attachment N (*Figures*)). The closest property not owned by the Permittees is at a distance greater than one mile from the permitted TA-16 OB units.

The TA-16 OB units (see Figure ~~16~~17 in Attachment N (*Figures*)) are managed by the Permittees' high explosives engineering personnel who are responsible for the safe treatment, storage, and handling of high explosives (HE)-contaminated waste material generated by the HE production facilities.

A.2.1 TA-16-388 Flash Pad

The TA-16-388 Flash Pad is comprised of a 22 by 22 ft concrete pad set on a 45-mil Hypalon liner that is six inches below the bottom of the pad, curved upwards to ground level on all four sides, and extends out two ft from the pad perimeter; the liner acts as secondary containment.

The base of the concrete pad is 12 inches thick. The pad is slanted down toward the back concrete wall providing secondary containment for spills and stormwater run-on and run-off. Inset one foot from the edge of the concrete pad along the two sides and back is a three foot high, eight inch thick, integrally-poured concrete wall.

The heat source for the flash pad consists of five ft long, forced-air, propane burners equipped with adjustable mounts. Burners are located around the pad and are used to burn the high explosives. To accommodate burning of wet explosives on the TA-16-388 Flash Pad, the propane burners can be adjusted appropriately to treat the waste. The configuration of the flash pad and the burners is shown in Figure ~~19~~20 in Attachment N (*Figures*).

The movable steel supports on the pad are used to stage pieces of large HE-contaminated equipment to be treated at the unit. Steel pallets may be positioned in the middle of the flash pad and the materials to be treated are placed on the pallets.

Smaller metal items can be moved by hand. These items are positioned and treated in a steel tray which is lined on the bottom with sand and on the sides with firebrick.

After the unit cools for the appropriate amount of time as required in Permit Part 6, the items can be reoriented for additional treatment, if necessary.

Combustible materials are stacked on the steel trays and covered with a steel screen. The two burners are used to thoroughly ignite the material and may be turned off if the burn is self-sustaining.

A steel tray combined with a smaller steel tray is used to destroy HE contamination in small batches of water or oils. These wastes are received in small polyethylene jars packed in a secondary container. These liquids are placed in the smaller tray and the propane-fired burners are used to ignite combustible gases and apply heat until the liquids are consumed and the HE is destroyed.

Residues from the TA-16-399 HE Burn Tray that require further treatment are also treated at the Flash Pad. These waste types are placed in a tray that is set on an open frame and covered with a steel plate. This assembly shall be set in the middle of another tray.

A.2.2 TA-16-399 HE Burn Tray

The TA-16-399 HE Burn Tray is comprised of a four ft wide, 16 ft long steel tray supported by 1.5-ft-high legs and lined with firebricks (*see* Figure ~~20~~21 in Attachment N (*Figures)*). Explosives to be burned are packed in cardboard and wooden boxes and transported to the HE Burn Tray. Padding is placed on the tray and the explosives are removed from the boxes and set on the padding which is then dampened with kerosene. Electric matches (squibs) are then connected to the firing cables and a train of excelsior saturated with kerosene is run from the squibs to the padding for ignition.

A.2.3 Operational and Waste Management Practices

The TA-16 OB units are located within a secured area at which security is maintained through both administrative controls and physical barriers. Access to the area can only be gained through controlled entry stations by persons possessing appropriate security clearance and site-specific training. The access stations are controlled by high explosives engineering personnel or by 24 hour badge and palm readers. In addition, entry into the permitted units is through an industrial fence with access granted through a controlled station. Security personnel inspect security fences on a regular basis and repairs are made as necessary. The locations of the security fence and access gates at TA-16 are shown on Figure ~~6~~5 in Attachment N (*Figures)*. Before treatment operations are conducted, non-authorized personnel are cleared from the permitted unit and a barrier is placed across the road to reduce the possibility of entry. Warning signs are posted near the entrance to the area and can be seen by personnel approaching the area. The legends on the signs indicate "Danger--Authorized Personnel Only" or "Danger--Unauthorized Personnel Keep Out." Warning signs are legible from a distance of 25 ft and are written in English and Spanish.

A.3 TA-50

TA-50 is located at the northeast corner of the intersection of Pajarito Drive and Pecos Road, on the finger mesa bounded by Mortandad Canyon to the north and Two-Mile Canyon to the south (*see* Figure 21 in Attachment N (*Figures)*). The container storage units at TA-50 include the TA-50-69 Indoor unit (Rooms 102 and 103) and the TA-50-69 Outdoor unit.

The northern and eastern portions of TA-50 drain mainly to an unlined channel on the boundary between TA-50 and TA-35 (east of TA-50), although some flow diverges into a shallow channel running southward between TA-50-37 and TA-50-1.

Security at TA-50 is predominantly maintained with artificial barriers. These barriers prevent the unknowing entry and minimize the possibility for unauthorized entry of persons or livestock into the area.

An 8ft high chain-link security fence surrounds the entire perimeter of TA-50. Bilingual (*i.e.*, English and Spanish) warning signs are posted on the fences at approximately 50 to 75 foot intervals. Warning signs are also posted at the entrances to each area that will manage hazardous and mixed waste and are visible from any approach to these areas. The legends on the posted

Table C-6

Descriptions of High Explosives (HE) Waste and HE-Contaminated Waste Treated by Open Burning at the Facility

(This table is for informational purposes only)

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated ~~Water~~Bulk Solvent Waste	Laboratory analysis; dissolving HE and polymers; HE ~~processing~~production; ~~maintenance~~ and R&D	Acceptable Knowledge[c]	D003	~~Reactivity~~	NA[d]
			~~D005~~	~~Barium~~	~~100.0~~
			~~D006~~	~~Cadmium~~	~~1.0~~
			~~D007~~	~~Chromium~~	~~5.0~~
			~~D008~~	~~Lead~~	~~5.0~~
			~~D009~~	~~Mercury~~	~~0.2~~
			~~D011~~	~~Silver~~	~~5.0~~
			~~D018~~	~~Benzene~~	~~0.5~~
			D030	~~Chloroform~~	0.13
			~~D035~~	1,2-Dichloroethane	~~200.0~~
			~~D036~~	~~2,4-Dinitrotoluene~~	~~2.0~~
			~~D038~~	~~Methyl ethyl ketone~~	~~5.0~~
			~~F004~~	~~Nitrobenzene~~	~~NA[d]~~
			~~F005~~	~~Pyridine~~	~~NA[d]~~
				~~Trichloroethylene~~	~~NA[d]~~
					~~NA[d]~~
HE-Contaminated Used Oils	~~Laboratory analysis; dissolving HE and polymers;~~ HE production; spills; and R&D activities	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D002	Corrosivity	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	0.5
			D022	Chloroform	6.0
			D028	1,2-Dichloroethane	0.5
			D029	1,2-Dichloroethylene	0.7

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated Used Oils			D030	2,4-Dinitrotoluene	0.13
			D035	Methyl ethyl ketone	200.0
			D036	Nitrobenzene	2.0
			D038	Pyridine	5.0
			D040	Trichloroethylene	0.5
			F001	–Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	NA[d]
Solid and Scrap HE	HE-processing; R&D activities; testing operations; disposition of weapons	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D018	Benzene	0.5
			D030	2,4-Dinitrotoluene	0.13

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE Process Waste from Water Filtration	Filtration of HE wastewater; R&D, and HE processing	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	0.5
			D022	Chloroform	0.13
			D028	1,2-Dichloroethane	200.0
			D029	1,2-Dichloroethylene	2.0
			D030	2,4-Dinitrotoluene	5.0
			D035	Methyl ethyl ketone	NA[d]
			D036	Nitrobenzene	NA[d]
			D038	Pyridine	NA[d]
			D040	Trichloroethylene	NA[d]
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	
			F003	Spent nonhalogenated solvents	
			F004	Spent nonhalogenated solvents	
			F005	Spent nonhalogenated solvents	
			K044	Wastewater sludges	
			K045	Spent carbon	

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated Solid Waste	HE processing activities; R&D and laboratory use	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D002	Corrosivity	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	6.0
			D022	Chloroform	6.0
			D028	1,2-Dichloroethane	0.7
			D029	1,1-Dichloroethylene	0.7
			D030	2,4-Dinitrotoluene	200.0
			D035	Methyl ethyl ketone	2.0
			D036	Nitrobenzene	2.0
			D038	Pyridine	5.0
			D040	Trichloroethylene	0.5
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	NA[d]
HE-Contaminated Equipment	HE processing; R&D activities and laboratory use	Acceptable Knowledge[c]	D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D030	2,4-Dinitrotoluene	0.13
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	NA[d]

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
~~HE-Contaminated Solvents in *de minimis* quantities (liquid acids, bases, and Inorganic salt solutions)~~	~~Materials used as titrants, solvents, and cleaning fluids and material from hydrolysis research~~	~~Acceptable Knowledge[c]~~	~~D002~~ ~~D003~~ ~~D018~~ ~~D030~~ ~~D035~~ ~~D036~~ ~~D038~~ ~~F003~~ ~~F004~~ ~~F005~~	~~Corrosivity~~ ~~Reactivity~~ ~~Benzene~~ ~~Chloroform~~ ~~2,4-Dinitrotoluene~~ ~~Methyl ethyl ketone~~ ~~Nitrobenzene~~ ~~Pyridine~~	~~NA[d]~~ ~~NA[d]~~ ~~0.5~~ ~~0.13~~ ~~200.0~~ ~~2.0~~ ~~5.0~~ ~~NA[d]~~ ~~NA[d]~~ ~~NA[d]~~

a U.S. Environmental Protection Agency. Note that these constituents will likely be present only in trace amounts.

b A solid waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, Test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA, 1986), the extract from a representative sample of the waste contains any of the contaminants listed at a concentration equal to or greater than the respective value given in the New Mexico Administrative Code, Title 20, Chapter 4, Part 1, Subpart II, Part 261, Subpart C [6-14-00]. These constituents are included if they are likely to be present; however, they are not expected to exceed the toxicity characteristic limits on a routine basis.

c Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

d Not applicable: refers to the absence of regulatory limits for ignitable, corrosive, reactive wastes, and F-, K-, and U-listed wastes. The amount of F-listed waste is expected to be trace in all waste streams, with the exception of the HE-contaminated spent solvent waste, which is expected to be 30 percent or more (by volume) solvent.

Table C-12

Parameters, Characterization Methods, and Rationale for Parameter Selection for High Explosives (HE) Waste and HE-Contaminated Waste

Waste Description	Parameter[a]	Characterization Method	Rationale
HE-Contaminated ~~Water~~Bulk Solvent Waste	– Ignitability – Reactivity – Toxicity – ~~Solvents from non-specific sources~~ – 25% by volume HE	– Acceptable Knowledge[b] – Field screening – Sampling and analysis – SW846 methodology	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (metals and organics) ~~– Determine the presence of F-listed solvents~~
HE-Contaminated Oil~~/Solvent~~ Waste	– Corrosivity – Ignitability – Reactivity – Toxicity – Solvents from non-specific sources – 25% by volume HE	– Acceptable Knowledge[b] – Sampling and analysis – SW846 methodology	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics) – Determine the presence of F-listed solvents
Solid and Scrap HE (i.e., bulk HE)	– Ignitability – Reactivity – Toxicity	– Acceptable Knowledge[b]	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (barium and dinitrotoluene)
~~HE-Contaminated Commercial Chemical Products~~	~~– Ignitability~~ ~~– Reactivity~~ ~~– Spill residues from commercial products~~	~~– Acceptable Knowledge[b]~~	~~– Determine characteristic for ignitability and reactivity~~ ~~– Determine the presence of U-listed wastes~~
~~Wet~~ HE Process Waste From Water Filtration	– Ignitability – Reactivity – Toxicity – Solvents from non-specific sources – Specific source wastes (K wastes)	– Acceptable Knowledge[b]	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F- and K-listed solvents

Refer to footnotes at end of table.

Table C-12 (continued)

Waste Description	Parameter[a]	Characterization Method	Rationale
HE-Contaminated Solid Waste (heterogeneous)	– Ignitability – Corrosivity – Reactivity – Toxicity – Solvents from non-specific sources	– Acceptable Knowledge[b] – Field screening – Sampling and analysis – Visual examination	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F-listed solvents
HE-Contaminated Solid Waste (homogeneous, i.e., sand)	– Ignitability – Corrosivity – Reactivity (i.e., 10% by weight) – Toxicity – Solvents from non-specific sources	– Acceptable Knowledge[b] – Field screening – Sampling and analysis	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F-listed solvents
HE-Contaminated Equipment	– Reactivity – Toxicity	– Acceptable Knowledge[b] – Field screening – Sampling and analysis	– Determine characteristic for reactivity – Determine toxicity characteristic (dinitrotoluene and metals)
~~HE-Contaminated Liquid Acids, Bases, and/or Inorganic Salt Solutions~~	~~– Corrosivity~~ ~~– Reactivity~~ ~~– Toxicity~~ ~~– Solvents from non-specific sources~~ ~~– 25% by volume HE~~	~~– Acceptable Knowledge[b]~~ ~~– Field screening~~ ~~– Sampling and analysis~~ ~~– SW846 methodology~~	~~– Determine characteristic for corrosivity and reactivity~~ ~~– Determine toxicity characteristic (organics)~~ ~~– Determine the presence of F-listed solvents~~

[a] Parameter selection is based on process knowledge for each waste stream. Additional parameters may be selected for each waste stream as necessary.

[b] Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

Table C-13

Summary of Characterization Methods for High Explosives (HE) Waste and HE-Contaminated Waste

Parameters	Method Numbers	Test Method	Rationale
HE in the Waste	SW-846 (Appropriate analytical method from the Method 8300 series)[a]	High Performance Liquid Chromatography or Acceptable Knowledge[b]	Determine HE concentrations directly in homogeneous materials or by process information.
		DX-2 Spot Test, DeTech, or other screening methods	Determine if HE is present in the waste stream.
		Acceptable Knowledge[b]	If all surfaces of heterogeneous waste cannot be directly tested or visually examined (e.g., debris or equipment) and the waste object was potentially contaminated with HE during its use.

[a] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.

[b] Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

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TA-16

ATTACHMENT D

CONTINGENCY PLAN

TA-16
ATTACHMENT D
CONTINGENCY PLAN

Specific information on emergency response resources and release prevention/mitigation at TA-16 is provided below. Emergency equipment currently available for use at the TA-16 Burn Ground is included as Table D-1 below.

D.1 EMERGENCY RESPONSE RESOURCES

The High Explosives Engineering personnel are responsible for the TA-16 OB units. Appropriate personnel have been trained in emergency procedures.

D.2 RESPONSIBILITY

At TA-16, High Explosives Engineering personnel are responsible for correction of a nonsudden release from the TA-16 OB units if the correction can be performed safely with normal maintenance and management procedures. Personnel from the Emergency Management and Response Office may provide assistance in mitigating releases. Any correction methods for nonsudden releases that have resulted in an impact to the environment will be coordinated with the New Mexico Environment Department.

D.3 REMEDIAL ACTION

Contingency or emergency measures are unanticipated "fires, explosions, or any unplanned sudden or non-sudden release of hazardous waste . . ." for which a schedule of remedial actions cannot be reasonably ascertained. Any remedial actions carried out under the provisions of the Contingency Plan will be performed as soon as possible to ensure protection of human health and the environment, as described in Attachment D. These remedial actions may include site cleanup; proper handling of recovered waste, contaminated soil, or contaminated surface water; decontaminating equipment, as needed; replacing or repairing equipment, as needed; and testing to verify successful cleanup.

High Explosives Engineering personnel conduct regularly scheduled inspections at TA-16 to detect deterioration and/or failure of containment at the TA-16 OB units. If an inspection reveals deterioration or failure, personnel ensure that maintenance or replacement is performed, as appropriate.

D.4 REFERENCES

LANL, 2002, "Los Alamos National Laboratory General Part B Permit Renewal Application", Revision 2.0, August 2002, LA-UR-03-5923, Los Alamos National Laboratory, Los Alamos, New Mexico.

LANL, 2003, "Los Alamos National Laboratory Technical Area 16 Part B Permit Renewal Application", Revision 4.0, June 2003, LA-UR-03-3903, Los Alamos National Laboratory, Los Alamos, New Mexico.

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TABLE D-1

TA-16

Emergency Equipment

FIRE CONTROL EQUIPMENT

Fire extinguishers are located at or in:

Tank-truck garage (TA-16-1507)
Control Building (TA-16-389)
High Explosives Wastewater Treatment Facility (HEWTF) (TA-16-1508)
Each truck used to transport high explosives

General Capabilities
These portable units may be used by any properly trained employee in the event of fire.

Seven fire hydrants are located at the TA-16 Burn Ground.

General Capabilities
The fire hydrants will supply water at adequate volume and pressure to satisfy the requirements of 40 CFR § 264.32(d).

Water spigots are located at TA-16-388 and TA-16-399.

A fire alarm pull station is located at the HEWTF.

The Central Alarm Station is notified before all open burning operations. In dry conditions, when operations may result in a grass fire, the Los Alamos County Fire Department is notified and requested to prepare to respond.

SPILL CONTROL

Portable berms to contain spills are stored in an all-weather cabinet near the center of the TA-16 Burn Ground, at the less-than-90-day storage area (TA-16-386), and beside the Control Building.

COMMUNICATION EQUIPMENT

Telephones are available at the Control Building, at the HEWTF, and at the railroad gate at the entrance to the Burn Ground.

General Capabilities
Telephones for internal and external communication are available for use by all employees.

DECONTAMINATION EQUIPMENT

Eyewash stations are located in the tank-truck garage and in the HEWTF.

Water spigots with hoses attached are available at the TA-16-388 Flash Pad/Burn Tray and the TA-16-399 HE Burn Tray for general wash down.

Material Safety Data Sheets (MSDS) are available at the Control Building.

General Capabilities

Eyewashes are used by personnel who receive a chemical splash to the eyes. MSDSs for the chemical(s) should be obtained prior to working with hazardous waste or hazardous material to determine if the application water is indicated for decontamination. The MSDSs are also maintained to provide information during emergency response.

PERSONNEL PROTECTION EQUIPMENT

Respirators, coveralls, and safety glasses are available for TA-16 personnel during waste-handling operations.

All vehicles are equipped with first-aid kits.

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15. Aboveground portions of tank systems to detect corrosion or releases of waste, overfill and spill control equipment, tank monitoring and leak detection systems, and data from these systems
16. Proper operating condition of treatment tank (if applicable)

E.4 INSPECTION SCHEDULE AND REQUIREMENTS FOR OPEN BURN UNITS

The Permittees shall inspect open burn units according to the schedule provided below.

E.4.1 On Day of Treatment

The Permittees shall conduct inspections every day of operation (i.e., every day that open burning occurs). For inspections conducted on the day of treatment at an open burn unit, the following items will be addressed, as applicable:

1. General IRF information (Items 1-6)
2. Secondary containment structures (if applicable)
3. Open Burn run on runoff control
4. (Un)loading area(s)

E.4.2 Weekly

The Permittees shall inspect open burn units weekly for the following items, as applicable:

1. General IRF information (Items 1-6)
2. Communications equipment
3. Warning signs
4. Security
5. Work surfaces
6. Spill/fire equipment
7. Eyewashes and safety showers
8. Wind sock (if applicable)
9. Secondary containment structures (if applicable)
10. Open burn unit run on and runoff control
11. Open burning units covered when not in use
12. (Un)loading area(s)

E.5 INSPECTION SCHEDULE AND REQUIREMENTS FOR STABILIZATION UNITS

The Permittees shall inspect stabilization units according to the schedule provided below.

E.5.1 Daily (During Operation

The Permittees shall inspect stabilization units each operating day (i.e., when waste is treated in the unit). The Permittees shall inspect and record the following items, as applicable.

1. General IRF information (Items 1-6)
2. Warning signs
3. Work surfaces and floors

~~INTERIM STATUS CLOSURE PLAN~~ [1]

OPEN BURN TREATMENT UNIT

TECHNICAL AREA 16-388 FLASH PAD

Summary of Comments on Microsoft Word - TA-16-388 closure plan_IS_CLEAN_ 2.1.10.doc

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ATTACHMENT G.2

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1.0 INTRODUCTION

This closure plan describes the activities necessary to close the hazardous waste open burning treatment unit at Technical Area 16 (TA-16-388) at the Los Alamos National Laboratory (Facility), hereinafter referred to as the unit. The information provided in this closure plan addresses the closure requirements specified in the Code of Federal Regulations (CFR), Title 40, Part 265, Subparts G and P for hazardous waste thermal treatment units at the Facility under the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act.

Until closure is complete and has been certified in accordance with Section 5.0 of this closure plan and 40 CFR § 265.115, a copy of the approved closure plan, any approved revisions, and closure activity documentation associated with the closure will be on file with hazardous waste compliance personnel at the Facility and at the U.S. Department of Energy (DOE) Los Alamos Site Office. Prior to closure of the unit, this closure plan may be amended in accordance with Section 4.3 of this closure plan and 40 CFR § 265.112(c), as necessary and appropriate, to provide, at a minimum, updated sampling and analysis plans and to incorporate updated decontamination technologies. Amended closure plans shall be submitted to the New Mexico Environment Department (Department) for approval prior to implementing closure decontamination and sampling activities.

2.0 DESCRIPTION OF UNIT TO BE CLOSED

This section provides an overview of past facility operations and waste management practices at the unit. It includes the location of the unit, a description of the unit, and past operational and waste management practices associated with it.

TA-16 is located in the southwestern quadrant of the Facility at the west end of the Pajarito Plateau near the foothills of the Jemez Mountains (*see* Figure 1). The unit was managed by the owner/operator's high explosives engineering personnel who are responsible for the safe treatment, storage, and handling of high explosives (HE) waste and HE contaminated waste generated by the HE production facilities.

2.1 Description of the Wastes Treated at the Unit

The wastes treated at the unit consisted of detonable quantities of high explosives (HE) waste (*i.e.*, bulk wet, dry HE) and HE contaminated wastes (*i.e.*, combustible and non-combustible solids, oils and solvents from equipment, water). HE-contaminated combustible solids include HE filter socks, paper, and rags; HE contaminated non-combustible solids include metal piping, equipment, and concrete.

2.2 Description of the Treatment Unit

The unit (*see* Figure 2) is comprised of a 22 foot by 22 foot concrete pad set on a 45-mil Hypalon liner that is six inches below the pad. The pad is curved upwards to ground level on all four sides and extends out two feet from the pad perimeter. The liner acts as secondary containment. The base of the concrete pad is 12 inches thick. The pad is slanted down toward the back concrete wall providing secondary containment for spills and stormwater run-on and run-off. Inset one foot from the edge of the concrete pad along the two sides and back is a three foot high, eight inch thick, integrally-poured concrete wall.

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2.3 Description of Treatments Conducted at the Unit

The heat source for the unit consisted of three five feet long, forced-air, propane burners equipped with adjustable mounts. The burners were positioned around the pad and were used to burn the HE waste and HE contaminated waste. Configuration of the unit is shown in Figure 3.

He waste and HE contaminated waste were treated at the unit in the following ways. The movable steel supports on the pad were used to stage pieces of large HE-contaminated equipment treated at the unit. Steel pallets were positioned in the middle of the pad and the materials treated were placed directly on the pallets; all three burners were used to treat the HE contaminated equipment.

Smaller metal items were moved manually for treatment. These types of items were positioned and treated in a steel tray lined on the bottom with sand and on the sides with firebrick. Combustible HE contaminated wastes were stacked on the steel trays and covered with a steel screen prior to treatment. Two of the three burners were used to thoroughly ignite the waste and then turned off when the burn was self-sustaining.

Small batches of HE contaminated water, solvents, and oils were placed in a steel tray, which was then placed into a second smaller steel tray, before treatment. These wastes were delivered to the unit in small polyethylene jars packed in a secondary container. These liquids were placed in the smaller tray and the burners were ignited until the liquids were consumed and the HE destroyed.

Residues from the TA-16-399 unit that required further treatment were also treated at the unit. This waste was placed in a tray which was then set on an open frame and covered with a steel plate. This assembly was set in the middle of another tray.

3.0 ESTIMATE OF MAXIMUM WASTE TREATED

Approximately 520,000 pounds of solids contaminated with HE and 840 gallons of liquids contaminated with HE have been treated at the unit since 1980.

4.0 GENERAL CLOSURE INFORMATION

4.1 Closure Performance Standard

The unit will be closed to meet the following performance standards:

a. remove all hazardous waste residues and hazardous constituents;

b. ensure contaminated media do not contain concentrations of hazardous constituents greater than the clean-up levels established in accordance with Section VIII of the March 1, 2005 *Compliance Order on Consent* (Order). For soils the cleanup levels shall be established based on residential use. The owner/operator must also demonstrate that there is no potential to contaminate groundwater.

If the owner/operator is unable to achieve any one of the clean closure standards in (a) or (b) above, they must:

c. control hazardous waste residues, hazardous constituents, and, as applicable, contaminated media such that they do not exceed a total excess cancer risk of 10^{-5} for carcinogenic substances and, for

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non-carcinogenic substances, a target Hazard Index of 1.0 for human receptors, and meet Ecological Screening Levels established in Section VIII of the Order;

d. minimize the need for further maintenance;

e. control, minimize, or eliminate, to the extent necessary to protect human health and the environment, the post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground, groundwater, surface waters, or to the atmosphere; and

f. comply with the closure requirements of 40 CFR Part 265 Subparts G and P.

Closure of the unit will be deemed complete when: 1) all surfaces and equipment have been decontaminated, or otherwise properly managed as waste; 2) closure has been certified by an independent, professional engineer licensed in the State of New Mexico; and 3) closure certification has been submitted to, and approved by, the Department.

4.2 Closure Schedule

Interim status shall be terminated upon the effective date of the Secretary's final administrative disposition (*see* 40 CFR § 270.73(a) and NMAC 20.4.1.901(A)(10)), which are incorporated herein by reference) of the owner/operator's permit application. The beginning of closure for this unit shall be marked by termination of the unit's interim status.

The owner/operator shall begin closure activities no later than 30 days after the loss of interim status. However, decontaminating or dismantling equipment, in accordance with this closure plan, may be conducted at any time before or after the loss of interim status.

The owner/operator shall complete the records review (review) and structural assessment (assessment), as described in Sections 5.1.1 and 5.1.2 of this closure plan, no later than 40 days after the loss of interim status. The owner/operator shall notify the Department at least 20 days prior to the scheduled assessment so the Department may have the opportunity to participate in the assessment. The notification shall include the date on which the owner/operator expects to conduct the assessment.

The owner/operator shall complete all closure activities, including submittal of a final closure certification report to the Department for review and approval, in accordance with this closure plan and within 180 days of the Secretary's approval of this closure plan (*see* 40 CFR § 265.113(b)). In the event that this timeframe can not be met, the owner/operator may request from the Department an extension in accordance with 40 CFR § 265.113(c)(2) (*see* 40 CFR § 265.113(b)(1)(i)).

4.3 Amendment of the Closure Plan

The owner/operator may amend this closure plan in accordance with the requirements in 40 CFR § 265.112(c), which is incorporated herein by reference. If results of the review or assessment require any changes to this closure plan (*e.g.*, the sampling and analysis plan), the owner/operator shall submit an amended closure plan to the Department, for review and approval, in accordance with this Section (4.3).

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5.0 CLOSURE PROCEDURES

Closure activities at the unit shall include: a physical review of the unit and a review of the unit's records; proper management and disposal of hazardous waste residues, if applicable, and contaminated surfaces and equipment associated with the unit; sampling to verify the closure performance standards in Section 4.1 of this closure plan have been achieved; and submittal of a final closure certification report. The following sections describe more specifically these closure activities applicable to the unit.

5.1 Records Review and Structural Assessment

Before starting closure decontamination and sampling activities, the Operating and Inspection Records for the unit will be reviewed and a structural assessment will be conducted to determine any previous finding(s) or action(s) that may influence closure activities or potential sampling locations.

5.1.1 Records Review

The Facility Operating Record (including, but not limited to, inspection and contingency plan implementation records) shall be reviewed at the time of closure and in accordance with the schedule in Section 4.2 of this closure plan. The goals of the review will be to:

a. confirm the specific hazardous waste constituents of concern listed in Table 6 of this closure plan;

b. update the above-mentioned list as necessary; and

c. confirm additional sampling locations (*e.g.*, locations of spills or chronic conditions identified in the Facility Operating and Inspection Records).

The owner/operator shall determine whether any spills or releases, defects, deterioration, damage, or hazards (*e.g.,* damage to the asphalt or concrete pads or other unit materials) affecting waste containment or treatment occurred or developed during the operational life of the unit during which hazardous waste was treated. If the records indicate any such incidents, the owner/operator shall amend this closure plan (*see* Section 4.3) in order to update the SAP (*see* Section 6.0) to incorporate the locations of these incidents as additional sampling locations. All additional sampling procedures, as applicable, shall be included in the amended closure plan.

5.1.2 Structural Assessment

The structural assessment is an assessment of the unit's physical condition. The assessment will include inspecting the unit's concrete and asphalt pads and the concrete side walls (for any existing cracks or conditions that indicate a potential for release of hazardous constituents) and assessing the unit for evidence of any releases. If the assessment reveals any evidence of a release (*e.g.*, stains) or damage (*e.g.*, cracks, gaps, chips) to the pads or side walls, the owner/operator shall amend this closure plan (*see* Section 4.3) in order to update the SAP (*see* Section 6.0) to incorporate these additional sampling locations. All additional sampling procedures, as applicable, shall be included in the amended closure plan. This assessment will be documented with photographs and drawings, as necessary.

5.2 Decontamination and Removal of Structures and Equipment

In accordance with 40 CFR § 265.112(b)(4) (which is incorporated herein by reference), the unit's related equipment and materials (*e.g.*, concrete pad) will be decontaminated, or removed, or both and managed

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according to Section 7.0 of this closure plan. All surfaces and related equipment that are removed and not intended for ~~recycle~~ [1]ill not require decontamination, will be considered solid and potentially hazardous waste when removed, and will be disposed of in accordance with Section 7.0. Decontamination activities will ensure the removal of all hazardous waste residues and hazardous waste constituents from the unit to meet the closure performance standards in Section 4.1.

5.2.1 Removal of Structures and Related Equipment

The burn tray, the three propane burners, the metal retractable cover (and its mechanisms) will all be removed from the unit at closure (but after the structural assessment)[2] ~~and will not be recycled~~.

5.2.2 Decontamination of Structures and Related Equipment

The unit's concrete pad and side walls will be decontaminated by steam cleaning or pressure washing with a solution consisting of a surfactant detergent (*e.g.*, Alconox®) and water mixed in accordance with the manufacturer's recommendations. Portable berms or other such devices (*e.g.*, absorbent socks, plastic sheeting, wading pools, existing secondary containment) will collect excess wash water and provide containment during the decontamination process. If results of the solid concrete chip or soil samples (*see* Section 6.1) from below the pad indicate contamination, the entire concrete pad, along with the 45 mil Hypalon liner under the pad, will be removed and disposed of according to Section 7.0.

No equipment at the unit is expected to be left in place. However, if equipment, identified during the assessment, is expected to be left in place, it will be decontaminated by pressure-washing or steam-cleaning and sampled according to Section 6.1.

5.2.3 Equipment Used During Decontamination Activities

Reusable protective clothing, tools, and equipment used during decontamination activities will be cleaned with a wash water solution. Residue, disposable equipment, and small reusable equipment that cannot be decontaminated will be containerized and managed as waste in accordance with Section 7.0.

6.0 SAMPLING AND ANALYSIS PLAN

This SAP identifies the specific sampling and analysis requirements for this unit and ensures the closure requirements of 40 CFR Part 265 Subparts G and P are met. It also describes the sampling, analysis, and quality assurance/quality control (QA/QC) methods that will be used to demonstrate that the owner/operator has met the closure performance standards in Section 4.1. The owner/operator shall comply with all the requirements in this closure plan section (6.0) as well as the requirements in Section IX of the Order.

This SAP is designed to:

1) verify decontamination of surfaces, equipment, and materials; and
2) determine whether a release of hazardous constituents to any environmental media has occurred.

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It includes:

3) A list of hazardous constituents of concern (*see* Table 6) for which soil, surface water, wipe, and chip samples will be analyzed. This list includes all hazardous constituents defined as:

   a) any constituent identified in 40 CFR Part 261 Appendix VII that caused the United States Environmental Protection Agency (EPA) to list a hazardous waste in 40 CFR Part 261 Subpart D;

   b) any constituent identified in 40 CFR Part 261, Appendix VIII; or

   c) any constituent identified in 40 CFR Part 264 Appendix IX, perchlorate, and nitrates.

   The list of hazardous constituents of concern shall be utilized to select the analytical methods capable of detecting those constituents;

4) A site plan for verification and soil samples. The site plan shall include, as applicable:

   a) a figure depicting the boundaries of the unit and verification and soil sampling locations. The locations include:

      1. discharge points (*e.g.*, storm water run-off location) (*see* Figure 7);
      2. secondary containment areas;
      3. conveyance systems (*e.g.*, pipe drains, drainage swales);
      4. locations of known spills or other releases of hazardous waste or hazardous constituents during operation of the unit;
      5. one verification sample every 250 square feet or less in the unloading zone;
      6. one verification sample every 900 square feet or less on the concrete pad;
      7. other potential release locations;
      8. one concrete chip sample at each location identified on Figure 4; and
      9. one sample at each location identified on Figures 5 and 6;

   b) a rationale for the number and locations of samples.

5) Type of samples. The type of samples to be collected (*e.g.*, wipe, chip, soil, surface water) and the rationale for the selection of the sample type;

6) Sampling methods. A description of the approved EPA *SW-846* sampling methods and procedures that will be used to collect each type of sample;

7) Analytical methods. A description of the approved EPA *SW-846* laboratory analytical methods that will be used to measure hazardous constituent concentrations; and

8) quality assurance and quality control (QA/QC) procedures. This SAP includes a description of the QA/QC procedures that include, but are not limited to:

   a) duplicates, trip blanks, equipment blanks;

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b) a description of methods for decontamination of re-usable sampling equipment; and

c) a description of all sample preservation, handling, labeling, and chain-of-custody procedures.

6.1 Sampling Activities

Sampling activities will be conducted to demonstrate that unit-related equipment, surfaces, surface water, and soils meet the closure performance standards in Section 4.1. All samples will be collected and analyzed in accordance with the procedures in Sections 6.2, 6.3, and 6.4 of this closure plan.

One wipe sample will be collected from each piece of decontaminated equipment related to the unit.

One verification solid concrete chip sample will be collected from a random location on the floor of the 22-foot by 22-foot concrete pad base and one will be collected from each of the three (the inner-facing sides) 3-foot-high, 8-inch-thick concrete side walls, for a minimum total of four solid chip samples (*see* Figure 4).

~~Soil samples shall be collected from the six sample locations indicated in Figure 5 and the 37 sample locations indicated in Figure 6.~~ These locations include, but are not limited to, the following:

a. soils surrounding the unit;

b. soils in the vicinity of the unit;

~~c. soils from beneath the asphalt pad where waste was offloaded from vehicles for treatment; and~~

~~d.~~ soils at the stormwater discharge point.

One surface water sample shall be collected at the stormwater sampling location identified in Figure 7; snow melt run-off shall not be substituted for storm water samples. The owner/operator shall collect a storm water sample (collected within the first 30 minutes of a measurable storm event) by taking a grab sample from a discharge. The sample shall be analyzed for total metals, explosive compounds, semi-volatile organic compounds, perchlorate, and dioxins/furans. If the precipitation event produces insufficient sample volume to perform all analyses, the owner/operator shall prioritize the list of analytes based on the sample volume collected as follows: 1) explosive compounds; 2) total metals; 3) semi-volatile organic compounds; and 4) perchlorate.

If it is not possible to collect the sample within the first 30 minutes of a measurable storm event, the sample shall be collected as soon as practicable after the first 30 minutes. An explanation shall be provided in the closure report describing the adverse condition(s) and why it was not possible to take samples within the first 30 minutes.

6.2 Sample Collection Procedures

Samples will be collected in accordance with the procedures identified in this SAP which incorporates guidance from the EPA (EPA, 2002), DOE (DOE, 1995), and other Department-approved procedures.

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Six soil samples will be collected using the multi-incremental sampling technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." Each soil sample will be a composite of at least 30 individual samples from locations around the unit.

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6.2.1 Liquid Sampling

Liquid samples will be collected and analyzed to determine if hazardous constituents are present in surface waters as a result of run-off from the unit. Liquid samples will be collected using glass or plastic tubes, a composite liquid sampler, a bacon bomb, a bailer, or by pouring liquid in sample containers.

6.2.2 Soil Sampling

Soil samples will be collected from soils below the sub-grade and beneath the pad at the interface of fill and native soil or tuff. They shall be analyzed to determine if hazardous constituents are present in soils at, or in the vicinity of, the unit.

Soil samples will be collected using a spade, scoop, auger, trowel or other tool as specified in approved methods for the type of analyte to be sampled (*i.e.*, EPA 1996 or 2002). Samples will be kept at their at-depth temperature or lower, protected from ultraviolet light, sealed tightly in the recommended container, and analyzed within the specific holding times listed in Table 4.

6.2.3 Wipe Sampling

Surface wipe samples will be collected and analyzed to determine if residual hazardous constituents remain on surfaces and equipment at the unit. Samples will be collected in accordance with the National Institute of Occupational Safety and Health (NIOSH) *Manual of Analytical Methods* (NIOSH, 1994). The appropriate wipe sample method will consider the type of surface being sampled, the type of constituent being sampled, the solution used, and the desired constituent detection limit.

The NIOSH method includes wiping a 100 square centimeter area at each discrete location with a gauze wipe wetted with a liquid solution appropriate for the desired analysis (*e.g.*, deionized water for lead). For wipe sampling, guidance from the analytical laboratory shall be obtained prior to wipe verification sampling to confirm that the solution chosen for each analysis is appropriate for the analysis to be conducted and that wipe sampling is a proper technique for the analysis.

6.2.4 Solid Chip Sampling

Solid chip samples will be collected and analyzed to verify if residual hazardous constituents remain on the concrete pad and side walls of the unit. Any non-porous inclusions from the sampling location will be removed by brushing or wiping. Using a chisel, drill, hole saw, or similar tool, a minimum 100 grams of the sample will be collected to a depth of 2 centimeters or to an alternate depth specified in the assessment. The material will be transferred to an appropriate container and the holding time and the preservation techniques to be used for each analysis will be selected from those listed on Table 4.

6.2.5 Cleaning of Sampling Equipment

A disposable sampler is considered clean only when directly removed from a factory-sealed wrapper. Reusable decontamination equipment, including protective clothing and tools, and sampling equipment used during closure activities will be scraped, as necessary, to remove residue, cleaned prior to each use with a wash solution, rinsed several times with tap water, and air-dried to prevent cross-contamination of samples. Sampling equipment rinsate blanks will be collected and analyzed only if reusable sampling equipment is used.

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6.3 Sample Management Procedures

The following sections provide a description of sample documentation, handling, preservation, storage, packaging, and transportation requirements that will be followed during the sampling activities associated with the closure.

6.3.1 Sample Documentation

Sampling personnel will complete and maintain records to document sampling and analysis activities. Sample documentation will include: sample identification numbers; chain-of-custody forms; analysis requested; sample logbooks detailing sample collection activities; and shipping forms (if necessary).

6.3.1.1 Chain-of-Custody

Chain-of-custody forms will be maintained by sampling personnel until the samples are relinquished to the analytical laboratory. This will ensure the integrity of the samples and provide for an accurate and defensible written record of the sampling possession and handling from the time of collection until laboratory analysis. One chain-of-custody form may be used to document all of the samples collected from a single sampling event. The sample collector will be responsible for the integrity of the samples collected until properly transferred to another person. The EPA considers a sample to be in a person's custody if it is:

a. in a person's physical possession;

b. in view of the person in possession; or

c. secured by that person in a restricted access area to prevent tampering.

The sample collector will document all pertinent sample collection data. Individuals relinquishing or receiving custody of the samples will sign, date, and note the time on the analysis request and chain-of-custody form. A chain-of-custody form must accompany all samples from collection through laboratory analysis. The analytical laboratory will return the completed chain-of-custody form to the Facility and it will become part of the permanent sampling record documenting the sampling efforts.

6.3.1.2 Sample Labels and Custody Seals

A sample label will be affixed to each sample container. The sample label will include the following information:

a. a unique sample identification number;

b. name of the sample collector;

c. date and time of collection;

d. type of preservatives used, if any; and

e. location from which the sample was collected.

A custody seal will be placed on each sample container to detect unauthorized tampering with the samples. These labels must be initialed, dated, and affixed by the sample collector in such a manner that it is necessary to break the seal to open the container.

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6.3.1.3 Sample Logbook

All pertinent information on the sampling effort must be recorded in a bound logbook. Information must be recorded in ink and any cross outs must be made with a single line and the change initialed and dated by the author. The sample logbook will include the following information:

a. the sample location;
b. suspected composition;
c. sample identification number;
d. volume/mass of sample taken;
e. purpose of sampling;
f. description of sample point and sampling methodology;
g. date and time of collection;
h. name of the sample collector;
i. sample destination and how it will be transported;
j. observations; and
k. name(s) of personnel responsible for the observations.

6.3.2 Sample Handling, Preservation, and Storage

Samples will be collected and containerized in appropriate pre-cleaned sample containers. Table 6 presents the requirements in *SW-846* (EPA, 1986) for sample containers, preservation techniques, and holding times. Samples that require cooling to 4 degrees Celsius will be placed in a cooler with ice or ice gel or in a refrigerator immediately upon collection.

6.3.3 Packaging and Transportation of Samples

All packaging and transportation activities will meet safety expectations, QA requirements, DOE Orders, and relevant local, state, and federal laws (including 10 CFR and 49 CFR). Appropriate Facility documents establish the requirements for packaging design, testing, acquisition, acceptance, use, maintenance, and decommissioning and for on-site, intra-site, and off-site shipment preparation and transportation of general commodities, hazardous materials, substances, waste, and defense program materials.

Off-site transportation of samples will occur via private, contract, or common motor carrier, air carrier, or freight. All off-site transportation will be processed through the Facility packaging and transportation organization unless the shipper is specifically authorized through formal documentation by that organization to independently tender shipments to common motor or air carriers.

6.4 Sample Analysis Requirements

Samples will be analyzed for all hazardous constituents listed in Table 2; if at closure it has been determined that other constituents listed in Appendix VIII of 40 CFR Part 261 and in Appendix IX of 40 CFR Part 264 were managed or treated at the unit over its operational history, this closure plan shall be amended to include those constituents for sampling and analysis. Samples will be analyzed by an

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independent laboratory using the methods outlined in Table 3. Analytes, test methods and instrumentation, target detection limits, and rationale for metals and organic analyses are presented in Table 3. If any of the information from these tables has changed at the time of closure, the owner/operator will amend this closure plan to update all methods in this SAP.

6.4.1 Analytical Laboratory Requirements

The analytical laboratory will perform the detailed qualitative and quantitative chemical analyses specified in Section 6.4.2. This analytical laboratory will have:

a. a documented comprehensive quality assurance/quality control (QA/QC) program;

b. technical analytical expertise;

c. a document control/records management plan; and

d. the capability to perform data reduction, validation, and reporting.

The selection of the analytical testing methods identified in Table 3 is based on the following considerations:

e. the physical form of the waste;

f. constituents of interest;

g. required detection limits (*e.g.*, regulatory thresholds); and

h. information requirements (*e.g.*, waste classification).

6.4.2 Quality Assurance/Quality Control

All sampling and analysis will be conducted in accordance with QA/QC procedures defined by the latest revision of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (*SW-846*) (EPA, 1986) or other Department-approved procedures. Field sampling procedures and laboratory analyses will be evaluated through the use of QA/QC samples to assess the overall quality of the data produced. QC samples evaluate precision, accuracy, and the potential for sample contamination associated with the sampling and analysis process which is described in the following sections. Information on calculations necessary to evaluate the QC results is also described below.

6.4.2.1 Field Quality Control

The field QC samples that may be collected include trip blanks, field blanks, field duplicates, and equipment rinsate blanks. Table 5 presents a summary of QC sample types, applicable analyses, frequency, and acceptance criteria. QC samples will be given a unique sample identification number and submitted to the analytical laboratory as blind samples. QC samples will be identified on the applicable forms so that the results can be applied to the associated sample.

6.4.2.2 Analytical Laboratory Quality Control Samples

QA/QC considerations are an integral part of analytical laboratory operations. Laboratory QA ensures that analytical methods generate data that are technically sound, statistically valid, and that can be documented. QC procedures are the tools employed to measure the degree to which these QA objectives are met.

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6.4.3 Data Reduction, Verification, Validation, and Reporting

Analytical data generated by the activities described in this closure plan will be verified and validated. Data reduction is the conversion of raw data to reportable units, transfer of data between recording media, and computation of summary statistics, standard errors, confidence intervals, and statistical tests.

6.4.4 Data Reporting Requirements

Analytical results will include all pertinent information about the condition and appearance of the sample-as-received. Analytical reports will include:

a. a summary of analytical results for each sample;

b. results from QC samples such as blanks, spikes, and calibrations;

c. reference to standard methods or a detailed description of analytical procedures; and

d. raw data printouts for comparison with summaries.

The laboratory will describe the analysis in sufficient detail so that the data user can understand how the sample was analyzed.

7.0 WASTE MANAGEMENT

By removing any hazardous waste or hazardous waste constituents during closure, the owner/operator may become a generator of hazardous waste. The owner/operator shall control, handle, characterize, and dispose of all wastes generated during closure activities in accordance with this Section (7.0), Facility waste management procedures, and in compliance with applicable state, federal, and local requirements (*see* 40 CFR § 265.114). These wastes include, but are not limited to:

(a) demolition debris;

(b) concrete;

(c) containerized waste;

(d) decontamination wash water; and

d) decontamination waste.

The different types of wastes generated at closure, including the unit's decontaminated structures and related equipment, and their disposition options (*e.g.*, reuse, recycling, or disposal) are listed in Table 2 of this closure plan.

8.0 CLOSURE CERTIFICATION REPORT

Upon completion of the closure activities at the unit, the owner/operator shall submit, by registered mail, a closure certification report (Report) for Department review and approval. The Report shall document that the unit has been closed in compliance with the specifications in this closure plan. The Report shall summarize all activities conducted during closure including, but not limited to:

a) the results of all investigations;

b) remediation waste management;

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c) decontamination;

d) decontamination verification and soil sampling activities; and

e) results of all chemical analyses and other characterization activities.

The owner/operator shall submit the Report to the Department no later than 60 days after completion of closure of the unit. The Department may require interim reports that document the progress of closure. The certification must be signed by the owner/operator and by an independent professional engineer registered in the State of New Mexico (*see* 40 CFR § 265.115).

The report shall document the unit's closure and contain, at a minimum, the following information:

f) a copy of the certification pursuant to 40 CFR § 265.115;

g) any variance, and the reason for the variance, from the activities approved in this closure plan;

h) documentation of the records review and structural assessment conducted;

i) a summary of all sampling results, showing:

   1. sample identification;
   2. sampling location;
   3. data reported;
   4. detection limit for each analyte;
   5. a measure of analytical precision (e.g., uncertainty, range, variance);
   6. identification of analytical procedure;
   7. identification of analytical laboratory;

j) a QA/QC statement on analytical data validation and decontamination verification;

k) the location of the file of supporting documentation, including:

   1. field logbooks;
   2. laboratory sample analysis reports;
   3. QA/QC documentation; and
   4. chain-of-custody forms;

l) storage or disposal location of hazardous waste resulting from closure activities;

m) a copy of the Human Health and Ecological Risk Assessment Reports, if a site-specific risk assessment was conducted pursuant to Sections 1.4 and 1.5 in Appendix III, for the unit; and

n) a certification statement of the accuracy of the Closure Report.

Documentation supporting the independent registered professional engineer's certification must be furnished to the Department before the owner/operator is released from the closure financial assurance requirements in 40 CFR § 265.143.

If the owner/operator leaves waste in place, they shall submit to the Department a survey plat as required by 40 CFR § 265.116 in conjunction with the closure certification report.

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9.0 REFERENCES

DOE, 1995. "DOE Methods for Evaluating Environmental and Waste Management Samples," DOE/EM-0089T, Rev. 2. Prepared for the U.S. Department of Energy by Pacific Northwest Laboratory, Richland, Washington.

EPA, 1986 and all approved updates. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA-*SW-846*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington, D.C.

EPA, 2002. "RCRA Waste Sampling Draft Technical Guidance Planning, Implementation, and Assessment," EPA530-D-02-002, August 2002, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, DC.

NIOSH, 1994. The National Institute for Occupational Health and Safety (NIOSH) *Manual of Analytical Methods*, 4th ed. Issue 1. 1994.

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Closure Schedule for the Permitted Unit

Activity	Maximum Time Required [a]
Notify the Department of intent to close.	-45 Days
Conduct records review and structural assessment.	-25 Days
Final receipt/treatment of waste.	Day 0
Begin closure activities after removal of waste.	Day 5
Decontaminate surfaces and equipment.	Day 20
Sample excess decontamination materials for disposal.	Day 20
Perform verification sampling.	Day 30
Evaluate analytical data from verification sampling.	Day 50
Perform additional decontamination, if necessary.	Day 55
Perform additional sampling, if necessary.	Day 60
Evaluate additional analytical data.	Day 75
Perform final cleanup and disposal (i.e., removal of decontaminated equipment and decontamination waste).	Day 140
Prepare closure certification report.	Day 150
Certify closure.	Day 175
Submit final report to the Department.	Day 180

[a] The schedule above indicates calendar days from the beginning by which activities will be completed. Some activities may be conducted simultaneously and/or may not require the maximum time listed. Extensions to this schedule may be requested, as needed.

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~~Table 1~~

~~Closure Schedule for the Technical Area 16-388 Open Burn Treatment Unit~~

~~Activity~~	~~Maximum Time Required~~
~~Begin closure activities.~~	~~Within 30 days of losing Interim Status~~
~~Complete records review and structural assessment.~~	~~Within 40 days of losing Interim Status~~
~~Complete all closure activities and submit final closure certification report to the Department.~~	~~Within 180 days of losing Interim Status~~

Table 2

Potential Waste Materials, Waste Types, and Disposal Options

Potential Waste Materials	Waste Types	Disposal Options
Personal protective equipment (PPE)	Non-regulated solid waste	Subtitle D landfill
	Hazardous waste	The PPE will be treated to meet Land Disposal Restriction (LDR) treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Decontamination water	Non-regulated liquid waste	High Explosives Waste Treatment Facility (HEWTF) or sanitary sewer
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Firebrick	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Metal covers/trays	Non-regulated solid waste	Recycled
	Hazardous waste	Treated if necessary to remove HE and recycled.
Soil and tuff	Non-regulated solid waste	Subtitle D landfill

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Potential Waste Materials	Waste Types	Disposal Options
	Hazardous waste	Waste will be treated to LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded waste management equipment	Non-regulated solid waste	Recycled, salvaged, or sent to a Subtitle D landfill
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded concrete	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded liner	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded sampling and decontamination equipment	Non-regulated solid waste	Subtitle D landfill
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.

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Table 3

Summary of Analytical Methods

Analyte	EPA SW-846 Analytical Method [a]	Test Methods/ Instrumentation	Target Detection Limit [b]	Rationale
		Metal Analysis		
Antimony	6010, 7010	ICP-AES, GFAA	20 ug/L	Determine the metal concentration in the samples.
Arsenic	6010, 7010, 7061A	ICP-AES, GFAA, CVAA	10 ug/L	
Barium	6010, 7010	ICP-AES,GFAA	200 ug/L	
Beryllium	6010, 7010	ICP-AES, GFAA	0.2 ug/L	
Cadmium	6010, 7010	ICP-AES, GFAA	2 ug/L	
Chromium	6010, 7010	ICP-AES, GFAA	10 ug/L	
Cobalt	6010, 7010	ICP-AES, GFAA	5 ug/L	
Copper	6010, 7010	ICP-AES, GFAA	5 ug/L	
Lead	6010, 7010	ICP-AES, GFAA	5 ug/L	
Mercury	6010, 7470A, 7471B	ICP-AES, CVAA	0.2 ug/L	
Selenium	6010, 7010, 7741A	ICP-AES, GFAA, CVAA	5 ug/L	
Silver	6010, 7010	ICP-AES, GFAA	10 ug/L	
Thallium	6010, 7010	ICP-AES, GFAA	30 ug/L	
Vanadium	6010, 7010	ICP-AES, GFAA	5 ug/L	
Zinc	6010, 7010	ICP-AES, GFAA	1 ug/L	
		Organic Analysis		
Target compound list VOCs plus ten tentatively identified	8260B	GC/MS	10 mg/L	Determine the VOCs concentration in the samples.

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compounds (TIC)				
Target compound list SVOCs plus 20 TICs	8270D, 8275	GC/MS	10 mg/L	Determine the SVOCs concentration in the samples.
Other Parameters				
Cyanide	9010, 9012	Colorimetric	20 µg/L	Determine cyanide concentration
Other Analysis				
Dioxins/Furans	8290	GC/MS	1.0 to 200 µg/L	Determine the dioxin/furan concentration in the samples

[a] U.S. Environmental Protection Agency (EPA), 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846.

[b] Detection limits listed for metals are for clean water. Detection limits for organics are expressed as practical quantitation limits. Actual detection limits may be higher depending on sample composition and matrix type.

CVAA = Cold-vapor atomic absorption spectroscopy
FLAA = Flame atomic absorption spectroscopy
GC/MS = Gas chromatography/mass spectrometry
GFAA = Graphite furnace atomic absorption spectroscopy
ICP-AES = Inductively coupled plasma-atomic emission spectrometry
mg/L = milligrams per liter

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Table 4

Recommended Sample Containers[a], Preservation Techniques, and Holding Times[b]

Analyte Class and Sample Type	Container Type and Materials	Preservation	Holding Time
	Metals		
TCLP/Total Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	Aqueous Media: 500-mL Wide Mouth-Polyethylene or Glass with Teflon Liner	Aqueous Media: HNO_3 to pH <2 Cool to 4 °C	180 Days
	Solid Media: 125-mL Glass	Solid Media: Cool to 4 °C	
TCLP/Total Mercury	Aqueous Media: 500-mL Wide Mouth-Polyethylene or Glass with Teflon Liner	Aqueous Media: HNO_3 to pH <2 Cool to 4 °C	28 Days
	Solid Media: 125-mL Glass	Solid Media: Cool to 4 °C	
	Volatile Organic Compounds		
Target Compound Volatile Organic Compounds	Aqueous Media: Two 40-mL Amber Glass Vials with Teflon-Lined Septa	Aqueous Media: HCl to pH<2 Cool to 4 °C	14 days
	Solid Media: 125-mL Glass or Two 40-mL Amber Glass Vials with Teflon-Lined Septa	Solid Media Cool to 4 °C Add 5 mL Methanol or Other Water Miscible Organic Solvent to 40-mL Glass Vials	

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Semi-Volatile Organic Compounds			
Target Compound Semi-volatile Organic Compounds	Aqueous Media: Four 1-L Amber Glass with Teflon-Lined Lid	Aqueous Media: Cool to 4 °C	Seven days from field collection to preparative extraction. 40 days from preparative extraction to determinative analysis.
	Solid Media: 250-mL Glass	Solid Media: Cool to 4 °C	

[a] Smaller sample containers may be required due to health and safety concerns associated with potential radiation exposure, transportation requirements, and waste management considerations.

[b] Information obtained from "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, U.S. Environmental Protection Agency, 1986 and all approved updates.

°C = degrees Celsius
HCl = hydrochloric acid
mL = milliter
HNO_3 = nitric acid
L = Liter
TCLP = Toxicity Characteristic Leaching Procedure

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Table 5

Recommended Quality Control Sample Types, Applicable Analyses, Frequency, and Acceptance Criteria

QC Sample Type	Applicable Analysis [a]	Frequency	Acceptance Criteria
Trip Blank	VOC	One set per shipping cooler containing samples to be analyzed for VOCs	Not Applicable
Field Blank	VOC/SVOC, metals	One sample daily per analysis	Not Applicable
Field Duplicate	Chemical	One for each sampling sequence	Relative percent difference less than or equal to 20 percent
Equipment Rinsate Blank[b]	VOC/SVOC, metals	One sample daily	Not Applicable

[a] For VOC and SVOC analysis, if blank shows detectable levels of any common laboratory contaminant (*e.g.*, methylene chloride, acetone, 2-butanone, toluene, and/or any phthalate ester), sample must exhibit that contaminant at a level 10 times the quantitation limit to be considered detectable. For all other contaminants, sample must exhibit the contaminant at a level 5 times the quantitation level to be considered detectable.

[b] Collected only if reusable sampling equipment used.

Table 6

Hazardous Waste Constituents of Concern at the TA-16-388 Outdoor Treatment Unit[a]

Category	EPA Hazardous Waste Numbers	Specific Constituents
HE and associated compounds	D003	HMX, RDX, TNT, PETN, Tetryl, and Other Nitrobenzenes and Nitrotoluenes
Toxic Metals	D004, D005, D006, D007, D008, D009, D010, D011	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver
Semi-volatile Organic Compounds	D030, D036, F004	2,4-Dinitrotoluene, Nitrobenzene
Volatile Organic Compounds	F002, F003, F004, F005	Acetone, Ethanol, Benzene, MEK, Methylene Chloride, Toluene, MIBK, Xylene, Ethyl Acetate, Methanol
Other constituents of concern		Dioxins/Furans, Perchlorate

[a] Based on the unit operating record.
PETN = pentaerythrioltetranitrate (2,2-bis[(nitroxy)methyl]-1,3-propanediol dinitrate)
HMX = cyclotetramethylenetetranitramine RDX = cyclonite MEK= methyl ethyl ketone
TNT = trinitrotoluene MIBK = 4-methyl-2-pentanone

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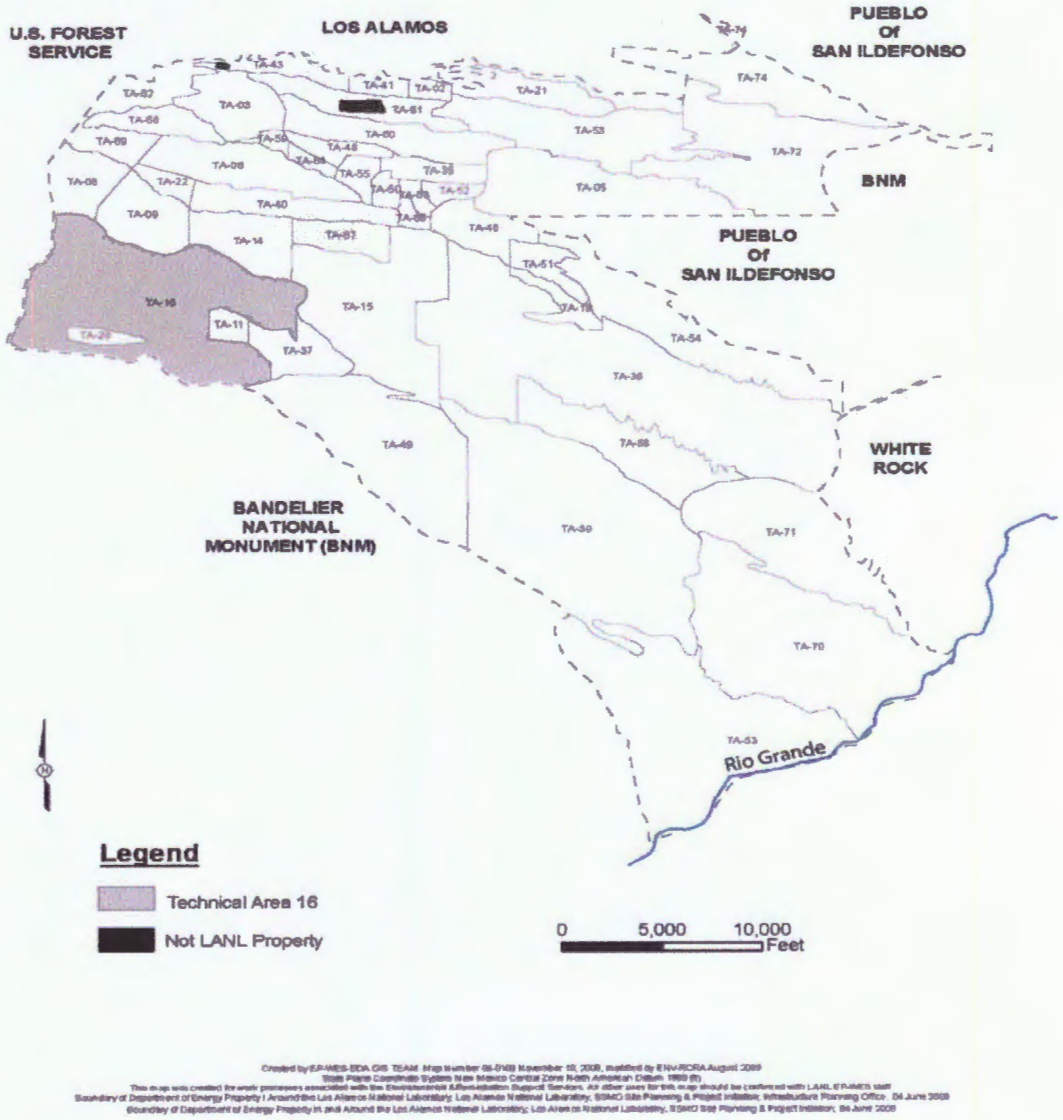

Figure 1: Technical Area 16 Location Map

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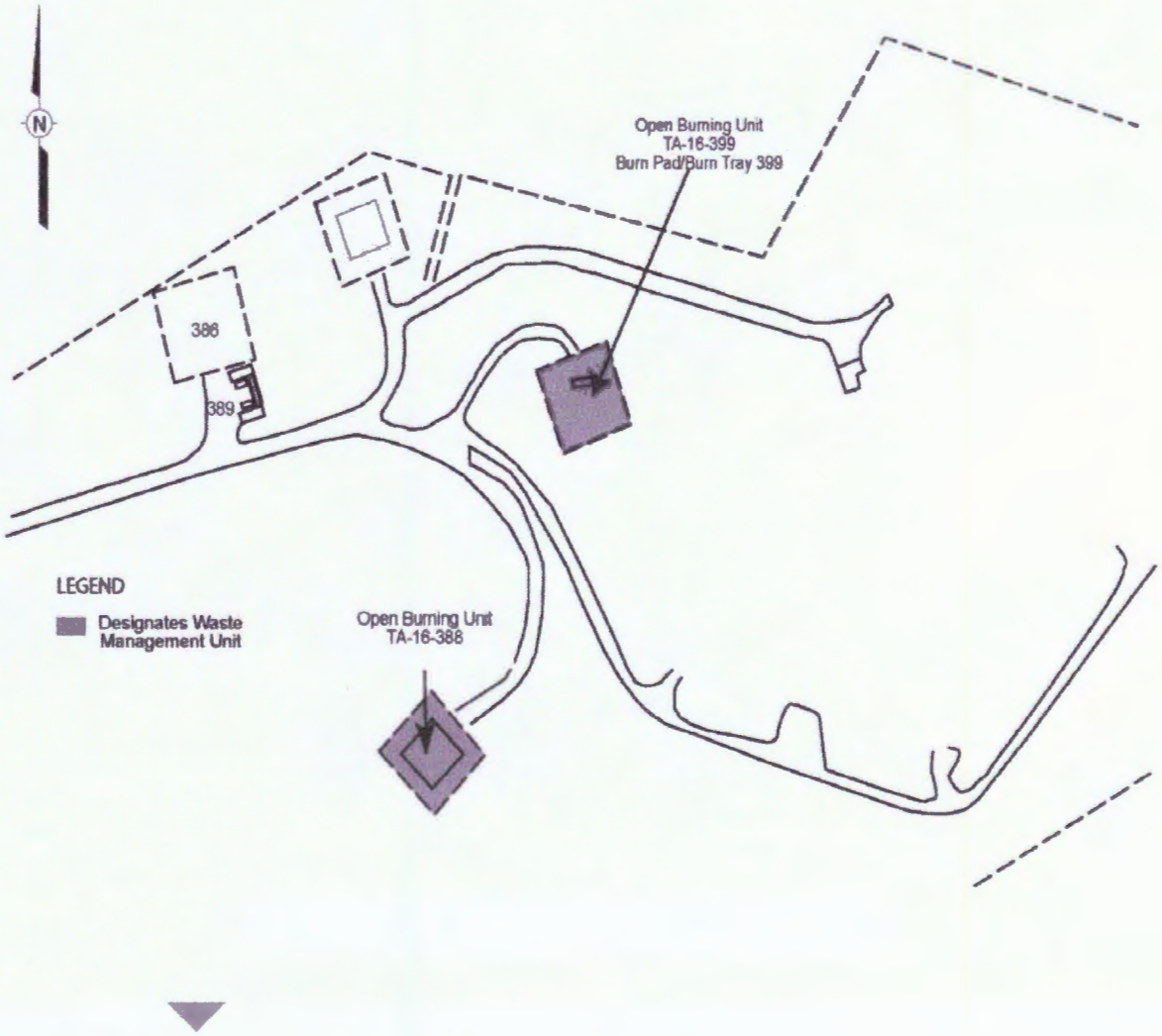

Figure 2: TA-16-388 Open Burn Treatment Unit Layout

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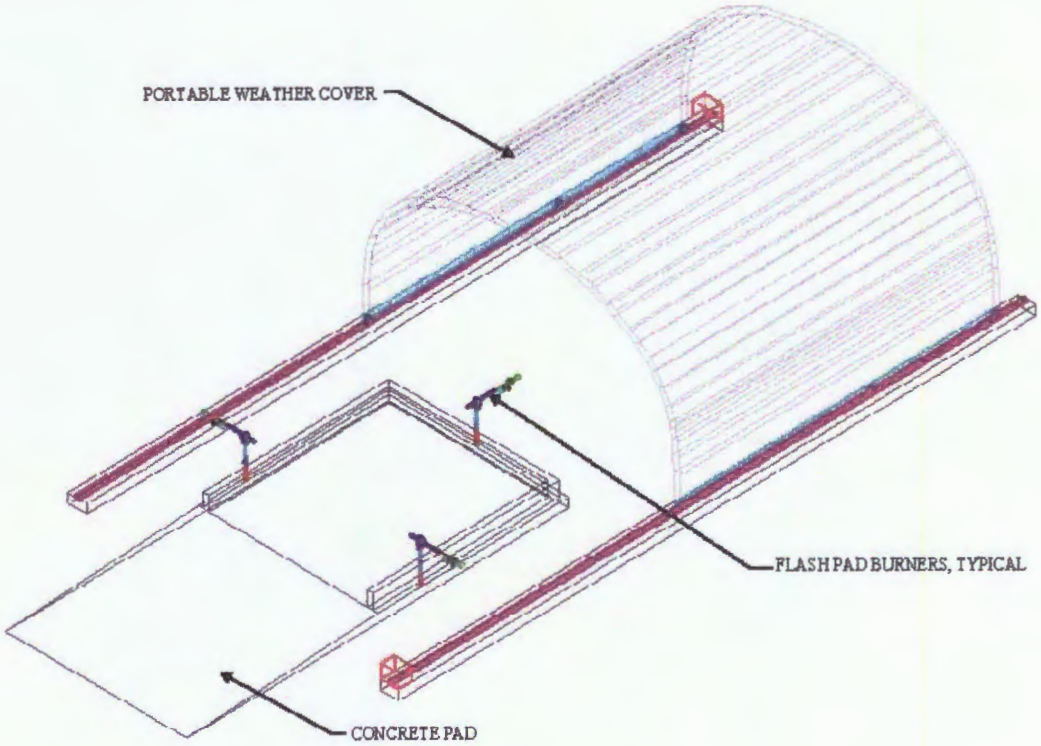

Figure 3: TA-16-388 Open Burn Treatment Unit Configuration

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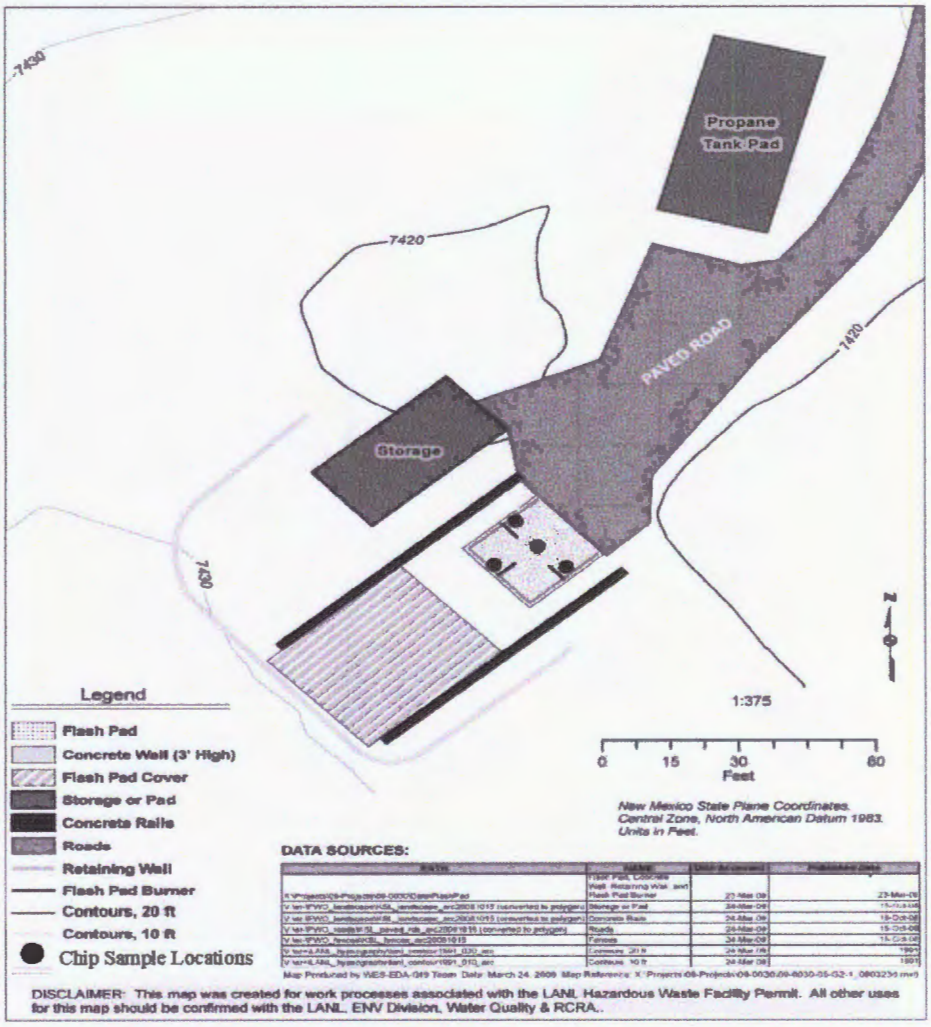

Figure 4: TA-16-388 Open Burn Treatment Unit Solid Concrete Chip Sampling Locations

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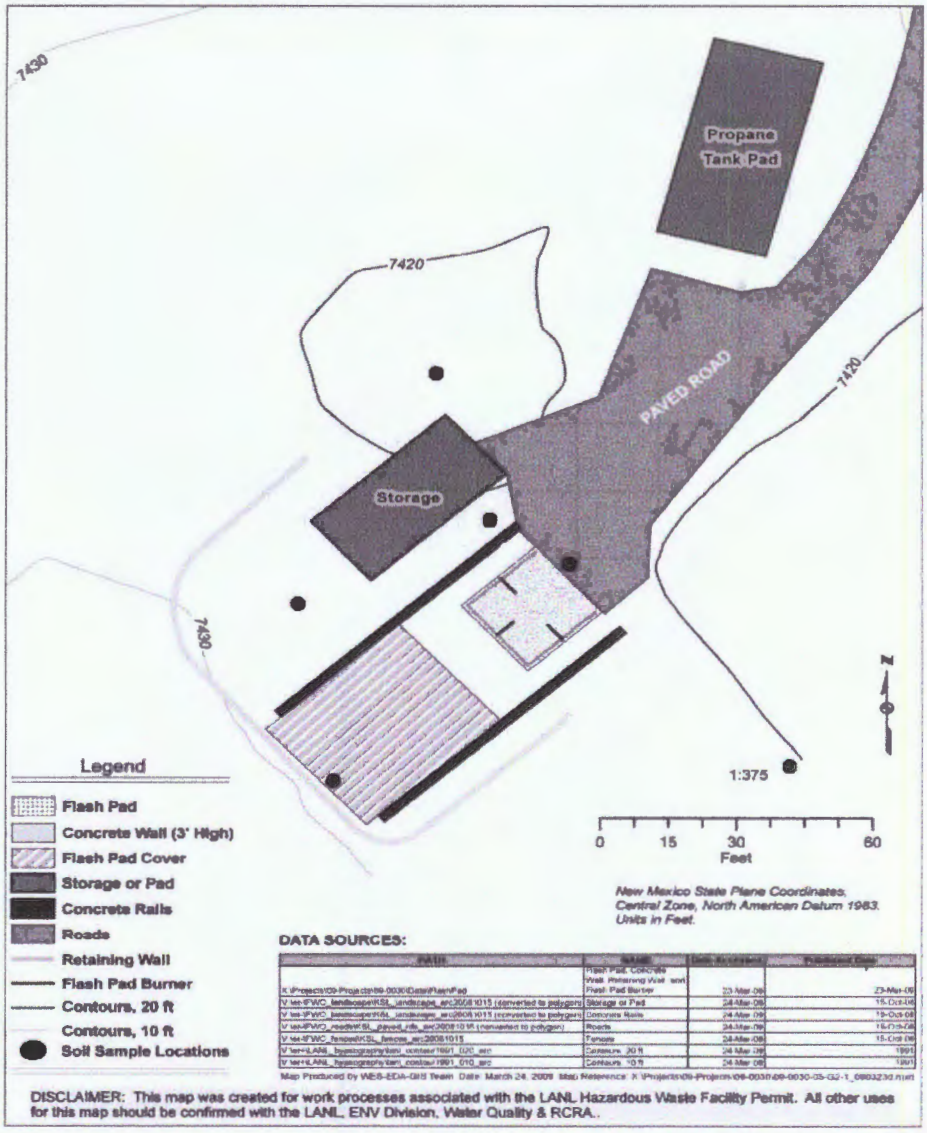

Figure 5: TA-16-388 Open Burn Treatment Unit Soil Sampling Locations

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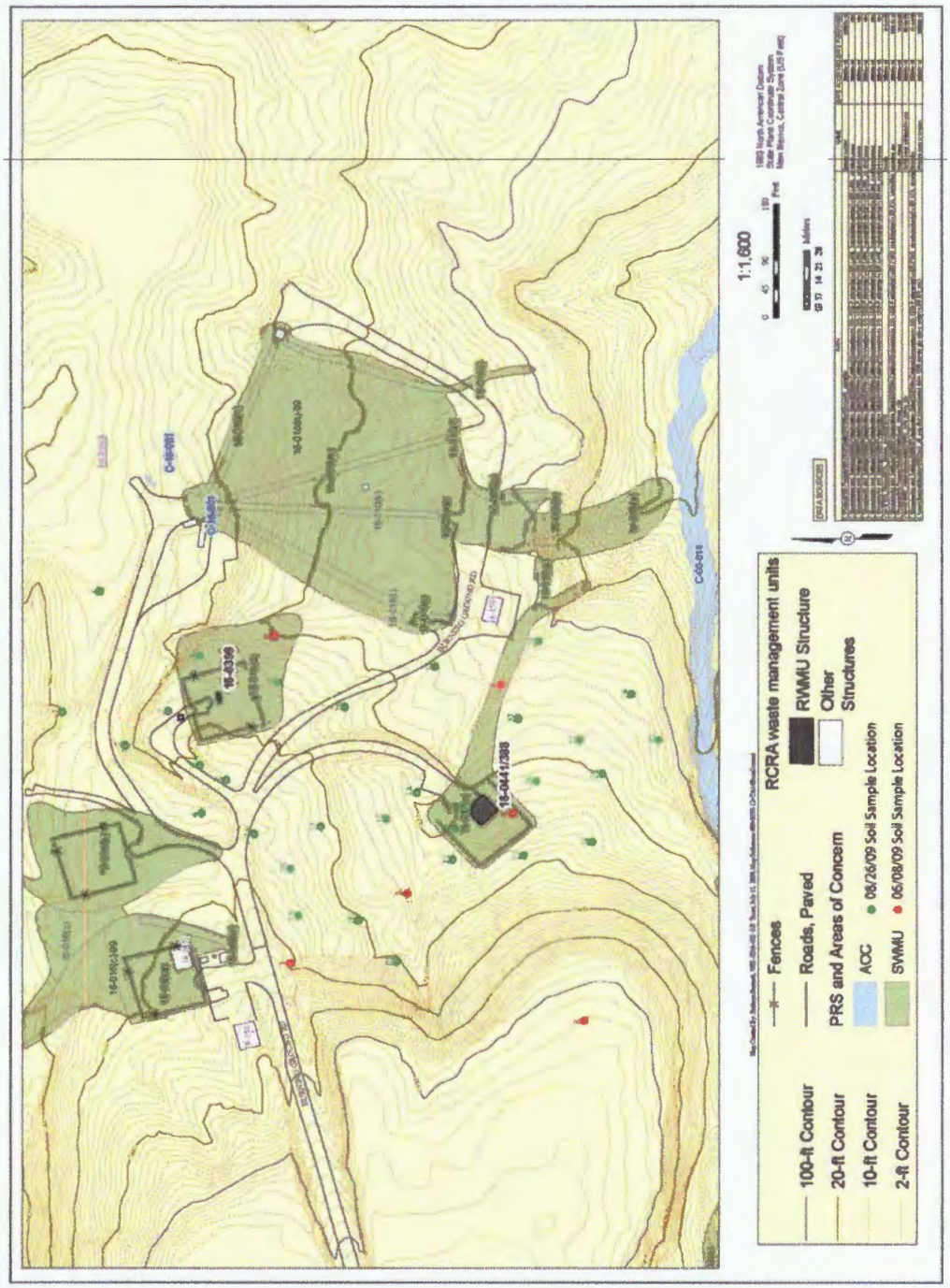

Figure 6: ~~Additional TA-16-388 Open Burn Treatment Unit Soil Sampling Locations~~

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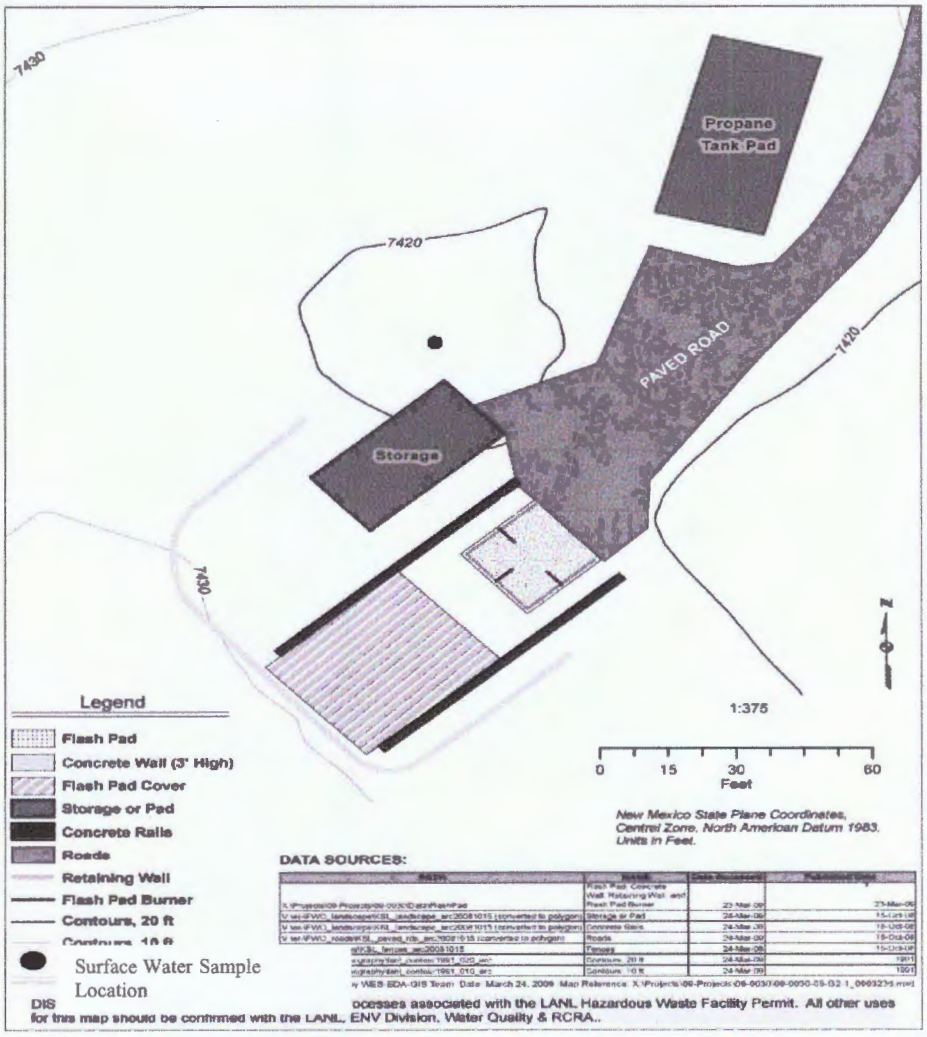

Figure 7: TA-16-388 Open Burn Treatment Unit Surface Water Sampling Location

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~~INTERIM STATUS CLOSURE PLAN~~ 1
OPEN BURN TREATMENT UNIT
TECHNICAL AREA 16-399 BURN TRAY

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Summary of Comments on Microsoft Word - TA-16-399 closure plan_IS_CLEAN_2.1.10.doc

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ATTACHMENT G.3

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1.0 INTRODUCTION

This closure plan describes the activities necessary to close the interim status hazardous waste open burning treatment unit at Technical Area 16 at the Los Alamos National Laboratory (Facility), hereinafter referred to as the unit. The information provided in this closure plan addresses the closure requirements specified in the Code of Federal Regulations (CFR), Title 40, Part 265, Subparts G and P for the thermal treatment units operated at the Facility under the Resource Conservation and Recovery Act (RCRA) and the New Mexico Hazardous Waste Act.

Until closure is complete and has been certified in accordance with Section 8.0 of this closure plan and 40 CFR § 265.115, a copy of the approved closure plan, any approved revisions, and closure activity documentation associated with the closure will be on file with hazardous waste compliance personnel at the Facility and at the U.S. Department of Energy (DOE) Los Alamos Site Office. Prior to closure of the unit, this closure plan may be amended in accordance with Section 4.3 of this closure plan and 40 CFR § 265.112(c), as necessary and appropriate, to provide, at a minimum, updated sampling and analysis plans and to incorporate updated decontamination technologies. Amended closure plans shall be submitted to the New Mexico Environment Department (Department) for approval prior to implementing closure decontamination and sampling activities.

2.0 DESCRIPTION OF UNIT TO BE CLOSED

TA-16 is located in the southwestern quadrant of the Facility at the west end of the Pajarito Plateau near the foothills of the Jemez Mountains (*see* Figure 1). It was managed by the owner/operator's high explosives engineering personnel who are responsible for the safe treatment, storage, and handling of high explosives (HE) waste and HE contaminated wastes generated by the HE production facilities.

2.1 Description of the Unit and the Wastes Treated at the Unit

The unit (*see* Figure 2) is comprised of a four foot wide by 16 foot long steel tray supported by 1.5-foot-high legs and is lined with firebricks (*see* Figure 3). Explosives were packed in cardboard and wooden boxes and transported to the unit for treatment. Padding was placed on the tray while the explosives were removed from the boxes and set on the padding. The padding was then dampened with kerosene. Electric matches (*e.g.*, squibs) were then connected to the firing cables and a train of excelsior saturated with kerosene was run from the squibs to the padding for ignition.

3.0 ESTIMATE OF MAXIMUM WASTE TREATED

Approximately 155,500 pounds of HE waste has been treated at the unit since 1980.

4.0 GENERAL CLOSURE INFORMATION

4.1 Closure Performance Standard

The unit will be closed to meet the following performance standards:

a. remove all hazardous waste residues and hazardous constituents;

b. ensure contaminated media do not contain concentrations of hazardous constituents greater than the clean-up levels established in accordance with Section VIII of the March 1, 2005 *Compliance*

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Order on Consent (Order). For soils, the cleanup levels shall be established based on residential use. The owner/operator must also demonstrate that there is no potential to contaminate groundwater.

If the owner/operator is unable to achieve any one of the clean closure standards in (a) or (b) above, they must:

c. control hazardous waste residues, hazardous constituents, and, as applicable, contaminated media such that they do not exceed a total excess cancer risk of 10^{-5} for carcinogenic substances and, for non-carcinogenic substances, a target Hazard Index of 1.0 for human receptors, and meet Ecological Screening Levels established in Section VIII of the Order;

d. minimize the need for further maintenance;

e. control, minimize, or eliminate, to the extent necessary to protect human health and the environment, the post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground, groundwater, surface waters, or to the atmosphere; and

f. comply with the closure requirements of 40 CFR Part 265 Subparts G and P.

Closure of the unit will be deemed complete when: 1) all surfaces and equipment have been decontaminated, or otherwise properly managed as waste; 2) closure has been certified by an independent, professional engineer licensed in the State of New Mexico; and 3) closure certification has been submitted to, and approved by, the Department.

4.2 Closure Schedule

Interim status shall be terminated upon the effective date of the Secretary's final administrative disposition (*see* 40 CFR § 270.73(a) and 20.4.1.901(A)(10) NMAC, which are incorporated herein by reference) of the owner/operator's permit application. The beginning of closure for this unit shall be marked by the termination of the unit's interim status.

The owner/operator shall begin closure activities no later than 30 days after the loss of interim status. However, decontaminating or dismantling equipment, in accordance with this closure plan, may be conducted at any time before or after the loss of interim status.

The owner/operator shall complete the records review (review) and structural assessment (assessment), as described in Sections 5.1.1 and 5.1.2 of this closure plan, no later than 40 days after the loss of interim status. The owner/operator shall notify the Department at least 20 days prior to the scheduled assessment so the Department may have the opportunity to participate in the assessment. The notification shall include the date on which the owner/operator expects to conduct the assessment

The owner/operator shall complete all closure activities, including submittal of a final closure certification report to the Department for review and approval, in accordance with this closure plan and within 180 days of the Secretary's approval of this closure plan (*see* 40 CFR § 265.113(b)). In the event that this timeframe can not be met, the owner/operator may request from the Department an extension in accordance with 40 CFR § 265.113(c)(2) (*see* 40 CFR § 265.113(b)(1)(i)).

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4.3 Amendment of the Closure Plan

The owner/operator may amend this closure plan in accordance with the requirements in 40 CFR § 265.112(c), which is incorporated herein by reference. If the results of the review or assessment require any changes to this closure plan (*e.g.*, the sampling and analysis plan), the owner/operator shall submit an amended closure plan to the Department, for review and approval, in accordance with this Section (4.3).

5.0 CLOSURE PROCEDURES

Closure activities at the unit shall include: a physical review of the unit and a review of the unit's records; proper management and disposal of hazardous waste residues, if applicable, and contaminated surfaces and equipment associated with the unit; sampling to verify the closure performance standards in Section 4.1 of this closure plan have been achieved; and submittal of a final closure certification report. The following sections describe more specifically these closure activities applicable to the unit.

5.1 Records Review and Structural Assessment

Before starting closure decontamination and sampling activities, the Operating and Inspection Records for the unit will be reviewed and a structural assessment will be conducted to determine any previous finding(s) or action(s) that may influence closure activities or potential sampling locations.

5.1.1 Records Review

The Facility Operating Record (including, but not limited to, inspection and contingency plan implementation records) shall be reviewed at the time of closure and in accordance with the schedule in Section 4.2 of this closure plan. The goals of the review will be to:

a. confirm the specific hazardous waste constituents of concern listed in Table 2 of this closure plan;

b. update the above-mentioned list as necessary; and

c. confirm additional sampling locations (*e.g.*, locations of spills or chronic conditions identified in the Operating and Inspection Records).

The owner/operator shall determine whether any spills or releases, defects, deterioration, damage, or hazards (*e.g.*, damage to the concrete pad or other unit materials) affecting waste containment or treatment occurred or developed during the operational life of the unit during which hazardous waste was treated. If the records indicate any such incidents, the owner/operator shall amend this closure plan (*see* Section 4.3) in order to update the SAP (*see* Section 6.0) to incorporate the locations of these incidents as additional sampling locations. All additional sampling procedures, as applicable, shall be included in the amended closure plan.

5.1.2 Structural Assessment

The structural assessment is an assessment of the unit's physical condition. The assessment will include inspecting the unit's concrete pad (for any existing cracks or conditions that indicate a potential for release of hazardous constituents) and assessing the unit for evidence of any releases. If the assessment reveals any evidence of a release (*e.g.*, stains) or damage (*e.g.*, cracks, gaps, chips) to the pad, the owner/operator shall amend this closure plan (*see* Section 4.3) in order update the SAP (*see* Section 6.0)

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to incorporate these additional sampling locations. All additional sampling procedures, as applicable, shall be included in the amended closure plan. This assessment will be documented with photographs and drawings, as necessary.

5.2 Decontamination and Removal of Structures Equipment

In accordance with 40 CFR § 265.112(b)(4) (which is incorporated herein by reference), the unit's related equipment and materials (*e.g.*, concrete pad) will be decontaminated, or removed, or both and managed according to Section 7.0 of this closure plan. All surfaces and related equipment that are removed and not intended for ~~recycle~~ [1] will not require decontamination, will be considered solid and potentially hazardous waste when removed, and will be disposed of in accordance with Section 7.0. Decontamination activities will ensure the removal of all hazardous waste residues and hazardous waste constituents from the unit to meet the closure performance standards in Section 4.1.

5.2.1 Removal of Structures and Related Equipment

The burn tray, the concrete pad, the metal cover, the cover tracks, and the electronic ignition assembly will be removed from the unit at closure (but after the structural assessment) [2] ~~and will not be recycled~~.

5.2.2 Decontamination of Structures and Related Equipment

Equipment will be decontaminated by steam cleaning or pressure washing with a solution consisting of a surfactant detergent (*e.g.*, Alconox®) and water mixed in accordance with the manufacturer's recommendations. Portable berms or other such devices (*e.g.*, absorbent socks, plastic sheeting, wading pools, existing secondary containment) will collect excess wash water and provide containment during the decontamination process.

5.2.3 Equipment Used During Decontamination Activities

Reusable protective clothing, tools, and equipment used during decontamination activities will be cleaned with a wash water solution. Residue, disposable equipment, and small reusable equipment that cannot be decontaminated will be containerized and managed as waste in accordance with Section 7.0.

6.0 SAMPLING AND ANALYSIS PLAN

This SAP identifies the specific sampling and analysis requirements for this unit and ensures the closure requirements of 40 CFR Subparts G and P are met. It also describes the sampling, analysis, and quality assurance/quality control (QA/QC) methods that will be used to demonstrate that the owner/operator has met the closure performance standards in Section 4.1. The owner/operator shall comply with all the requirements in this closure plan section (6.0) as well as the requirements in Section IX of the Order.

This SAP is designed to:

1) verify decontamination of surfaces, equipment, and materials; and

2) determine whether a release of hazardous constituents to any environmental media has occurred.

It includes:

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3) A list of hazardous constituents of concern (*see* Table 2) for which soil, surface water, and wipe samples will be analyzed. This list includes all hazardous constituents defined as:

   a) any constituent identified in 40 CFR Part 261 Appendix VII that caused the United States Environmental Protection Agency (USEPA) to list a hazardous waste in 40 CFR Part 261 Subpart D;

   b) any constituent identified in 40 CFR Part 261, Appendix VIII; or

   c) any constituent identified in 40 CFR Part 264 Appendix IX, perchlorate, and nitrates.

   The list of hazardous constituents of concern shall be utilized to select the analytical methods capable of detecting those constituents;

4) A site plan for verification and soil samples. The site plan shall include:

   a) a figure depicting the boundaries of the unit and verification and soil sampling locations. The locations include:

      1. one sample at each location identified on Figures 4 and 5;
      2. one sample at the unit's discharge point (*e.g.*, storm water run-off location) (*see* Figure 6);
      3. locations of known spills or other releases of hazardous waste or hazardous constituents during operation of the unit; and
      4. other potential release locations;

   b) a rationale for the number and locations of samples.

5) Type of samples. The type of samples to be collected (*e.g.*, wipe, soil, surface water) and the rationale for the selection of the sample type;

6) Sampling methods. A description of the approved EPA *SW-846* sampling methods and procedures that will be used to collect each type of sample;

7) Analytical methods. A description of the approved EPA *SW-846* laboratory analytical methods that will be used to measure hazardous constituent concentrations; and

8) quality assurance and quality control (QA/QC) procedures. This SAP includes a description of the QA/QC procedures that include, but are not limited to:

   a) duplicates, trip blanks, equipment blanks;

   b) a description of methods for decontamination of re-usable sampling equipment; and

   c) a description of all sample preservation, handling, labeling, and chain-of-custody procedures.

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6.1 Sampling Activities

Sampling activities will be conducted in order to demonstrate that unit-related equipment, soils, and surface water meet the closure performance standards in Section 4.1. All samples will be collected and analyzed in accordance with the procedures in Sections 6.2, 6.3, and 6.4 of this closure plan.

One wipe sample will be collected from each piece of decontaminated equipment related to the unit.

~~Four soil samples will be collected from locations around the unit's concrete pad (*see* Figure 4) and from the 36 sample locations depicted in Figure 5.~~ 1

One surface water sample shall be collected at the stormwater sampling location identified in Figure 6; snow melt run-off shall not be substituted for storm water samples. The owner/operator shall collect a storm water sample (collected within the first 30 minutes of a measurable storm event) by taking a grab sample from a discharge. The sample shall be analyzed for total metals, explosive compounds, semi-volatile organic compounds, perchlorate, and dioxins/furans. If the precipitation event produces insufficient sample volume to perform all analyses, the owner/operator shall prioritize the list of analytes based on the sample volume collected as follows: 1) explosive compounds; 2) total metals; 3) semi-volatile organic compounds; and 4) perchlorate.

If it is not possible to collect the sample within the first 30 minutes of a measurable storm event, the sample shall be collected as soon as practicable after the first 30 minutes. An explanation shall be provided in the closure report describing the adverse condition(s) and why it was not possible to take samples within the first 30 minutes.

6.2 Sample Collection Procedures

Samples will be collected in accordance with the procedures identified in this SAP which incorporates guidance from the EPA (EPA, 1986 and EPA, 2002), DOE (DOE, 1995), and other Department-approved procedures.

6.2.1 Liquid Sampling

Liquid samples will be collected and analyzed to determine if hazardous constituents are present in surface waters as a result of run-off from the unit. Liquid samples will be collected using glass or plastic tubes, a composite liquid sampler, a bacon bomb, a bailer, or by pouring liquid in sample containers.

6.2.2 Soil Sampling

Soil samples will be collected from soils below the sub-grade and beneath the pad at the interface of fill and native soil or tuff. They shall be analyzed to determine if hazardous constituents are present in soils at, or in the vicinity of, the unit.

Soil samples will be collected using a spade, scoop, auger, trowel, or other tool as specified in approved methods for the type of analyte to be sampled (*i.e.*, EPA 1996 or 2002). Samples will be kept at their at-depth temperature or lower, protected from ultraviolet light, sealed tightly in the recommended container, and analyzed within the specific holding times listed in Table 5.

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Five soil samples will be collected using the multi-incremental sampling technique outlined in Appendix A of Method 8330B of the Environmental Protection Agency's "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods." Each soil sample will be a composite of at least 30 individual samples from locations around the unit.

6.2.3 Wipe Sampling

Surface wipe samples will be collected and analyzed to determine if residual hazardous constituents remain in the surfaces or related equipment at the unit. Samples will be collected in accordance with the National Institute of Occupational Safety and Health (NIOSH) *Manual of Analytical Methods* (NIOSH, 1994). The appropriate wipe sample method will consider the type of surface being sampled, the type of constituent being sampled, the solution used, and the desired constituent concentration detection limit.

The NIOSH method includes wiping a 100 square centimeter area at each discrete location with a gauze wipe wetted with a liquid solution appropriate for the desired analysis (e.g., deionized water for lead). For wipe sampling, guidance from the analytical laboratory shall be obtained prior to wipe verification sampling to confirm that the solution chosen for each analysis is appropriate for the analysis to be conducted and that wipe sampling is a proper technique for the analysis.

6.2.4 Cleaning of Sampling Equipment

A disposable sampler is considered clean only when directly removed from a factory-sealed wrapper. Reusable decontamination equipment, including protective clothing and tools, and sampling equipment used during closure activities will be scraped, as necessary, to remove residue, cleaned prior to each use with a wash solution, rinsed several times with tap water, and air-dried to prevent cross-contamination of samples. Sampling equipment rinsate blanks will be collected and analyzed only if reusable sampling equipment is used.

6.3 Sample Management Procedures

The following sections provide a description of sample documentation, handling, preservation, storage, packaging, and transportation requirements that will be followed during the sampling activities associated with the closure.

6.3.1 Sample Documentation

Sampling personnel will complete and maintain records to document sampling and analysis activities. Sample documentation will include sample identification numbers, chain-of-custody forms, analysis requested, sample logbooks detailing sample collection activities, and shipping forms (if necessary).

6.3.1.1 Chain-of-Custody

Chain-of-custody forms will be maintained by sampling personnel until the samples are relinquished to the analytical laboratory. This will ensure the integrity of the samples and provide for an accurate and defensible written record of the sampling possession and handling from the time of collection until laboratory analysis. One chain-of-custody form may be used to document all of the samples collected from a single sampling event. The sample collector will be responsible for the integrity of the samples collected until properly transferred to another person. The EPA considers a sample to be in a person's custody if it is:

a. in a person's physical possession;

b. in view of the person in possession; or

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c. secured by that person in a restricted access area to prevent tampering.

The sample collector will document all pertinent sample collection data. Individuals relinquishing or receiving custody of the samples will sign, date, and note the time on the analysis request and chain-of-custody form. A chain-of-custody form must accompany all samples from collection through laboratory analysis. The analytical laboratory will return the completed chain-of-custody form to the Facility and it will become part of the permanent sampling record documenting the sampling efforts.

6.3.1.2 Sample Labels and Custody Seals

A sample label will be affixed to each sample container. The sample label will include the following information:

a. a unique sample identification number;

b. name of the sample collector;

c. date and time of collection;

d. type of preservatives used, if any; and

e. location from which the sample was collected.

A custody seal will be placed on each sample container to detect unauthorized tampering with the samples. These labels must be initialed, dated, and affixed by the sample collector in such a manner that it is necessary to break the seal to open the container.

6.3.1.3 Sample Logbook

All pertinent information on the sampling effort must be recorded in a bound logbook. Information must be recorded in ink and any cross-outs must be made with a single line with the change initialed and dated by the author. The sample logbook will include the following information:

a. the sample location;

b. suspected composition;

c. sample identification number;

d. volume/mass of sample taken;

e. purpose of sampling;

f. description of sample point and sampling methodology;

g. date and time of collection;

h. name of the sample collector;

i. sample destination and how it will be transported;

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j. observations; and

k. name(s) of personnel responsible for the observations.

6.3.2 Sample Handling, Preservation, and Storage

Samples will be collected and containerized in appropriate pre-cleaned sample containers. Table 5 presents the requirements in *SW-846* (EPA, 1986) for sample containers, preservation techniques, and holding times. Samples that require cooling to 4 degrees Celsius will be placed in a cooler with ice or ice gel or in a refrigerator immediately upon collection.

6.3.3 Packaging and Transportation of Samples

All packaging and transportation activities will meet safety expectations, QA requirements, DOE Orders, and relevant local, state, and federal laws (including 10 CFR and 49 CFR). Appropriate Facility documents establish the requirements for packaging design, testing, acquisition, acceptance, use, maintenance, and decommissioning and for on-site, intra-site, and off-site shipment preparation and transportation of general commodities, hazardous materials, substances, waste, and defense program materials.

Off-site transportation of samples will occur via private, contract, or common motor carrier, air carrier, or freight. All off-site transportation will be processed through the Facility packaging and transportation organization unless the shipper is specifically authorized through formal documentation by that organization to independently tender shipments to common motor or air carriers.

6.4 Sample Analysis Requirements

Samples will be analyzed for all the hazardous constituents listed in Table 2; if at closure it has been determined that other constituents listed in Appendix VIII of 40 CFR Part 261 and in Appendix IX of 40 CFR Part 264 were managed or treated at the unit over its operational history, this closure plan shall be amended to include those constituents for sampling and analysis. Samples will be analyzed by an independent laboratory using the methods outlined in Table 4. Analytes, test methods and instrumentation, target detection limits, and rationale for metals and organic analyses are presented in Table 4. If any of the information from these tables has changed at the time of closure, the owner/operator will amend this closure plan to update all methods in this SAP.

6.4.1 Analytical Laboratory Requirements

The analytical laboratory will perform the detailed qualitative and quantitative chemical analyses specified in Section 6.4.2. The analytical laboratory will have:

a. a documented comprehensive QA/QC program;

b. technical analytical expertise;

c. a document control/records management plan; and

d. the capability to perform data reduction, validation, and reporting.

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The selection of the analytical testing methods identified in Table 4 is based on the following considerations:

e. the physical form of the waste;

f. constituents of interest;

g. required detection limits (*e.g.*, regulatory thresholds); and

h. information requirements (*e.g.*, waste classification).

6.4.2 Quality Assurance/Quality Control

All sampling and analysis will be conducted in accordance with quality assurance (QA)/quality control (QC) procedures defined by the latest revision of "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (*SW-846*) (EPA, 1986) or other Department-approved procedures. Field sampling procedures and laboratory analyses will be evaluated through the use of QA/QC samples to assess the overall quality of the data produced. QC samples evaluate precision, accuracy, and the potential for sample contamination associated with the sampling and analysis process which is described in the following sections. Information on calculations necessary to evaluate the QC results is also described below.

6.4.2.1 Field Quality Control

The field QC samples that will be collected are trip blanks, field blanks, field duplicates, and equipment rinsate blanks. Table 6 presents a summary of QC sample types, applicable analyses, frequency, and acceptance criteria. QC samples will be given a unique sample identification number and submitted to the analytical laboratory as blind samples. QC samples will be identified on the applicable forms so that the results can be applied to the associated sample.

6.4.2.2 Analytical Laboratory Quality Control Samples

QA/QC considerations are an integral part of analytical laboratory operations. Laboratory QA ensures that analytical methods generate data that are technically sound, statistically valid, and that can be documented. QC procedures are the tools employed to measure the degree to which these QA objectives are met.

6.4.3 Data Reduction, Verification, Validation, and Reporting

Analytical data generated by the activities described in this closure plan will be verified and validated. Data reduction is the conversion of raw data to reportable units, transfer of data between recording media, and computation of summary statistics, standard errors, confidence intervals, and statistical tests.

6.4.4 Data Reporting Requirements

Analytical results will include all pertinent information about the condition and appearance of the sample-as-received. Analytical reports will include:

a. a summary of analytical results for each sample;

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b. results from QC samples such as blanks, spikes, and calibrations;

c. reference to standard methods or a detailed description of analytical procedures; and

d. raw data printouts for comparison with summaries.

The laboratory will describe the analysis in sufficient detail so that the data user can understand how the sample was analyzed.

7.0 WASTE MANAGEMENT

By removing any hazardous waste or hazardous waste constituents during closure, the owner/operator may become a generator of hazardous waste. The owner/operator shall control, handle, characterize, and dispose of all wastes generated during closure activities in accordance with this Section (7.0), Facility waste management procedures, and in compliance with applicable state, federal, and local requirements (*see* 40 CFR § 265.114). These wastes include, but are not limited to:

(a) demolition debris;

(b) concrete;

(c) containerized waste;

(d) decontamination wash water; and

d) decontamination waste.

The different types of wastes generated at closure, including the unit's decontaminated structures and related equipment, and their disposition options (*e.g.*, reuse, recycling, or disposal) are listed in Table 2 of this closure plan.

8.0 CLOSURE CERTIFICATION REPORT

Upon completion of the closure activities at the unit, the owner/operator shall submit, by registered mail, a closure certification report (Report) for Department review and approval. The Report shall document that the unit has been closed in compliance with the specifications in this closure plan. The Report shall summarize all activities conducted during closure including, but not limited to:

a) the results of all investigations;

b) remediation waste management;

c) decontamination;

d) decontamination verification and soil sampling activities; and

e) results of all chemical analyses and other characterization activities.

The owner/operator shall submit the Report to the Department no later than 60 days after completion of closure of the unit. The Department may require interim reports that document the progress of closure. The certification must be signed by the owner/operator and by an independent professional engineer registered in the State of New Mexico (*see* 40 CFR § 265.115).

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The report shall document the unit's closure and contain, at a minimum, the following information:

f) a copy of the certification pursuant to 40 CFR § 265.115;

g) any variance, and the reason for the variance, from the activities approved in this closure plan;

h) documentation of the records review and structural assessment conducted;

i) a summary of all sampling results, showing:

1. sample identification;
2. sampling location;
3. data reported;
4. detection limit for each analyte;
5. a measure of analytical precision (*e.g.*, uncertainty, range, variance);
6. identification of analytical procedure;
7. identification of analytical laboratory;

j) a QA/QC statement on analytical data validation and decontamination verification;

k) the location of the file of supporting documentation, including:

1. field logbooks;
2. laboratory sample analysis reports;
3. QA/QC documentation; and
4. chain-of-custody forms;

l) storage or disposal location of hazardous waste resulting from closure activities;

m) a copy of the Human Health and Ecological Risk Assessment Reports, if a site-specific risk assessment was conducted pursuant to Sections 1.4 and 1.5 in Appendix III, for the unit; and

n) a certification statement of the accuracy of the Closure Report.

Documentation supporting the independent registered professional engineer's certification must be furnished to the Department before the owner/operator is released from the closure financial assurance requirements in 40 CFR § 265.143.

If the owner/operator leaves waste in place, they shall submit to the Department a survey plat as required by 40 CFR § 265.116 in conjunction with the closure certification report.

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9.0 REFERENCES

DOE, 1995. "DOE Methods for Evaluating Environmental and Waste Management Samples," DOE/EM-0089T, Rev. 2. Prepared for the U.S. Department of Energy by Pacific Northwest Laboratory, Richland, Washington.

EPA, 1986 and all approved updates. "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," EPA-*SW-846*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, U.S. Government Printing Office, Washington, D.C.

EPA, 2002. "RCRA Waste Sampling Draft Technical Guidance Planning, Implementation, and Assessment," EPA530-D-02-002, August 2002, Office of Solid Waste, U.S. Environmental Protection Agency, Washington, DC.

LANL, 1999. "Screening Level Ecological Risk Assessment Methods," LA-UR-99-1406, Los Alamos National Laboratory, Los Alamos, New Mexico.

NIOSH, 1994. The National Institute for Occupational Health and Safety (NIOSH) *Manual of Analytical Methods*, 4th ed. Issue 1. 1994.

NMED, 2006. "Technical Background Document for Development of Soil Screening Levels," Rev. 4.0, June 2006, New Mexico Environment Department, Santa Fe, New Mexico.

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Closure Schedule for the Permitted Unit

Activity	Maximum Time Required [a]
Notify the Department of intent to close.	-45 Days
Conduct records review and structural assessment.	-25 Days
Final receipt/treatment of waste.	Day 0
Begin closure activities after removal of waste.	Day 5
Decontaminate surfaces and equipment.	Day 20
Sample excess decontamination materials for disposal.	Day 20
Perform verification sampling.	Day 30
Evaluate analytical data from verification sampling.	Day 50
Perform additional decontamination, if necessary.	Day 55
Perform additional sampling, if necessary.	Day 60
Evaluate additional analytical data.	Day 75
Perform final cleanup and disposal (i.e., removal of decontaminated equipment and decontamination waste).	Day 140
Prepare closure certification report.	Day 150
Certify closure.	Day 175
Submit final report to the Department.	Day 180

[a] The schedule above indicates calendar days from the beginning by which activities will be completed. Some activities may be conducted simultaneously and/or may not require the maximum time listed. Extensions to this schedule may be requested, as needed.

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~~Table 1~~

~~Closure Schedule for the Technical Area 16-399 Outdoor Treatment Unit~~

~~Activity~~	~~Maximum Time Required~~
~~Begin closure activities.~~	~~Within 30 days of losing interim status~~
~~Complete records review and structural assessment.~~	~~Within 40 days of losing interim status~~
~~Complete all closure activities and submit final closure certification report to the Department.~~	~~Within 90 days of losing interim status~~

Table 2

Hazardous Waste Constituents of Concern at the TA-16-399 Open Burn Treatment Unit[a]

Category	EPA Hazardous Waste Numbers	Specific Constituents
HE and associated compounds	D003	HMX, RDX, TNT, PETN, Tetryl, and Other Nitrobenzenes and Nitrotoluenes
Toxic Metals	D004, D005, D006, D007, D008, D009, D010, D011	Arsenic, Barium, Cadmium, Chromium, Lead, Mercury, Selenium, Silver
Semi-volatile Organic Compounds	D030, D036, F004	2,4-Dinitrotoluene, Nitrobenzene
Volatile Organic Compounds	F002, F003, F004, F005	Acetone, Ethanol, Benzene, MEK, Methylene Chloride, Toluene, MIBK, Xylene, Ethyl Acetate, Methanol
Other constituents of concern		Dioxins/Furans, Perchlorate

[a] Based on the unit operating record.
PETN = pentaerythriol tetranitrate (2,2-bis[(nitroxy)methyl]-1,3-propanediol dinitrate
HMX = cyclotetramethylenetetranitramine
RDX = cyclonite
MEK= methyl ethyl ketone
TNT = trinitrotoluene
MIBK = 4-methyl-2-pentanone

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Table 3

Potential Waste Materials, Waste Types, and Disposal Options

Potential Waste Materials	Waste Types	Disposal Options
Personal protective equipment (PPE)	Non-regulated solid waste	Subtitle D landfill
	Hazardous waste	The PPE will be treated to meet Land Disposal Restriction (LDR) treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Decontamination water	Non-regulated liquid waste	High Explosives Waste Treatment Facility (HEWTF) or sanitary sewer
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Firebrick	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Metal covers/trays	Non-regulated solid waste	Recycled
	Hazardous waste	Treated if necessary to remove HE and recycled.
Soil and tuff	Non-regulated solid waste	Subtitle D landfill
	Hazardous waste	Waste will be treated to LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded waste management equipment	Non-regulated solid waste	Recycled, salvaged, or sent to a Subtitle D landfill
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded concrete	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a

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Potential Waste Materials	Waste Types	Disposal Options
		Subtitle C or D landfill, as appropriate.
Discarded liner	Non-regulated solid waste	Subtitle D landfill or reuse
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.
Discarded sampling and decontamination equipment	Non-regulated solid waste	Subtitle D landfill
	Hazardous waste	Waste will be treated to meet LDR treatment standards, if necessary, and disposed in a Subtitle C or D landfill, as appropriate.

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Table 4

Summary of Analytical Methods

Analyte	EPA *SW-846* Analytical Method [a]	Test Methods/ Instrumentation	Target Detection Limit [b]	Rationale
		Metal Analysis		
Antimony	6010, 7010	ICP-AES, GFAA	20 ug/L	Determine the metal concentration in the samples.
Arsenic	6010, 7010, 7061A	ICP-AES, GFAA, CVAA	10 ug/L	
Barium	6010, 7010	ICP-AES,GFAA	200 ug/L	
Beryllium	6010, 7010	ICP-AES, GFAA	0.2 ug/L	
Cadmium	6010, 7010	ICP-AES, GFAA	2 ug/L	
Chromium	6010, 7010	ICP-AES, GFAA	10 ug/L	
Cobalt	6010, 7010	ICP-AES, GFAA	5 ug/L	
Copper	6010, 7010	ICP-AES, GFAA	5 ug/L	
Lead	6010, 7010	ICP-AES, GFAA	5 ug/L	
Mercury	6010, 7470A, 7471B	ICP-AES, CVAA	0.2 ug/L	
Selenium	6010, 7010, 7741A	ICP-AES, GFAA, CVAA	5 ug/L	
Silver	6010, 7010	ICP-AES, GFAA	10 ug/L	
Thallium	6010, 7010	ICP-AES, GFAA	30 ug/L	
Vanadium	6010, 7010	ICP-AES, GFAA	5 ug/L	
Zinc	6010, 7010	ICP-AES, GFAA	1 ug/L	
		Organic Analysis		
Target compound list VOCs plus ten tentatively identified	8260B	GC/MS	10 mg/L	Determine the VOCs concentration in the samples.

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compounds (TIC)				
Target compound list SVOCs plus 20 TICs	8270D, 8275	GC/MS	10 mg/L	Determine the SVOCs concentration in the samples.
Other Parameters				
Cyanide	9010, 9012	Colorimetric	20 ug/L	Determine cyanide concentration
Other Analysis				
Dioxins/Furans	8290	GC/MS	1.0 to 200 µg/L	Determine the dioxin/furan concentration in the samples

[a] U.S. Environmental Protection Agency (EPA), 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.

[b] Detection limits listed for metals are for clean water. Detection limits for organics are expressed as practical quantitation limits. Actual detection limits may be higher depending on sample composition and matrix type.

CVAA = Cold-vapor atomic absorption spectroscopy
FLAA = Flame atomic absorption spectroscopy
GC/MS = Gas chromatography/mass spectrometry
GFAA = Graphite furnace atomic absorption spectroscopy
ICP-AES = Inductively coupled plasma-atomic emission spectrometry
mg/L = milligrams per liter
ug/L = micrograms per liter.

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Table 5

Recommended Sample Containers[a], Preservation Techniques, and Holding Times[b]

Analyte Class and Sample Type	Container Type and Materials	Preservation	Holding Time
	Metals		
TCLP/Total Metals: Arsenic, Barium, Cadmium, Chromium, Lead, Selenium, Silver	Aqueous Media: 500-mL Wide Mouth-Polyethylene or Glass with Teflon Liner	Aqueous Media: HNO_3 to pH <2 Cool to 4 °C	180 Days
	Solid Media: 125-mL Glass	Solid Media: Cool to 4 °C	
TCLP/Total Mercury	Aqueous Media: 500-mL Wide Mouth-Polyethylene or Glass with Teflon Liner	Aqueous Media: HNO_3 to pH <2 Cool to 4 °C	28 Days
	Solid Media: 125-mL Glass	Solid Media: Cool to 4 °C	
	Volatile Organic Compounds		
Target Compound Volatile Organic Compounds	Aqueous Media: Two 40-mL Amber Glass Vials with Teflon-Lined Septa	Aqueous Media: HCl to pH<2 Cool to 4 °C	14 days
	Solid Media: 125-mL Glass or Two 40-mL Amber Glass Vials with Teflon-Lined Septa	Solid Media Cool to 4 °C Add 5 mL Methanol or Other Water Miscible Organic Solvent to 40-mL Glass Vials	

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Semi-Volatile Organic Compounds			
Target Compound Semi-volatile Organic Compounds	Aqueous Media: Four 1-L Amber Glass with Teflon-Lined Lid	Aqueous Media: Cool to 4 °C	Seven days from field collection to preparative extraction. 40 days from preparative extraction to determinative analysis.
	Solid Media: 250-mL Glass	Solid Media: Cool to 4 °C	

[a] Smaller sample containers may be required due to health and safety concerns associated with potential radiation exposure, transportation requirements, and waste management considerations.

[b] Information obtained from "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*, U.S. Environmental Protection Agency, 1986 and all approved updates.

°C = degrees Celsius
HCl = hydrochloric acid
mL = milliter
HNO_3 = nitric acid
L = Liter
TCLP = Toxicity Characteristic Leaching Procedure

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Table 6

Recommended Quality Control Sample Types, Applicable Analyses, Frequency, and Acceptance Criteria

QC Sample Type	Applicable Analysis [a]	Frequency	Acceptance Criteria
Trip Blank	VOC	One set per shipping cooler containing samples to be analyzed for VOCs	Not Applicable
Field Blank	VOC/SVOC, metals	One sample daily per analysis	Not Applicable
Field Duplicate	Chemical	One for each sampling sequence	Relative percent difference less than or equal to 20 percent
Equipment Rinsate Blank[b]	VOC/SVOC, metals	One sample daily	Not Applicable

[a] For VOC and SVOC analysis, if blank shows detectable levels of any common laboratory contaminant (*e.g.*, methylene chloride, acetone, 2-butanone, toluene, and/or any phthalate ester), sample must exhibit that contaminant at a level 10 times the quantitation limit to be considered detectable. For all other contaminants, sample must exhibit the contaminant at a level 5 times the quantitation level to be considered detectable.

[b] Collected only if reusable sampling equipment used.

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This page contains no comments

Figure 1: Technical Area 16 Location Map

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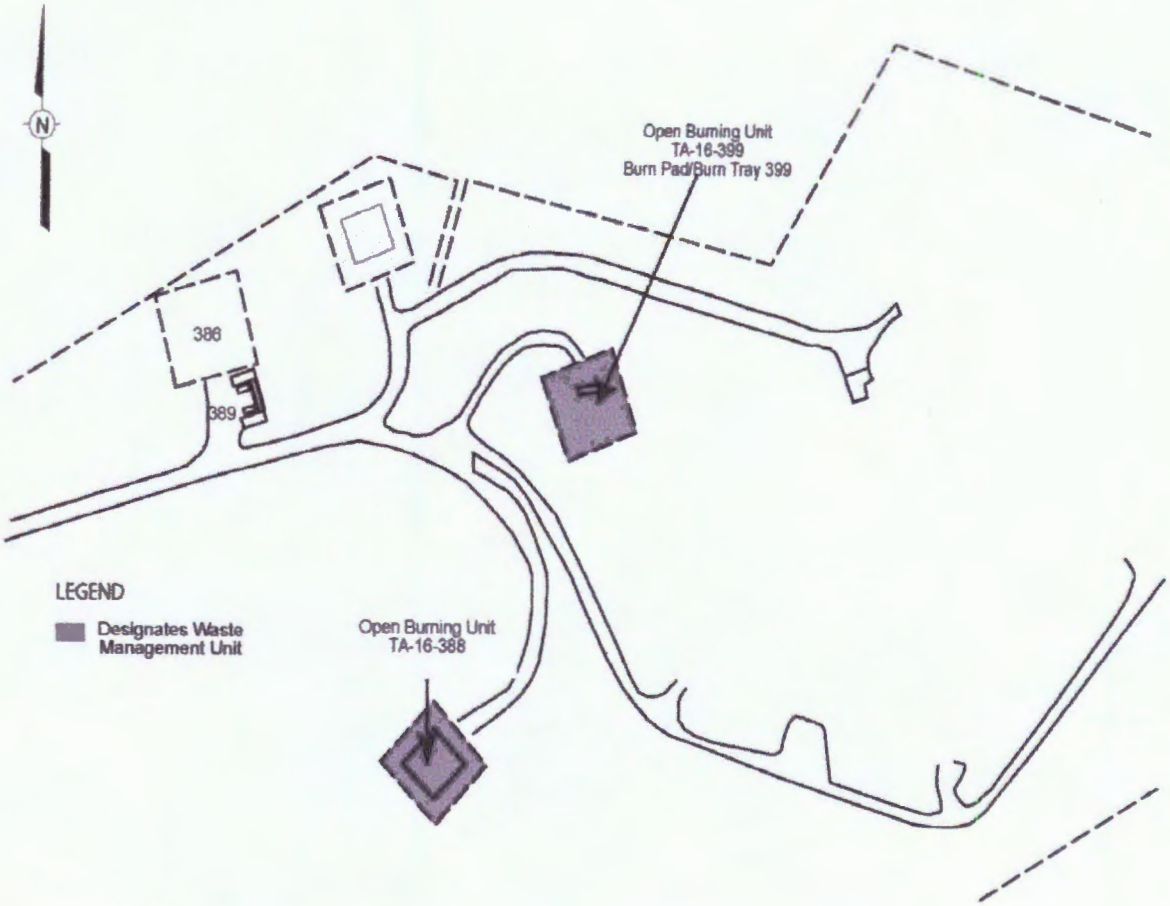

Figure 2: TA-16-399 Open Burn Treatment Unit Layout

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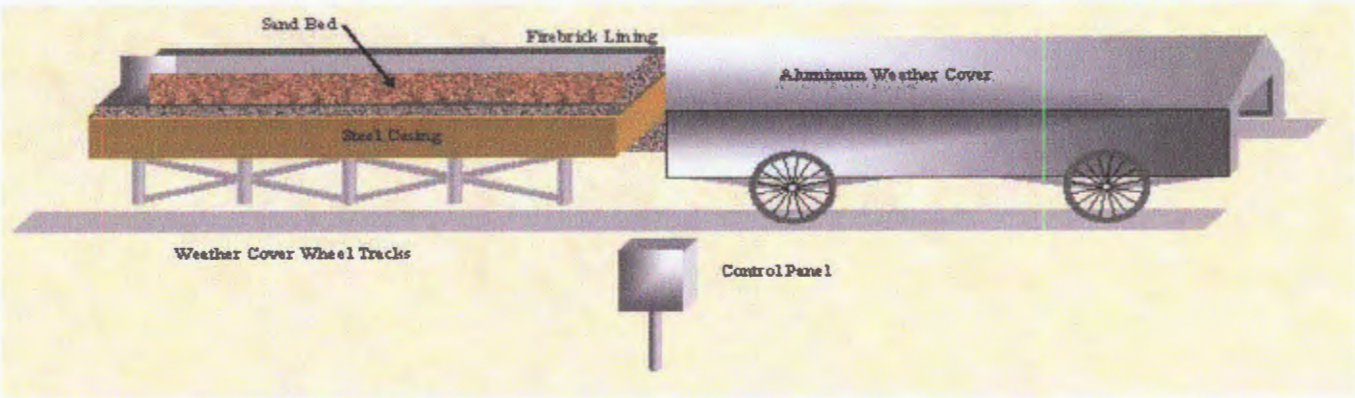

Figure 3: TA-16-16-399 Open Burn Treatment Unit Configuration

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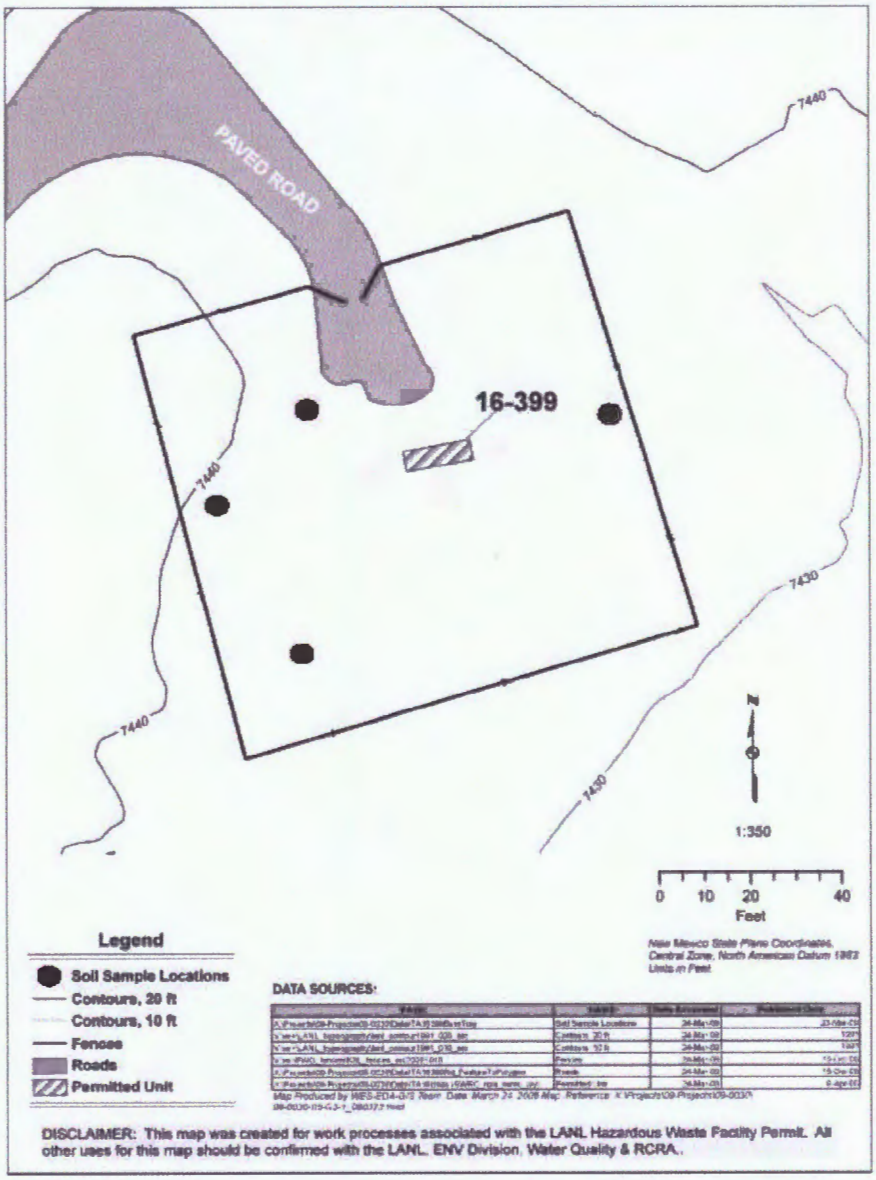

~~Figure 4: TA-16-399 Open Burn Treatment Unit Soil Sampling Locations~~

Number: 1 Subject: Cross-Out Date: 3/19/2010 9:03:38 AM

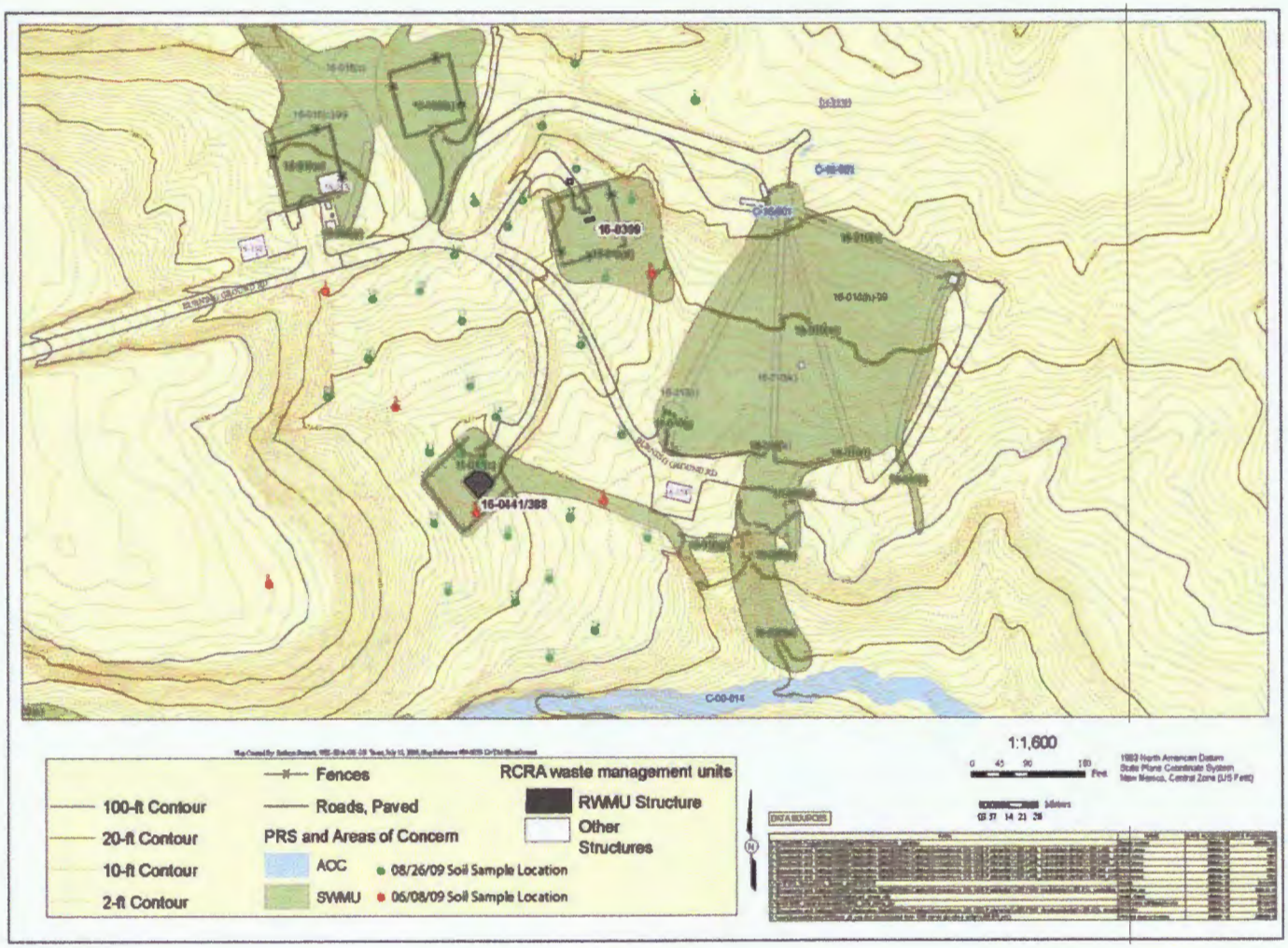

Figure 5: Additional TA-16-399 Open Burn Treatment Unit Soil Sampling Locations

Number: 1 Subject: Cross-Out Date: 3/19/2010 9:03:13 AM

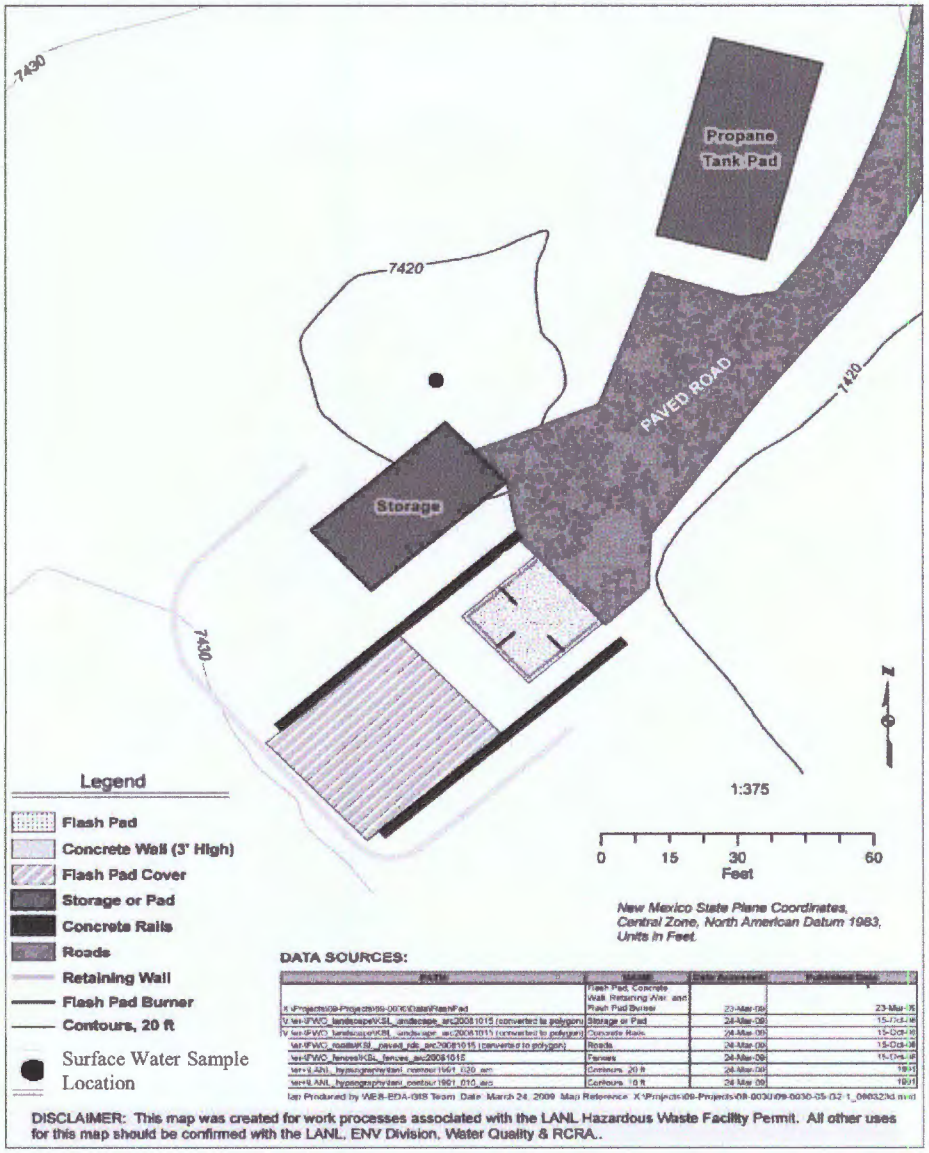

Figure 6: TA-16-399 Open Burn Treatment Unit Surface Water Sampling Location

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TABLE J-1

Active Portion of the Facility

Includes units permitted to store and treat hazardous waste, interim status units, and the Material Disposal Areas.

Process codes and associated process descriptions:

- S01-storage in containers
- S02-storage in tanks
- S99-other storage
- D80-landfill
- T04 – treatment in tanks
- X01*-open burning
- X01**-open detonation

Unit Identifier	Process Codes	Operating Capacity	General Information	Type of Unit
TA-3-29	S01	18,500 gal	Includes Room 9010 and portions of Room 9020 and 9030 Located in Wing 9 of the basement of Building 29 Total square footage – 3,040	Indoor
TA-14-23	X01*	50 lbs HE/burn	Near Structure TA-14-23 Interim Status Unit	NA
TA-14-23	X01**	20 lbs HE/ detonation	Near Structure TA-14-23 Interim Status Unit	NA
TA-16-388	X01*		Flash Pad Total square footage - 484	Outdoor (associated with a open burn unit)
TA-16-399	X01*		Burn Tray Total square footage - 64	Outdoor (associated with an open burn unit)

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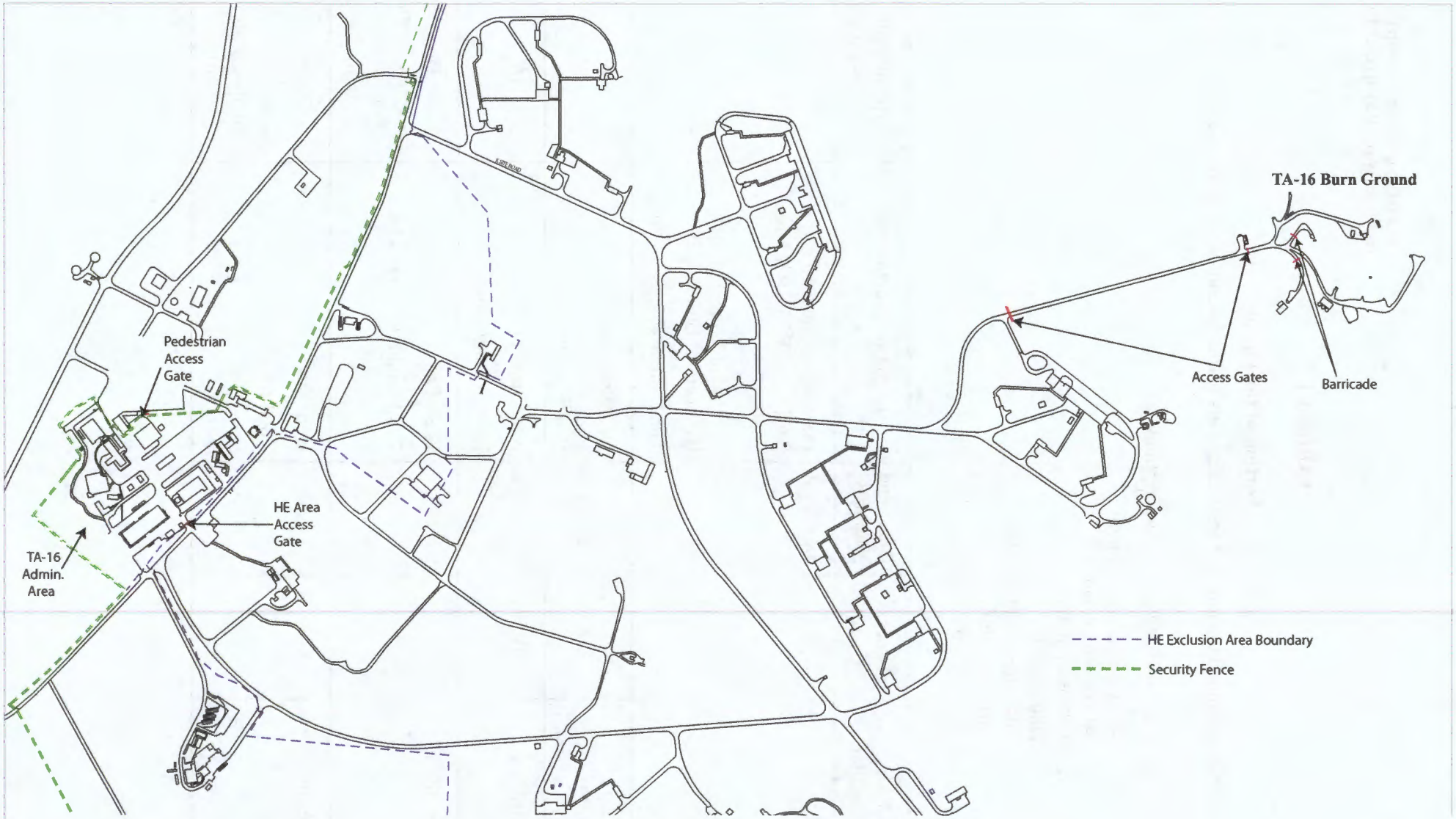

Figure 5:
Technical Area (TA) 16 Security Fences, Entry Gates, and Entry Stations

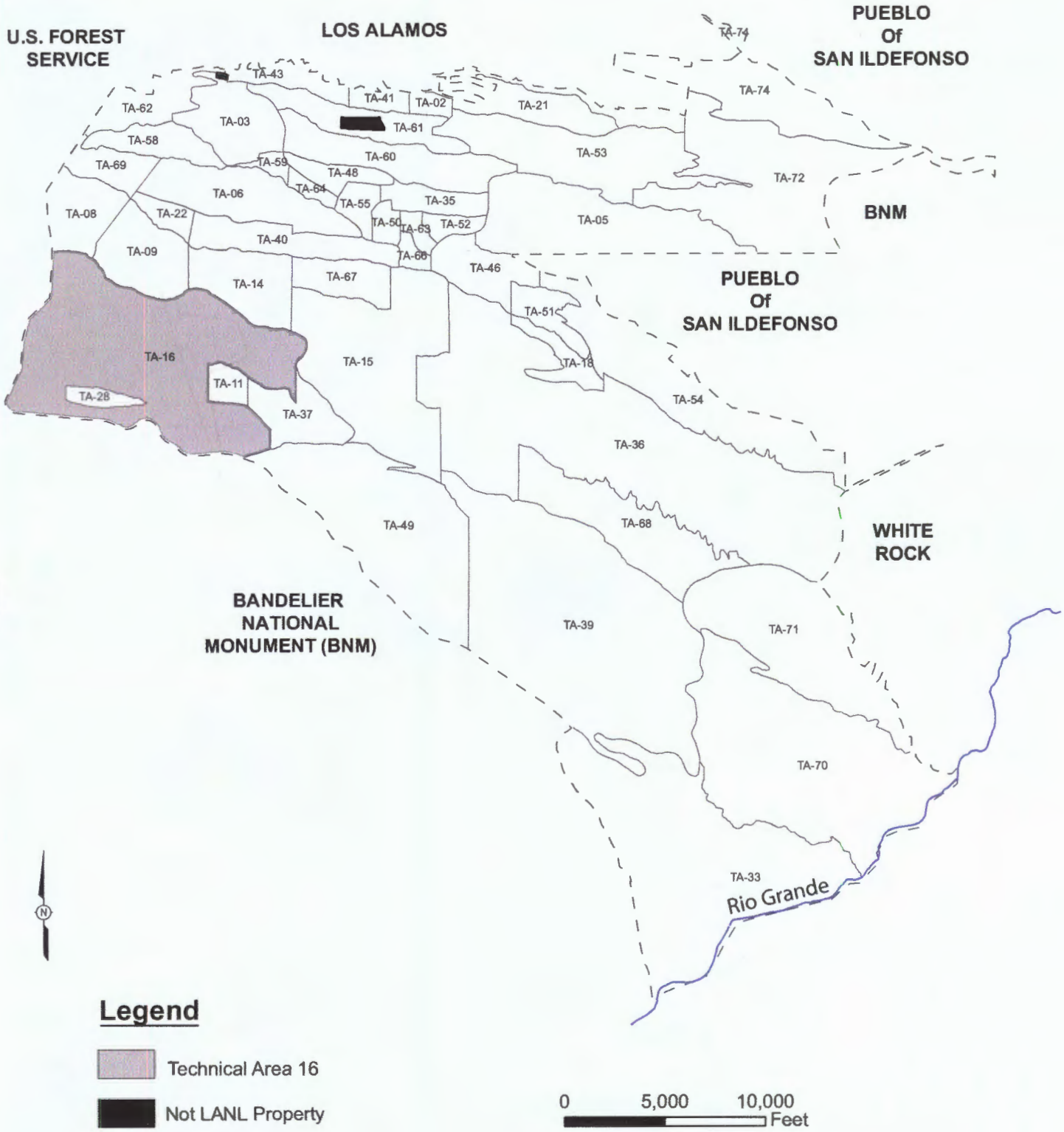

Figure 16:

Technical Area (TA) 16 Location Map

Created by EP-WES-EDA GIS TEAM. Map Number 06-0108 November 13, 2008, modified by ENV-RCRA August 2009
State Plane Coordinate System New Mexico Central Zone North American Datum 1983 (ft)
This map was created for work processes associated with the Environmental &Remediation Support Services. All other uses for this map should be confirmed with LANL EP-WES staff.
Boundary of Department of Energy Property I Around the Los Alamos National Laboratory; Los Alamos National Laboratory, SSMO Site Planning & Project Initiation; infrastructure Planning Office. 04 June 2008
Boundary of Department of Energy Property In and Around the Los Alamos National Laboratory; Los Alamos National Laboratory, SSMO Site Planning & Project Initiation; 04 June 2008

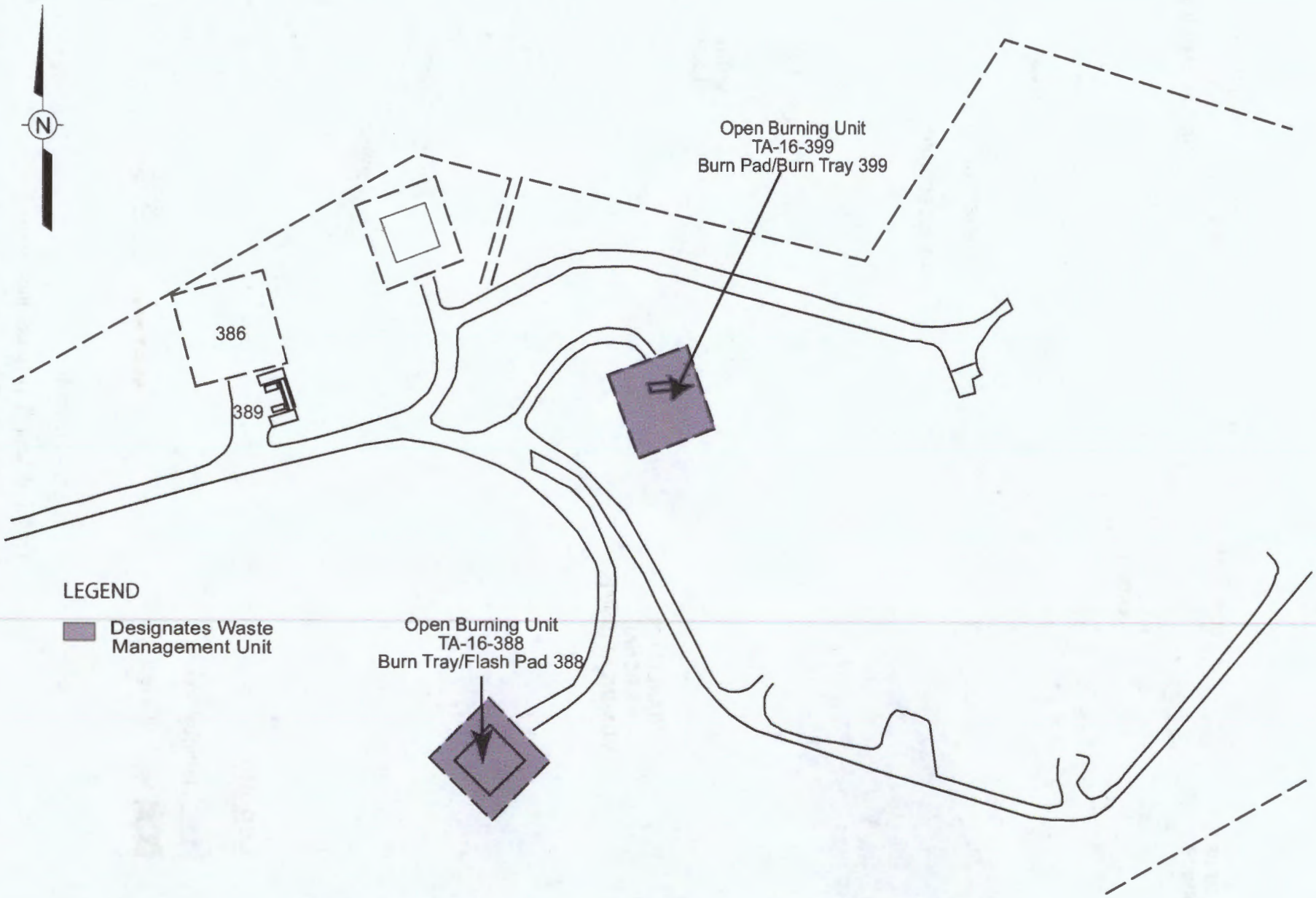

Figure 17
Technical Area (TA) 16 Open Burn Treatment Units (16-388 & 16-399)

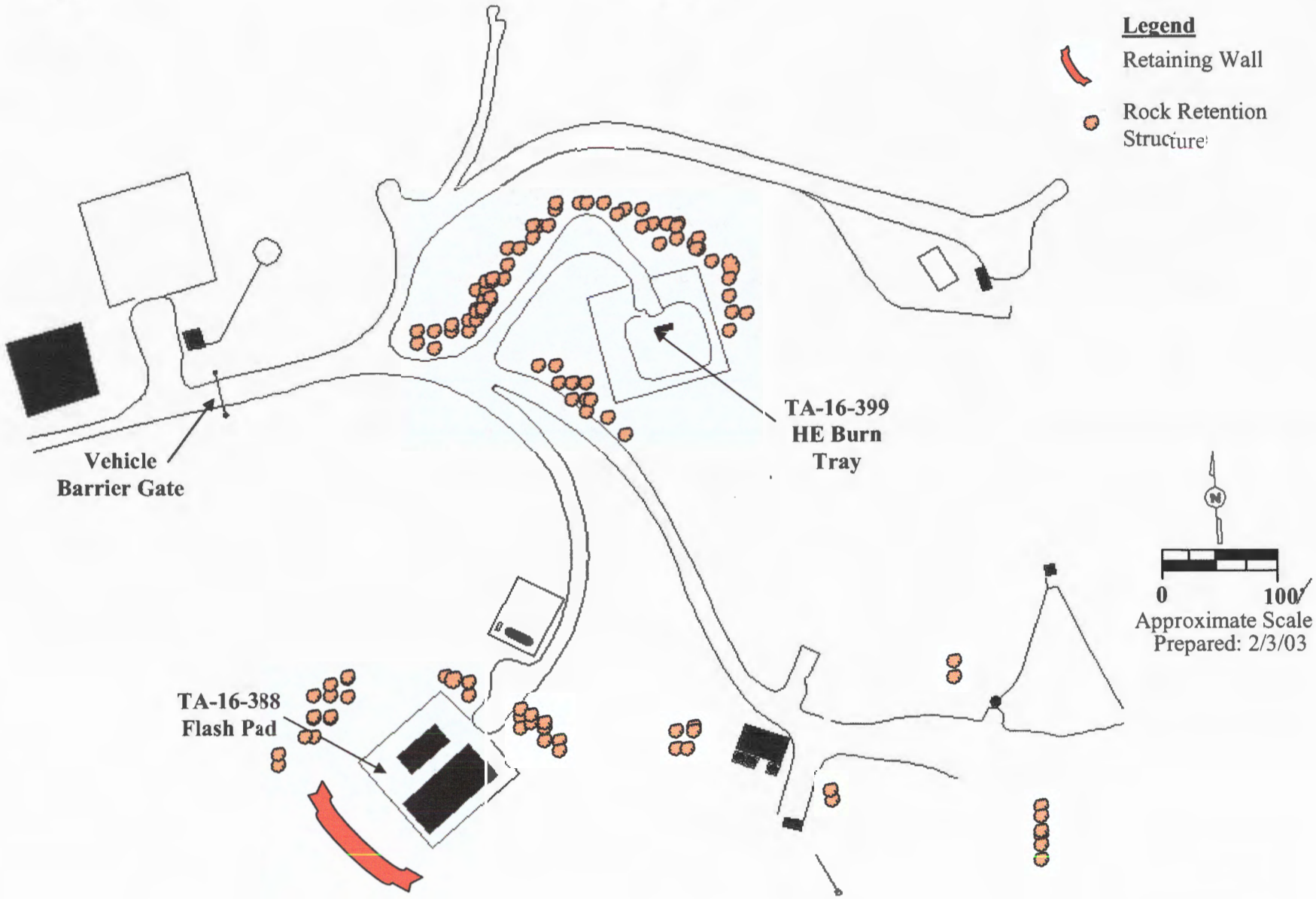

Figure 6-2

Drainage Control Features for the Technical Area (TA) 16 Burn Ground

Figure 17: Technical Area 16 Baseline Soil Sample Locations and Location of Surface Water Monitoring Station for Open Burning Treatment Units (TA-16-388 and TA-16-399)

100-ft Contour
20-ft Contour
10-ft Contour
2-ft Contour

Fences
Roads, Paved
Soil Sample Location
Structures
Storm water monitor station

RCRA waste management units
Structure
RWMU

N

Los Alamos NATIONAL LABORATORY

DISCLAIMER:
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA..

1:1,600

0 40 80 160 Feet

Meters
0 4.5 9 18 27 36

1983 North American Datum
State Plane Coordinate System
New Mexico, Central Zone (US Feet)

DATA SOURCES:

PATH	NAME	DATE ACCESSED	DATE PUBLISHED
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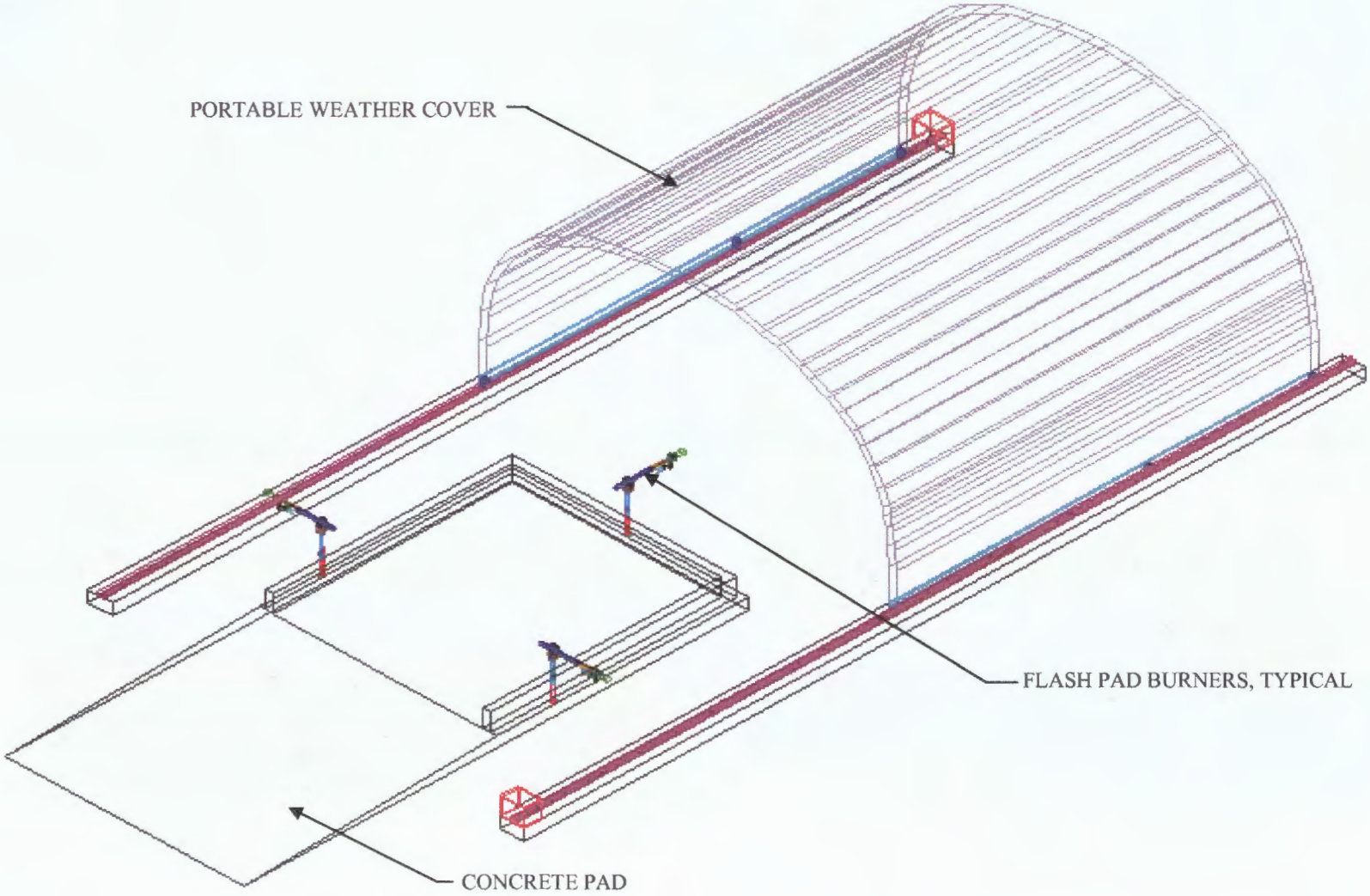

Figure 20

Technical Area (TA) 16-388 - Configuration of Flash Pad and Burners

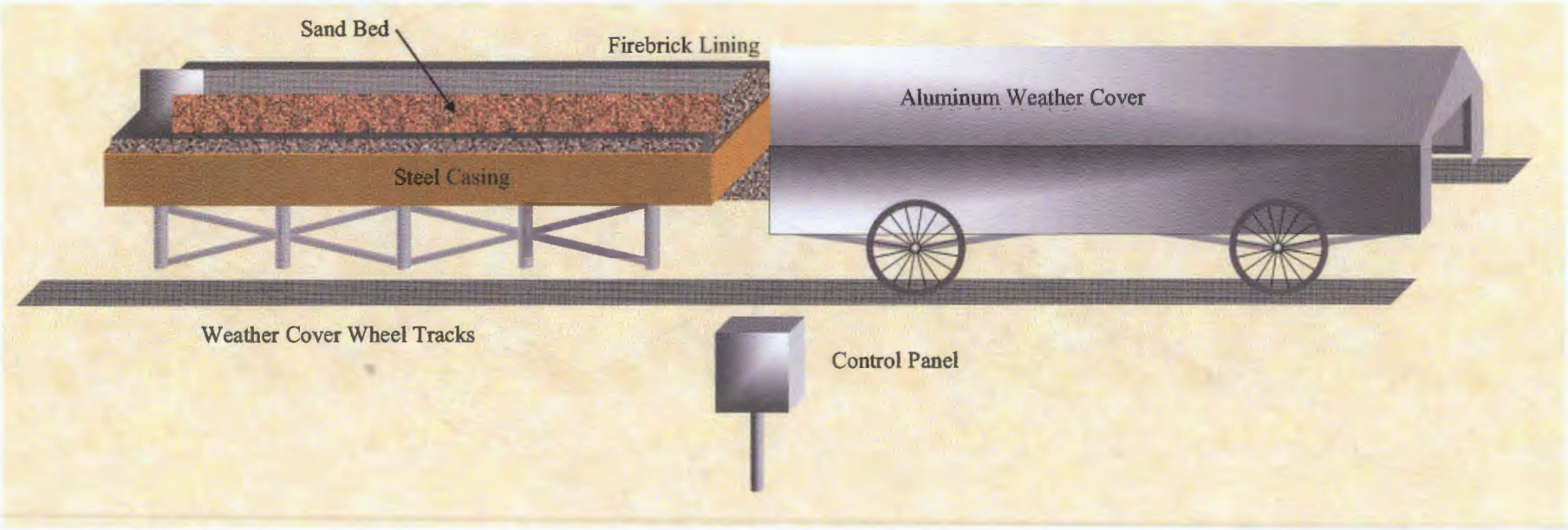

Figure G-5

Technical Area (TA) 16-399 HE Burn Tray

Excerpts from the September 3, 2009 comments to the July 2009 Revised Draft Permit

(Excerpt from LA-UR-09- 05638)

Com#	Part/ Attachment	Section	Comment	Suggested Text Change
21	Part 6	6.2	NMED states in the July 6, 2009, Fact Sheet, which provides the basis for requirements not specified in state regulations, that its prohibition on burning the hazardous component of mixed wastes "effectively prohibits the burning of radionuclides." NMED has authority to regulate only the hazardous portion of mixed waste, therefore its prohibition amounts to an impermissible regulation of the radioactive component of mixed waste.	Page 82, line 34, modify the sentence to read as follows: (1) ~~the hazardous component of mixed wastes, and~~ beryllium (*see* 40 CFR §270.32(b)(2));
22	Part 6	6.2(2)(i)	To clarify this section, the Permittees propose to add language stating that the certification will be included in the Biennial Report.	Page 83, lines 2-4, add the following sentence: Certification will be included in the Biennial Report.
23	Part 6	6.2(9)	The Permittees request the removal of the waste prohibition in Section 6.2(9), which prohibits the treatment of "wastes capable of generating dioxins and furans." The following presents the Permittees' support for the removal of this Permit condition. *Air Model Background* To demonstrate that the OB units will not cause adverse effects on human health or the environment, air modeling was performed and reports were generated by both the Permittees and NMED. The Permittees' modeling showed that OB treatment operations at Technical Area (TA)-16 are protective of human health and the environment and pose no adverse effects due to migration of waste constituents in the air. The NMED model showed that open burning treatment of 20,000 pounds (lbs) of bulk high explosive (HE) waste "can be conducted and considered protective of human health and the environment." However, the NMED conclusion was that burning 20,000 lbs per year of HE-contaminated waste "can be considered protective of human health but not protective of ecological receptors." The model found that the estimated 10-year soil deposition value for dioxin/furan due to the burning of HE-contaminated wastes would fail the LANL Ecological Screening Level for a Montane Shrew. The NMED model report stated that the "exceedances were driven	Page 83, delete lines 16-24: ~~(9) wastes capable of generating dioxins and furans.~~ ~~(i) The Permittees shall provide to the Department, prior to each treatment event, a certification that wastes being treated are not capable of generating dioxins and furans.~~ ~~(ii) To remove the prohibition, the Permittees must submit to the Department a Class 3 permit modification request that includes a demonstration that the treatment of waste capable of generating dioxins or furans will be conducted in a manner that will ensure protection of human health and the environment.~~

RCR000086-002

Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			by the emission factors chosen for furans while the dioxin component did not contribute to the exceedance." The NMED model report also recommended that the treatment of HE-contaminated wastes at TA-16-388 required "performance of a more refined analysis of ecological risk, restrictions on the types of HE-contaminated wastes treated, and/or implementation of controls or procedures to prevent exposure of small mammals." *Model screening exceedance only with HE-contaminated combustibles* The NMED model results determined that operations at the open burning treatment units pose <u>no adverse effects</u> for the treatment of bulk HE waste up to 20,000 lbs. Most of the waste treated through open burning at LANL (approximately 90%) is bulk HE from the machining of high explosives components used for testing, research and development projects within the DOE Complex. This waste consists of scraps and chips of explosives from machining mixed with water and the fiber filter socks used to strain the larger chunks of explosives from the water used for cooling. All waste treated at the TA-16-399 Burn Tray is bulk HE and most of the waste treated at the TA-16-388 Flash Pad is bulk HE and filters. The treatment of the HE-contaminated combustible waste makes up a small percentage of the waste treated at the open burning treatment units and in recent years has been less than 2% of the 20,000 lbs. modeled. Another major factor influencing the result for the open burning of HE-contaminated waste is the uncertainty associated with the emission factors used in the analysis. The emission factors for furans chosen by NMED represented a surrogate waste that did not accurately represent waste actually treated at the TA-16-388 Flash Pad. The emission factors were associated with the open burning of propellant-contaminated Manufacturer's Waste consisting of 65% aluminized ammonium perchlorate propellant, 20% plastic material (polyethylene gloves), 11% paper/wood/cloth and 4% diesel fuel. These emissions factors represent the highest values available for furans. The HE-contaminated combustible waste	

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			stream that is treated at the TA-16-388 Flash Pad, however, consists of pieces or powder HE, cloth, cardboard, kim-wipes, limited plastic bags, small amounts of solvent or oil on kim-wipes or filters, small glass pieces, and small metal pieces. This waste stream does not contain a high percentage of plastics, wood, or paper as these items would lead to the higher production of furans. Also, propellants such as ammonium perchlorate are not treated through open burning by the Permittees and are not considered high explosives. Based on these potential impacts, and to address recommendations from NMED modelers, the Permittees will implement the following. *Ecological Risk Analysis* To address recommendations from NMED's modelers, the Permittees conducted limited soil sampling, which found a higher value of dioxin/furan congeners in one out of the six samples. The elevated furan reading is suspected to result from activities that are no longer performed at that location. It was determined that more data is necessary to assess the ecological risk at the site. On August 26, 2009, 31 additional soil samples were collected and sent for analysis for dioxin/furans and the eight Resource Conservation and Recovery Act metals. The analysis of these soil samples will be added to the previously collected samples and the data will be used to characterize the TA-16 Burn Ground in regards to the air depositional impact that could occur from the current open burning treatment operations. The risk assessment will characterize the risk to wildlife in the area associated with the open burning treatment units at the TA-16 Burn Ground and take into consideration past operational activities and acts of nature (forest fires) that have impacted the site. Anticipated results of the risk assessment include data presenting values close to concentrations measured within other areas of LANL property, while taking into consideration historic activities and occurrences at the site. The data quality objectives and a map of the soil sampling locations for the most recent sampling event are included in	

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			Appendix 3, hereto. *Restrictions on Waste Treated* The revised draft Permit includes restrictions on the amount of waste treated as well as the types of waste at the open burning treatment units. The amount of waste that can be treated at the open burning treatment units was decreased from the volume of waste that was modeled. The model volume of waste was 20,000 lbs. and the draft Permit condition requires that the Permittees treat no more than 12,500 lbs. per year. An additional list of prohibited wastes has been added to the revised draft Permit that includes many dioxin/furan producers. The list includes chlorinated solvents and ammonium perchlorate, polyvinyl chloride, and structural components of demolition and decommissioning wastes. The prohibition of these wastes covers much of the concern for dioxin/furan producers. In fact, the Permittees are prohibited from treating the waste stream upon which NMED's modeling was based. Additionally, these specific waste bans are much less complicated to comply with for the Permittees and increase the enforceability for the NMED-HWB compliance inspectors. *Controls to Prevent Small Mammal Exposure* Periodic surveys of the TA-16 Burn Ground were recommended by NMED's model report to identify and relocate nesting areas. The fire break that is described in the comment to Section 6.1.1.1(1) of this document helps to discourage small animals from living in the area and the Permittees are committed to adding a periodic survey to look for signs of small burrowing mammals as an operational requirement that would be documented in the operating record for the permitted units. See Appendix 3 for supporting documents.	
24	Part 6	6.1.1.1(1)	NOTE: this should be 6.3.1.1(1). The requirement for <u>all</u> vegetation to be trimmed to 6 inches or less is excessive. The Permittees follow the requirements for vegetation control and combustible material control within the Department of Energy (DOE) Explosives Safety Manual (DOE M 440.1-1A).	Page 84, Lines 5-8, modify the text to read as follows: <u>Grasses and shrubs</u> ~~Vegetation~~ within a 200 ft radius of the Flash Pad and the Burn Tray shall be trimmed to less than or equal to six inches above

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			Vegetation control for fire protection (Section 5.1) states "Vegetation around storage magazines and explosives operating facilities should be controlled to minimize potential damage to the magazine or facility from erosion or grass, brush, or forest fires. A firebreak at least 50-ft (15-m) wide and free from combustible material should be maintained around each aboveground magazine or explosives operating facility." For waste management areas, Section 20.5(d) of the manual states "[d]uring destruction operations, the area within 200 ft (60 m) of the destruction point shall be kept clear of dry grass, leaves, and other extraneous combustible material. This clearance may be reduced to fire brand distance if aids to limit the range of fragments and debris are provided for the destruction points used within the disposal area." Combustible material is defined by the DOE Explosive Safety Manual as "[a]ny material that, when ignited, will sustain burning." Stakeholders expressed concern with erosion due to tree removal during a site visit on June 30, 2009. Vegetation at the open burning treatment units is controlled in a manner that minimizes the combustible material around each of the units. There are evergreen trees within the 200 ft radius that are necessary to aid in erosion control at the site.	the ground surface and the area will be kept free of other combustible material, before treatment. The Permittees shall document compliance with this provision in the Operating Record;
25	Part 6	6.1.1.1(2)	NOTE: This section should be 6.3.1.1(2). The Permittees request that the requirement in 6.3.1.1.(2) be modified to be consistent with Section 6.3.3.2, which requires the Permittees to cover and inspect the treatment units within 10 hours of the last open burn treatment. As written, this section prohibits all access to the treatment units for 10 hours and is inconsistent with the requirement in Section 6.3.3.2.	Page 84, lines 9-11, modify sentence to read as follows: The barricade at TA-16-389 shall be closed for the duration of the treatment. ~~and for.~~ Safety barricades will be used during the ten-hour cool-down period after treatment to prevent the entry of unauthorized personnel into ~~the area~~ TA-16-388 or TA-16-399, except as provided in Permit Section 6.3.3.2.
26	Part 6	6.1.1.3(4)	NOTE: This Section should be 6.3.1.3(4)). Section 6.3.1.3(4) inappropriately prohibits treatment during high fire danger conditions. Current operations at the open burning treatment units allow for safe operation under "High" Fire Danger Rating. The ratings system was developed by the United States	Page 85, Lines 11-14, modify the section to read as follows: (4) Open burning treatments shall not be conducted during ~~High,~~ Very High, or Extreme Fire Danger classes as designated by the ~~National~~

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			Forest Service's Wild Fire Assessment System and modified by Facility personnel for specific terrain and weather conditions. Forecast for fire danger each day utilizes the Wild Fire Assessment System and the National Oceanic and Atmospheric Administration's Storm Prediction Center, which are incorporated at http://www.weather.lanl.gov/fire_outlook.asp. The Storm Prediction Center's Fire Outlook indicates areas where the combination of dry dead fuels, such as grass and timber, and meteorological conditions (wind, relative humidity, temperature, and dry thunderstorms) might contribute to potentially dangerous wild fire behavior. However, it does not forecast local meteorological conditions (i.e., local variability of relative humidity or the effects of terrain on wind direction and speed). Local meteorological conditions are considered when the fire danger rating is posted each day at LANL. In addition, an assessment of slope of local terrain, types of fuels, variability of fuels, and live fuel moisture content at the site initially establishes and regularly reaffirms specific controls for operations during each fire danger rating. The *Restrictions on Operations* section (currently Section 6.1.1) of the revised draft Permit includes these operational controls. During "High" Fire Danger, open burning operations can be conducted with controls in addition to the conditions already included within the Permit for lower fire danger ratings. The suggested text highlights the extra precaution taken when open burning treatment occurs under "High" fire conditions. Through evaluation by fire protection personnel, it has been determined that treatment operations at the TA-16 open burning treatment units are conducted safely and without any additional risk to human health and the environment. Other general controls during a burn include scheduling with other waste treatment and experimental firing sites, so as not to overload any resources; receiving High Explosive Safety Operations personnel approval; notifying site access control as well as the Los Alamos Fire Department (LAFD); watching the burn remotely through a camera during and 30 minutes after completion; and measuring wind speed just prior to the burn to ensure it is within the fire danger matrix. Additionally, water and	~~Oceanic and Atmospheric Administration's National Weather Service~~ United States Forest Service. Treatment during High Fire Danger must only occur at wind speeds less than 10 miles per hour.

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			fire extinguishers are available if they are needed and personnel are trained to use fire extinguishers, and LAFD Station #5 is located less than 5 minutes away from the open burning treatment units. The ability to treat waste during High Fire Danger is needed to ensure compliance with regulatory and safety requirements for the storage of high explosives waste and high explosive contaminated waste. Specific requirements which must be met include generator storage area time frames or laboratory safety storage volume limits.	
27	Part 6	6.5.1	The list of analytes for soil monitoring at the open burning treatment units includes constituents that are not representative of treatment operations at the permitted units. The revised draft Permit includes a prohibition on treatment of perchlorate at the open burning treatment units. Therefore, the Permittees should not have to monitor for this constituent "to monitor for hazardous constituents release to soils during open burning treatment events" as is stated in the first paragraph of the section. Additionally, the revised draft Permit currently includes a prohibition on the treatment of wastes capable of generating dioxins/furans. In Comment 23, above, the Permittees objected to the prohibition. Therefore, based on the current prohibition, the Permittees should not have to monitor for this constituent. However, if the prohibition in Section 6.2(9) is removed, the Permittees do not object to soil monitoring requirements for dioxin/furan congeners. Additionally, volatile organic compounds and semi-volatile organic compounds are not constituents likely to be released to soils from the open burning treatment units. The deposition of these constituents is unlikely and analysis for metals will give a better indication of adverse impacts to the soil from the open burning treatment operations as they have the highest potential to impact the soil from open burning treatment operations. The Environmental Protection Agency submitted comments to the first draft permit indicating that a multi increment sampling approach is appropriate for this site. The Permittees support this suggestion and request reconsideration of the multi increment	Page 87, lines 4-6, modify the sentence to read as follows: The Permittees shall analyze the soil samples collected during each monitoring event for total metals and explosive compounds.~~, volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), perchlorate, and dioxins/furans.~~

RCR00086.008

Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			sampling approach and sampling locations to allow for this method.	
28	Part 6	6.5.2	The list of analytes for surface water monitoring at the open burning treatment units includes analytes that are not representative of treatment operations at the permitted units and constituents that in practice are not reliably detected in storm water. Storm water monitoring for perchlorate is not warranted because it is prohibited from treatment at the permitted units. Storm water monitoring for dioxins/furan is not warranted because the treatment of wastes capable of generating dioxins/furans is prohibited. However, if the prohibition in Section 6.2(9) is removed, the Permittees will monitor for dioxin/furan congeners. Storm water should not be monitored for volatile organic compounds and semi-volatile organic compounds because it is difficult to collect a representative sample. Analysis for metals will give a better indication of the impacts on storm water from the open burning treatment operations as they have the highest potential to impact the soil from open burning treatment operations.	Page 88, lines 3-4 and 7-8, modify the section to read as follows: The samples shall be analyzed for total metals~~,~~ and explosive compounds.~~, volatile organic compounds, semi-volatile organic compounds, perchlorate, and dioxins/furans.~~ If the precipitation event produces insufficient sample volume to perform all analyses, the Permittees will prioritize the list of analytes based on the sample volume collected as follows: 1) explosive compounds; and 2) total metals;~~ 3) semi-volatile organic compounds; and 4) perchlorate.~~
65	Attachment C	Table C-6	Table C-6 should be revised in order to be consistent with the waste streams that may be treated at the Open Burn treatment units. Further discussion of the proposed changes to Table C-6 is found in Comment 231 in Part 2 of the Comments and revised Table C-6 is attached in Appendix 6.	Attachment C, page 59, replace Table C-6 in the revised draft Permit with Table C-6 in Appendix 6.
132	Attachment N	Figure 5	Update of Figure 5 clarifies access control via barricades placed on roadways versus access gates.	Updated figure is included with this document as part of Appendix 5.
142	Attachment N	Figure 16	Updated Figure 16 depicts current Facility boundary.	Updated figure is included with this document as part of Appendix 5.
143	Attachment N	Figure 17	Updated Figure 17 removes outlines of units and structures that no longer exist at the site.	Updated figure is included with this document as part of Appendix 5.
174	Attachment A	A.2	Administrative – Suggested text change corrects a typographical error.	Section A.2: Change the references to Attachment N within the section as follows: • Page 6, Line 38 should be changed from

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
				"Figure 15" to "Figure 16". • Page 7, Line 1 should be changed from 'Figure 16" to "Figure 17".
175	Attachment A	A.2.1	Administrative – Suggested text change corrects a typographical error.	Section A.2.1, Page 7, Line 17: Change the reference to Attachment N within the section from "Figure 19" to "Figure 20".
176	Attachment A	A.2.2	Administrative – Suggested text change corrects a typographical error.	Section A.2.2, Page 8, Line 3: Change the reference to Attachment N within the section from "Figure 20" to "Figure 21".
177	Attachment A	A.2.3	Administrative – Suggested text change corrects a typographical error.	Section A.2.3, Page 8, Line 17: Change the reference to Attachment N within the section from "Figure 6" to "Figure 5".
232	Attachment C	Table C-6	The waste descriptions included in Table C-6 of the draft Permit do not coincide with the descriptions of waste treated by open burning in Section C.1.3.2. Suggested changes bring the table into alignment with the descriptions in the waste analysis plan. Changes to the first row of the table coincide with the waste stream description for bulk solvent waste. The Permittees define this waste stream to only include HE and dimethyl sulfoxide, there would be no other Environmental Protection Agency Numbers other than D003 and D030. Changes to the second, fourth and fifth rows of the table add EPA Hazardous Waste Numbers from the table transmitted from the Permittees' permit application which have been omitted but are allowed for acceptance at the open burning treatment units as outlined in Attachment B of the draft Permit (*Part B Permit Application*). Additional changes in the description in the second row limit the acceptance of this waste stream. Deletion of the sixth row of the table is recommended because solvent in de minimus quantities is not itself a waste stream. Solvents may be accepted at the open burning treatment units as	Pages 59-62: Suggested changes are in Appendix 6, revised Table C-6.

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Com#	Part/ Attachment	Section	Comment	Suggested Text Change
			part of the other waste streams as recommended by the suggested changes.	
233	Attachment C	Table C-12	The waste descriptions included in Table C-12 of the draft Permit do not coincide with the descriptions of waste treated by open burning in Section C.1.3.2. Suggested changes bring the table into alignment with the descriptions in the waste analysis plan. Changes to the first row of the table coincide with the waste stream description for bulk solvent waste. The Permittees define this waste stream to only include HE and dimethyl sulfoxide, there would be no EPA Hazardous Waste Numbers other than D003 and D030. Recommend deleting "solvents" from the waste stream name to match the description in Section C.1.3.2. Delete the row "HE Commercial Chemical Products" as this is not a waste stream that will be accepted at the open burning treatment units. Change "Wet HE" to "HE Process Waste from Water Filtration" to match the description in Section C.1.3.2. Delete the row "HE-Contaminated Liquid Acids, Bases, and/or Inorganic Salt Solutions" as this is not a waste stream that will be accepted at the open burning treatment units.	Pages 72-73: Suggested changes are in Appendix 6, revised Table C-12.
234	Attachment C	Table C-13	Administrative –Table C-13 is all one row.	Page 74: Include Table C-13 formatted as follows:

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Table C-13

Summary of Characterization Methods for High Explosives (HE) Waste and HE-Contaminated Waste

Parameters	Method Numbers	Test Method	Rationale
HE in the Waste	SW-846 (Appropriate analytical method from the Method 8300 series)[a]	High Performance Liquid Chromatography or Acceptable Knowledge[b]	Determine HE concentrations directly in homogeneous materials or by process information.
		DX-2 Spot Test, DeTech, or other screening methods	Determine if HE is present in the waste stream.
		Acceptable Knowledge[b]	If all surfaces of heterogeneous waste cannot be directly tested or visually examined (e.g., debris or equipment) and the waste object was potentially contaminated with HE during its use.

[a] U.S. Environmental Protection Agency, 1986 and all approved updates, "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," *SW-846*.

[b] Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

RCR00086.012

DOE/LANS COMMENTS ON THE REVISED DRAFT PERMIT FOR LOS ALAMOS NATIONAL LABORATORY

APPENDICES

Appendix 1- Documents supporting Comment 20, RLWTF

Appendix 2- Documents supporting Comment 10, mixed waste venting

Appendix 3 Documents supporting Comment 23, dioxin/furan prohibition

Appendix 4 Attachment K-summary of changes to Tables K-1, K-2 and K-3

Appendix 5 Attachment N-updated figures

Appendix 6 Attachment C-updated Tables C-6, C-12

Appendix 7 Attachment A Table of Contents

Appendix 8 Attachment D revisions

RCR00086.013

Appendix 5

Attachment N- Updated Figures

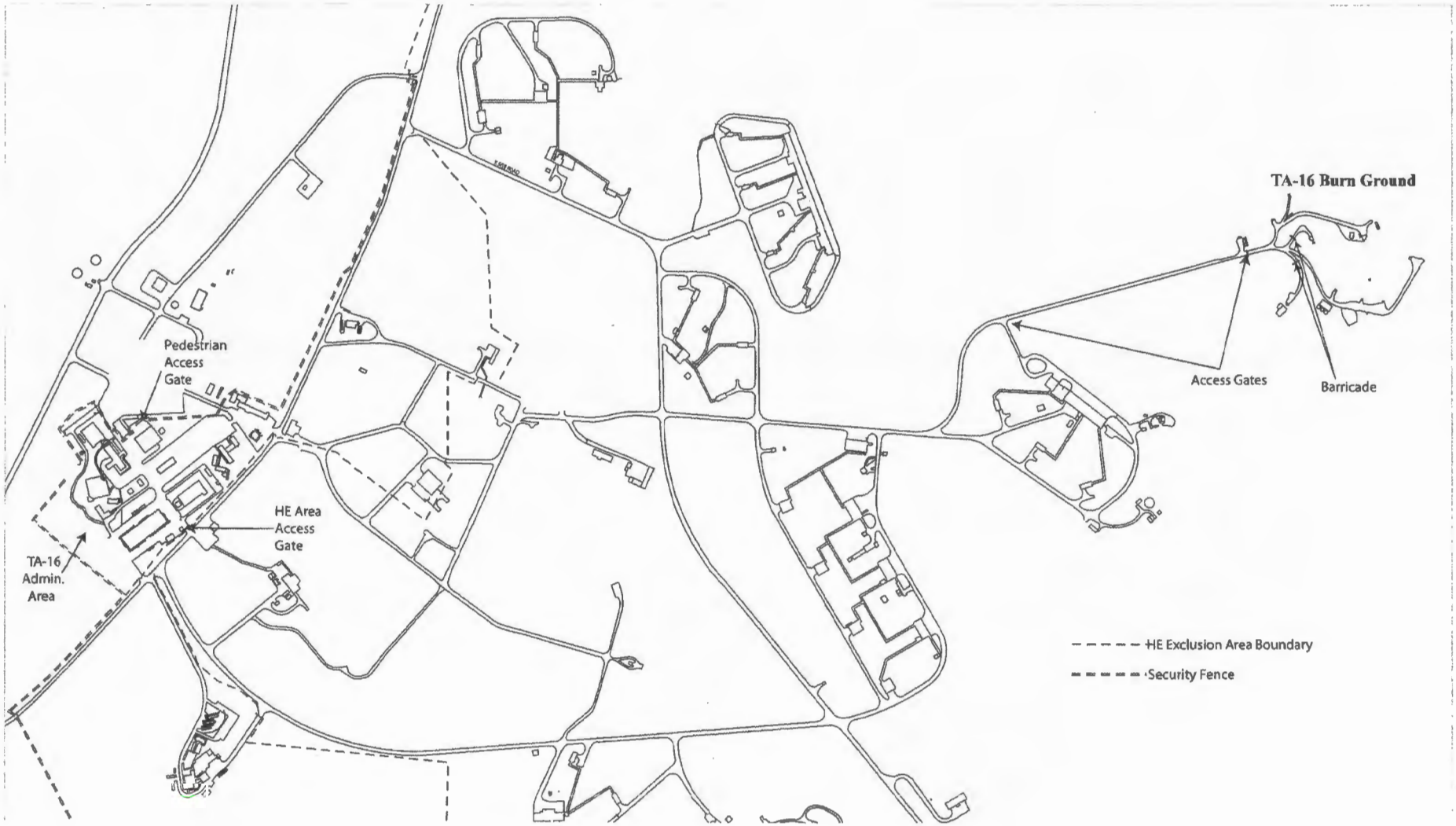


Figure 5:
Technical Area (TA) 16 Security Fences, Entry Gates, and Entry Stations

Figure 16:

Technical Area (TA) 16 Location Map

Created by EP-WES-EDA GIS TEAM. Map Number 06-0108 November 13, 2006, modified by ENV-RCRA August 2008
State Plane Coordinate System New Mexico Central Zone North American Datum 1983 (ft)
This map was created for work processes associated with the Environmental &Remediation Support Services. All other uses for this map should be confirmed with LANL EP-WES staff.
Boundary of Department of Energy Property I Around the Los Alamos National Laboratory; Los Alamos National Laboratory, SSMO Site Planning & Project Initiation, Infrastructure Planning Office. 04 June 2008
Boundary of Department of Energy Property In and Around the Los Alamos National Laboratory; Los Alamos National Laboratory, SSMO Site Planning & Project Initiation; 04 June 2008

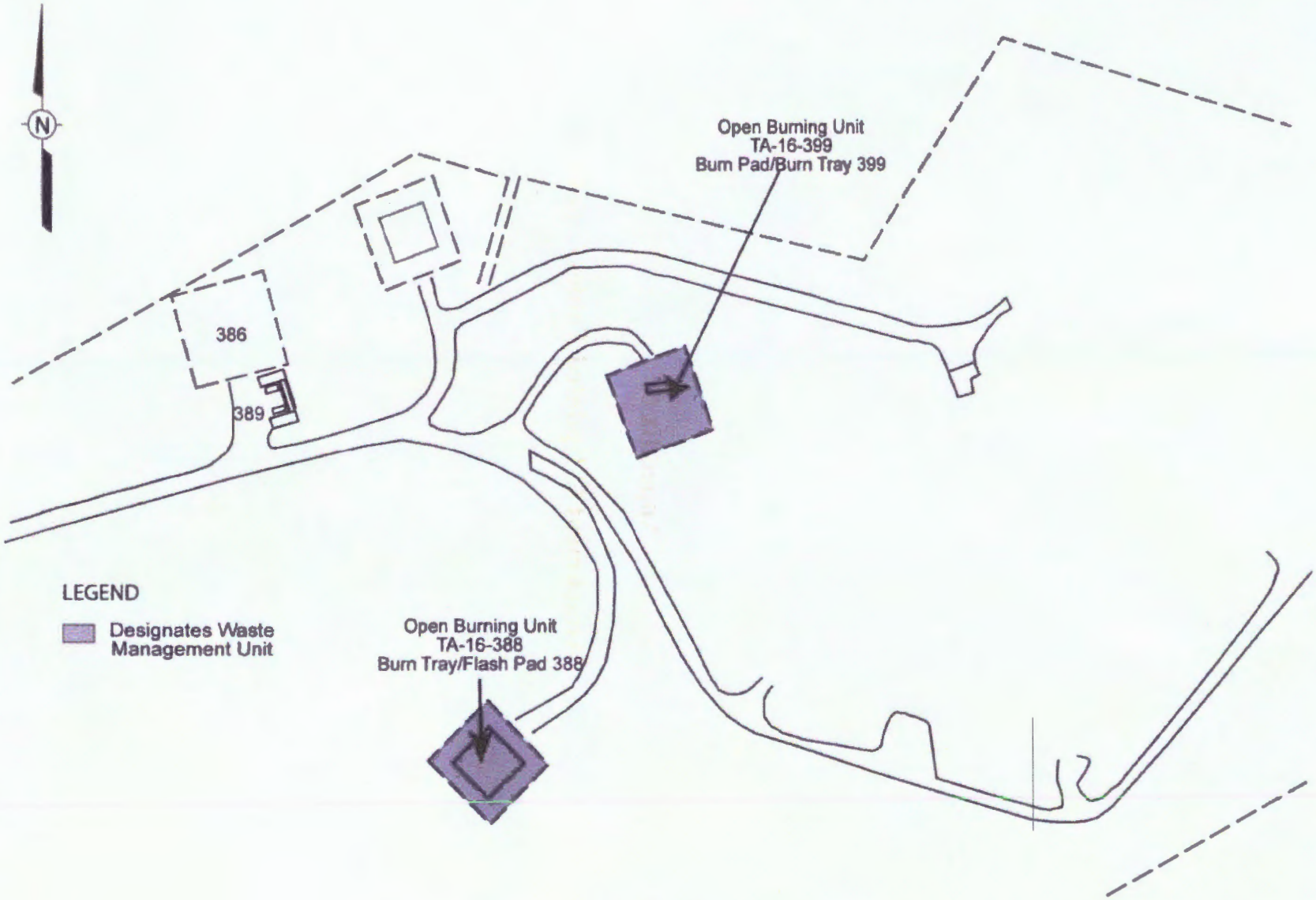


Figure 17
Technical Area (TA) 16 Open Burn Treatment Units (16-388 & 16-399)

Appendix 6

Attachment C-Updated Tables C-6, C-12

Table C-6

Descriptions of High Explosives (HE) Waste and HE-Contaminated Waste Treated by Open Burning at the Facility

(This table is for informational purposes only)

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated ~~Water~~Bulk Solvent Waste	Laboratory analysis, dissolving HE and polymers; HE ~~processing~~production; ~~maintenance~~ and R&D	Acceptable Knowledge[c]	D003	~~Reactivity~~	NA[d]
			~~D005~~	~~Barium~~	~~100.0~~
			~~D006~~	~~Cadmium~~	~~1.0~~
			~~D007~~	~~Chromium~~	~~5.0~~
			~~D008~~	~~Lead~~	~~5.0~~
			~~D009~~	~~Mercury~~	~~0.2~~
			~~D011~~	~~Silver~~	~~5.0~~
			~~D018~~	~~Benzene~~	~~0.5~~
			D030	~~Chloroform~~	0.13
			~~D035~~	1,2-Dichloroethane	~~200.0~~
			~~D036~~	~~2,4-Dinitrotoluene~~	~~2.0~~
			~~D038~~	~~Methyl ethyl ketone~~	~~5.0~~
			~~F004~~	~~Nitrobenzene~~	~~NA[d]~~
			~~F005~~	~~Pyridine~~	~~NA[d]~~
				~~Trichloroethylene~~	~~NA[d]~~
					~~NA[d]~~
HE-Contaminated Used Oils	~~Laboratory analysis, dissolving HE and polymers;~~ HE production; spills; and R&D activities	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D002	Corrosivity	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	0.5
			D022	Chloroform	6.0
			D028	1,2-Dichloroethane	0.5
			D029	1,2-Dichloroethylene	0.7

RCR00086.019

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated Used Oils			D030	2,4-Dinitrotoluene	0.13
			D035	Methyl ethyl ketone	200.0
			D036	Nitrobenzene	2.0
			D038	Pyridine	5.0
			D040	Trichloroethylene	0.5
			F001	–Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	NA[d]
Solid and Scrap HE	HE-processing; R&D activities; testing operations; disposition of weapons	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D018	Benzene	0.5
			D030	2,4-Dinitrotoluene	0.13

RCR00086.020

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE Process Waste from Water Filtration	Filtration of HE wastewater; R&D, and HE processing	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	0.5
			D022	Chloroform	0.13
			D028	1,2-Dichloroethane	200.0
			D029	1,2-Dichloroethylene	2.0
			D030	2,4-Dinitrotoluene	5.0
			D035	Methyl ethyl ketone	NA[d]
			D036	Nitrobenzene	NA[d]
			D038	Pyridine	NA[d]
			D040	Trichloroethylene	NA[d]
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	
			F003	Spent nonhalogenated solvents	
			F004	Spent nonhalogenated solvents	
			F005	Spent nonhalogenated solvents	
			K044	Wastewater sludges	
			K045	Spent carbon	

RCR00086.021

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
HE-Contaminated Solid Waste	HE processing activities; R&D and laboratory use	Acceptable Knowledge[c]	D001	Ignitability	NA[d]
			D002	Corrosivity	NA[d]
			D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D018	Benzene	6.0
			D022	Chloroform	0.5
			D028	1,2-Dichloroethane	0.7
			D029	1,1-Dichloroethylene	0.13
			D030	2,4-Dinitrotoluene	200.0
			D035	Methyl ethyl ketone	2.0
			D036	Nitrobenzene	5.0
			D038	Pyridine	0.5
			D040	Trichloroethylene	NA[d]
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	
HE-Contaminated Equipment	HE processing; R&D activities and laboratory use	Acceptable Knowledge[c]	D003	Reactivity	NA[d]
			D005	Barium	100.0
			D006	Cadmium	1.0
			D007	Chromium	5.0
			D008	Lead	5.0
			D009	Mercury	0.2
			D011	Silver	5.0
			D030	2,4-Dinitrotoluene	0.13
			F001	Spent halogenated solvents	NA[d]
			F002	Spent halogenated solvents	NA[d]
			F003	Spent nonhalogenated solvents	NA[d]
			F004	Spent nonhalogenated solvents	NA[d]
			F005	Spent nonhalogenated solvents	NA[d]

RCR00086.022

Waste Description	Waste Generating Activity	Basis for Hazardous Waste Designation	Potential EPA[a] Hazardous Waste Numbers	Potential Hazardous Constituents and/or Characteristics in the Waste	Regulatory Limits[b] (milligrams per liter)
~~HE-Contaminated Solvents in de minimis quantities (liquid acids, bases, and Inorganic salt solutions)~~	~~Materials used as titrants, solvents, and cleaning fluids and material from hydrolysis research~~	~~Acceptable Knowledge[c]~~	~~D002~~ ~~D003~~ ~~D018~~ ~~D030~~ ~~D035~~ ~~D036~~ ~~D038~~ ~~F003~~ ~~F004~~ ~~F005~~	~~Corrosivity~~ ~~Reactivity~~ ~~Benzene~~ ~~Chloroform~~ ~~2,4-Dinitrotoluene~~ ~~Methyl ethyl ketone~~ ~~Nitrobenzene~~ ~~Pyridine~~	~~NA[d]~~ ~~NA[d]~~ ~~0.5~~ ~~0.13~~ ~~200.0~~ ~~2.0~~ ~~5.0~~ ~~NA[d]~~ ~~NA[d]~~ ~~NA[d]~~

[a] U.S. Environmental Protection Agency. Note that these constituents will likely be present only in trace amounts.

[b] A solid waste exhibits the characteristic of toxicity if, using the Toxicity Characteristic Leaching Procedure, Test Method 1311 in "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" (EPA, 1986), the extract from a representative sample of the waste contains any of the contaminants listed at a concentration equal to or greater than the respective value given in the New Mexico Administrative Code, Title 20, Chapter 4, Part 1, Subpart II, Part 261, Subpart C [6-14-00]. These constituents are included if they are likely to be present; however, they are not expected to exceed the toxicity characteristic limits on a routine basis.

[c] Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

[d] Not applicable: refers to the absence of regulatory limits for ignitable, corrosive, reactive wastes, and F-, K-, and U-listed wastes. The amount of F-listed waste is expected to be trace in all waste streams, with the exception of the HE-contaminated spent solvent waste, which is expected to be 30 percent or more (by volume) solvent.

RCR00086.023

Table C-12

Parameters, Characterization Methods, and Rationale for Parameter Selection for High Explosives (HE) Waste and HE-Contaminated Waste

Waste Description	Parameter[a]	Characterization Method	Rationale
HE-Contaminated ~~Water~~Bulk Solvent Waste	– Ignitability – Reactivity – Toxicity ~~Solvents from non-specific sources~~ 25% by volume HE	– Acceptable Knowledge[b] – Field screening Sampling and analysis SW846 methodology	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (metals and organics) ~~Determine the presence of F-listed solvents~~
HE-Contaminated Oil~~/Solvent~~ Waste	– Corrosivity – Ignitability – Reactivity – Toxicity Solvents from non-specific sources 25% by volume HE	– Acceptable Knowledge[b] Sampling and analysis SW846 methodology	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics) – Determine the presence of F-listed solvents
Solid and Scrap HE (i.e., bulk HE)	– Ignitability – Reactivity – Toxicity	– Acceptable Knowledge[b]	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (barium and dinitrotoluene)
~~HE-Contaminated Commercial Chemical Products~~	~~Ignitability~~ ~~Reactivity~~ ~~Spill residues from commercial products~~	~~Acceptable Knowledge[b]~~	~~Determine characteristic for ignitability and reactivity~~ ~~Determine the presence of U-listed wastes~~
~~Wet~~ HE Process Waste From Water Filtration	– Ignitability – Reactivity – Toxicity – Solvents from non-specific sources – Specific source wastes (K wastes)	– Acceptable Knowledge[b]	– Determine characteristic for ignitability and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F- and K-listed solvents

Refer to footnotes at end of table.

Table C-12 (continued)

Waste Description	Parameter[a]	Characterization Method	Rationale
HE-Contaminated Solid Waste (heterogeneous)	– Ignitability – Corrosivity – Reactivity – Toxicity – Solvents from non-specific sources	– Acceptable Knowledge[b] – Field screening – Sampling and analysis – Visual examination	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F-listed solvents
HE-Contaminated Solid Waste (homogeneous, i.e., sand)	– Ignitability – Corrosivity – Reactivity (i.e., 10% by weight) – Toxicity – Solvents from non-specific sources	– Acceptable Knowledge[b] – Field screening – Sampling and analysis	– Determine characteristic for ignitability, corrosivity, and reactivity – Determine toxicity characteristic (organics and metals) – Determine the presence of F-listed solvents
HE-Contaminated Equipment	– Reactivity – Toxicity	– Acceptable Knowledge[b] – Field screening – Sampling and analysis	– Determine characteristic for reactivity – Determine toxicity characteristic (dinitrotoluene and metals)
~~HE-Contaminated Liquid Acids, Bases, and/or Inorganic Salt Solutions~~	~~– Corrosivity~~ ~~– Reactivity~~ ~~– Toxicity~~ ~~– Solvents from non-specific sources~~ ~~– 25% by volume HE~~	~~– Acceptable Knowledge[b]~~ ~~– Field screening~~ ~~– Sampling and analysis~~ ~~– SW846 methodology~~	~~– Determine characteristic for corrosivity and reactivity~~ ~~– Determine toxicity characteristic (organics)~~ ~~– Determine the presence of F-listed solvents~~

[a] Parameter selection is based on process knowledge for each waste stream. Additional parameters may be selected for each waste stream as necessary.

[b] Acceptable knowledge is broadly defined as process knowledge, additional characterization data, and/or facility records of analysis, U.S. Environmental Protection Agency, 1994, "Waste Analysis at Facilities that Generate, Treat, Store, and Dispose of Hazardous Waste, A Guidance Manual," *OSWER 9938.4-03*, U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, Washington, D.C.

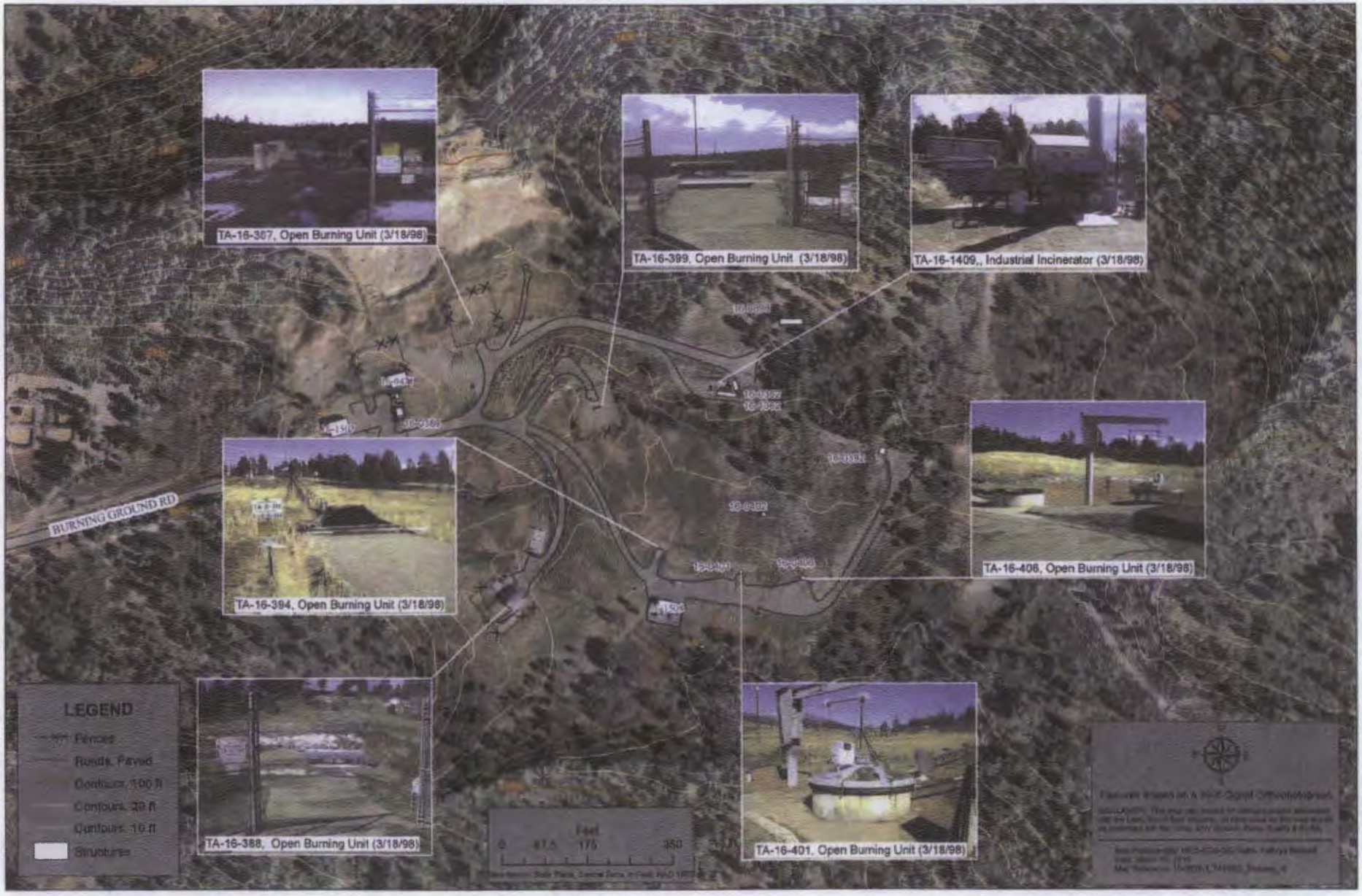
Photograph of Technical Area 16, 388 Flash Pad

RCR00087.002

Photograph of Technical Area 16, 399 Burn Tray

RCR00088.002

Aerial Photograph of TA-16 Currently and Photos of Open Burning Units in 1998



RCR00089.002

Clip of open burning treatment activity at TA-16-388

(LA-UR-08-05503)

16

Thermal Data Collection Report From Propane Burners at TA-16-388
(LA-UR-10-01709)

LANL Exhibit QQ

TA-16-388 HE Burn System

Thermal Data Collection

March 17, 2010

By

James Jurney

Laura Cartelli

Marcus Unzueta

Unclassified

RCR00091.002

Acknowledgements

The following people provided needed support in getting this report to completion.

Connie Gerth, ENV-EAQ
Sandra Powell, W-15, ADC
Bart Olinger, W-15, ADC
Steven Oritz, W-15
Sabrina Larsen, PS-4
Melinda Lucero, AET-5
Arthur Romero, AET-5

Abstract

This report was commissioned to provide verification data that the HE burning system is operating at temperatures in excess of 1400 °F. Using state of the art data acquisition equipment and calibrated temperature sensors we recorded data on two separate days.

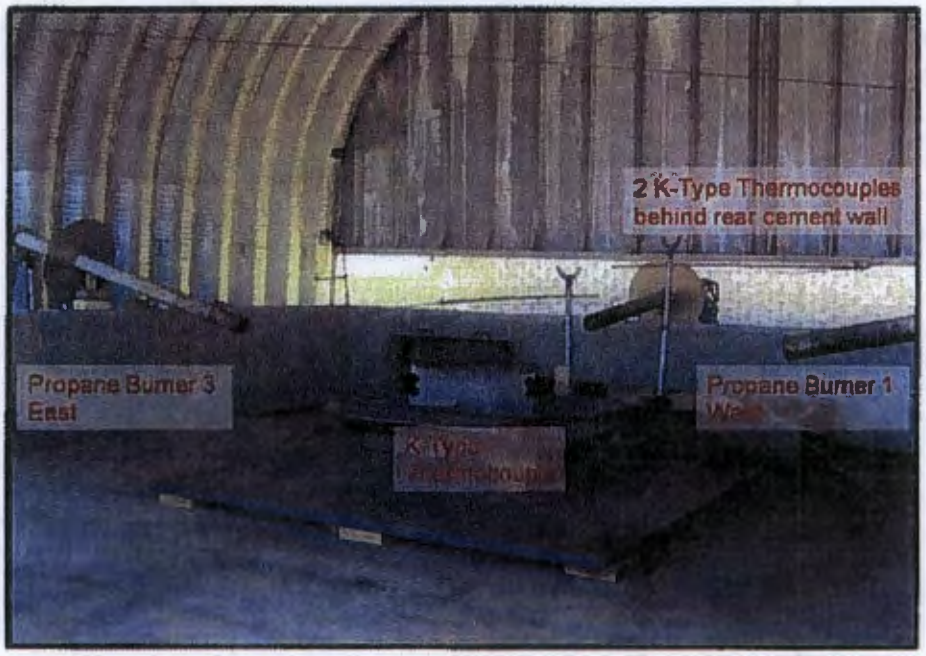
The data collected verified burn temperatures indeed surpass 1400 °F within 10 seconds of starting the system.

RCR00091.003

Test Setup

To obtain a thorough data set two different measurement technologies were used to gather the temperatures: thermocouple and elements infrared pyrometry. New standard limits of error Type K thermocouples were used in conjunction with the existing Type J thermocouples of unknown error specification. The Type K thermocouple data is clearly shown in the Test Results section. The Type J thermocouple data is not included because of their unknown error specification. For the pyrometry equipment a two-wavelength pyrometer, a single-wavelength pyrometer, and a single-wavelength thermal imager were used. The high speed two-color pyrometer provided for high accuracy by eliminating any surface emissivity errors. Note that the surfaces being measured only varied in emissivity from about 0.90 to 0.98. This slight variation in surface emissivity could only account for about a 3% measurement error on the single-wavelength units had the two-wavelength pyrometer not been used. Calibration data and equipment specification sheets are included in the appendix.

The following pictures illustrate the test equipment layout used at the burn site. Both tests were setup identically with one exception; for the 20100316 Test, a small graphite felt pad was attached to the burn screen to serve as a known-emissivity target for the thermal imager.



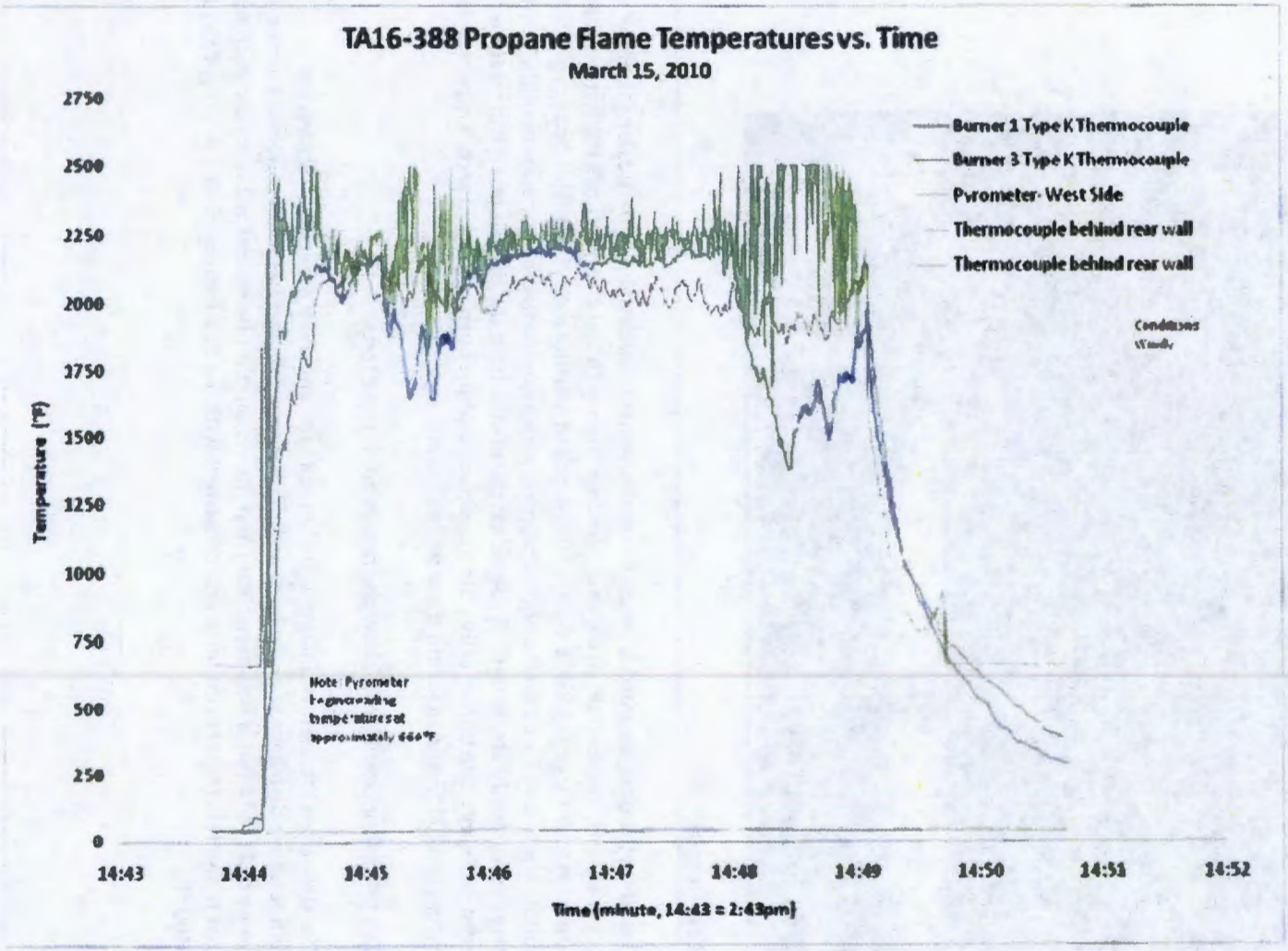
Test Results

Based on the data recorded from all the measurement devices and in particular the high-accuracy two-wavelength pyrometer, the data from each test clearly shows the temperature of the burn area exceeds 1400 °F within 10 seconds of starting the system. The two graphs that follow show that based on the highest accuracy measurement, the temperature of the burn area stays consistently above 1800 °F. Based on the results from the second test it can be shown that even with only one burner active the temperature of the burn area will reach temperatures in excess of 1400 °F and maintain these without issue.

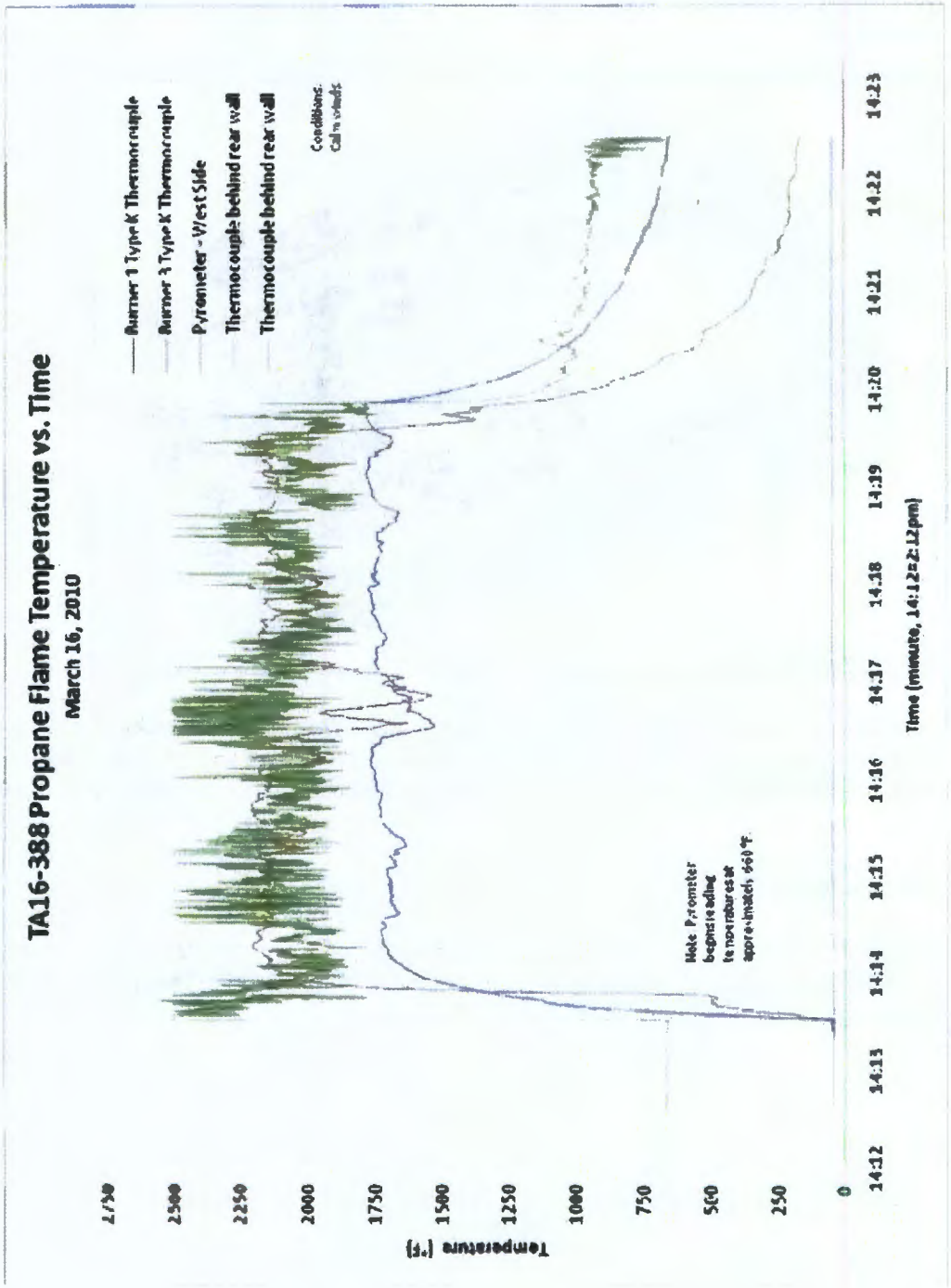
The following Graphs best show the results from these tests.

The data from the thermal imager is included in the appendix and clearly shows the temperature distribution at the burn area. The thermal imager has a top calibrated temperature range of 1112 °F but is was very clear from the visual color being emitted from the burn screen that temperatures were uniform and consistent with the other sensor data; i.e.: far greater than 1400 °F.

RCR00091.005

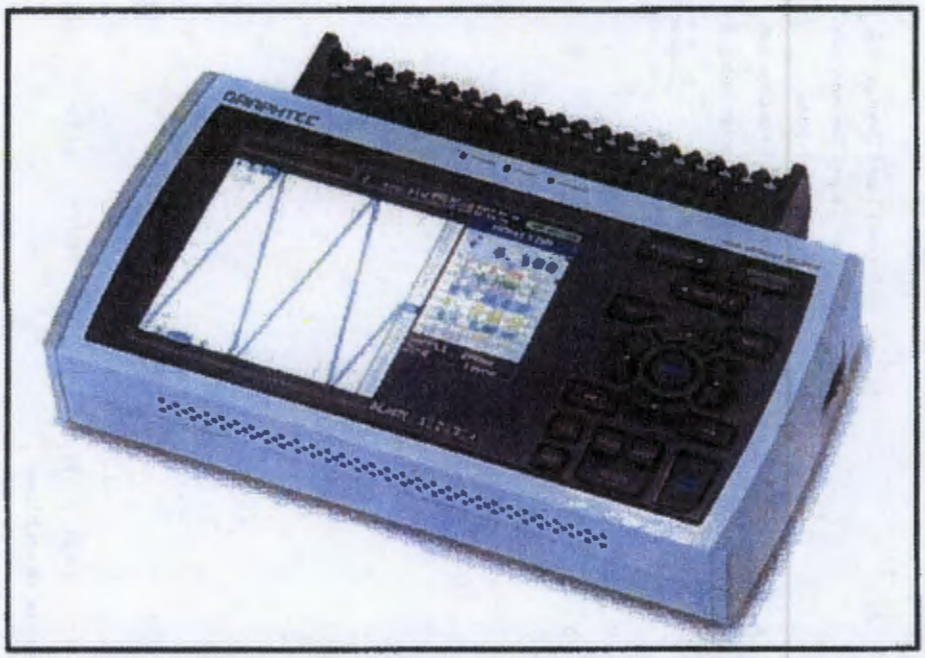

TA16-388 Propane Flame Temperatures vs. Time
March 15, 2010
Burner 1 Type K Thermocouple
Burner 3 Type K Thermocouple
Pyrometer- West Side
Thermocouple behind rear wall
Thermocouple behind rear wall
Temperature (°F)
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
0
14:43
14:44
14:45
14:46
14:47
14:48
14:49
14:50
14:51
14:52
Time (minute, 14:43 = 2:43pm)

20100316 Test



Equipment Used

Datalogger

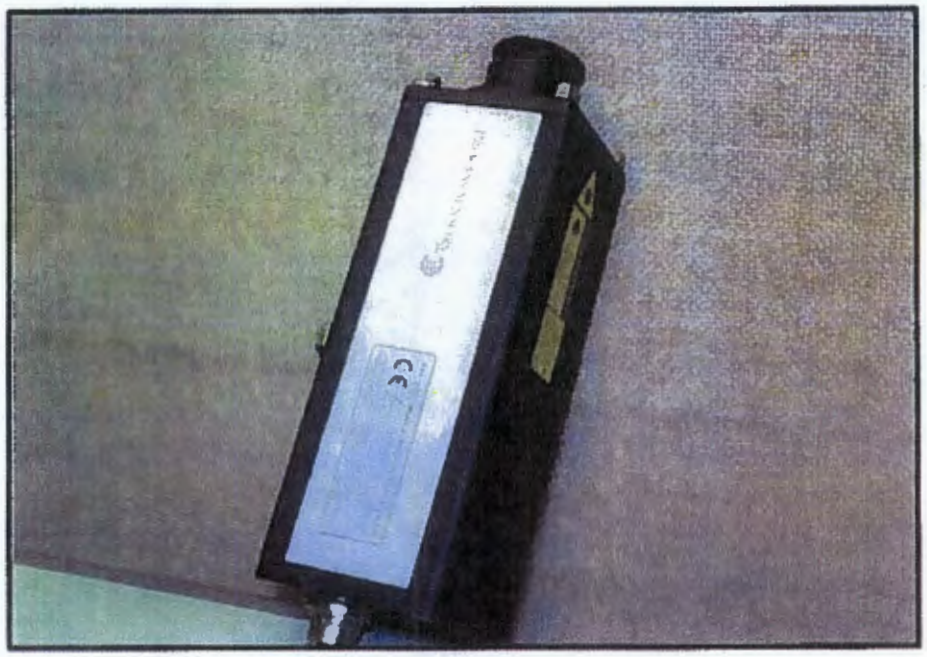


Graphtec midiLogger GL800 – The GL 800 is a compact data logger providing the ability for multiple types of inputs. The logger will accept temperature and voltage, and will log at a rate of up to 5 data points/second. All channels are isolated channel-to-channel and channel-to-ground.

Thermocouples

Insulated Type K Thermocouples - Hi-Temperature Inconel over-braided ceramic fiber insulated thermocouples have a temperature rating of up to 2000 °F. The range of Type K thermocouples is -40 to 2300 °F.

Infrared Pyrometer: 2-wavelength



Metis MQ22 Two-Color Pyrometer – The pyrometer measures temperatures from the ratio of radiation signals of two adjacent wavelengths. The range of the pyrometer is 662 – 2372 °F. The accuracy of the unit is 0.3% of measured value in °F +2 °F.

RCR00091.00E

Infrared Pyrometer: Single wavelength

Fluke 568 IR Thermometer – This thermometer has a temperature range of -40 to 1472 °F. The infrared accuracy is ±2°F. The output from this device went above the upper calibrated range value of 1472 °F during both tests.

Thermal Imager

Fluke Ti45FT – This thermal imager has a temperature range of -4 to 1112 °F. Both thermal and digital images are recorded giving the ability to superimpose images to pinpoint exact locations.

Process Documenting Calibrator

Fluke 743B Documenting Process Calibrator – The 743B is a multi-use piece of equipment, providing functions such as sourcing, simulating and measuring pressure, temperature, and electrical signals in one device.

RCR00091.012

Appendix

Calibration Information

See attached certificates or pictures of calibration sticker for details.

PROCESS SENSORS CORPORATION

METIS DATA SHEET

662 - 2372°F

Device: METIS Basic Range: 350 - 1200° C

Model Number: MQ2203501300/52230/00 Range: 350 - 1200° C

Serial Number: 4161 Accuracy: 0.3% / 0.5% v. Measwert

Test Results

Visual Test: passed Insulation Test: passed

Operation Test: passed Accuracy Test: according to data sheet

a) Results	Expected °C	Actual °C	Expected mA	Actual mA
	500	501	3.16	3.18
	946	947	12.39	12.58
	1201	1202	17.92	17.94

b) **Reference Equipment:** Pt100 Widerstand 1546-DKD-K-06701 2008-10; Pyrometer QS0085, und Zeichen 5575-PTB-06

Measuring Uncertainty: at 500°C: 0.4K; at 300°C: 1.2K; at 1500°C: 2K, at 2500°C: 2.5K

Last Verification: October 28, 2008/May 18, 2006/April 28, 2009

Traceability: International Temperature Scale ITS 90

Quality Control: **Date:** 10/7/09 **Inspector:** RW

113 Cedar Street, S. Milford, MA 01757 USA • Tel (508) 473-9901 • Fax (508) 473-0715
www.processsensors.com

Fluke Thermography

Certificate of Calibration

Model: FLK-T145FT-20

Serial Number: 1145FT - 0809168

Accuracy: 2°C or 2% of Reading

Measurement Temperature Range: -20°C to 600°C

Date: 09/22/08

Certified By: Fluke QA Manager

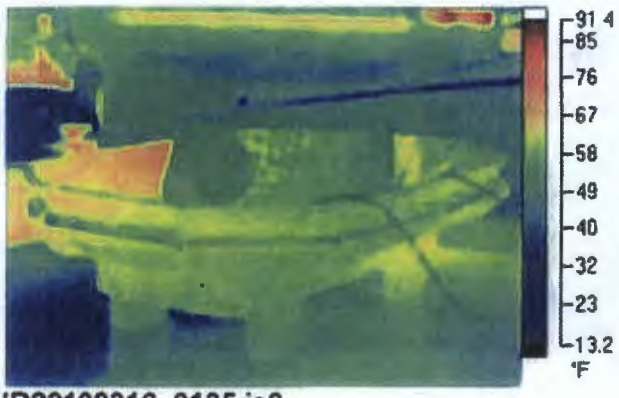
Fluke Corporation certifies the above instrumentation has been calibrated to meet or exceed the published specifications. The calibration was performed using instrumentation and standards that are traceable to the United States National Institute of Standards and Technology (NIST) or other signatories of the International Laboratory Accreditation Cooperation (ILAC) Mutual Recognition Arrangement (MRA). This Certificate/Report shall not be reproduced, except in full, without the written consent of Fluke Corporation

Thermal Imager Report

The following pages are the analysis from the thermal imager taken at 5 second intervals during the burn process.

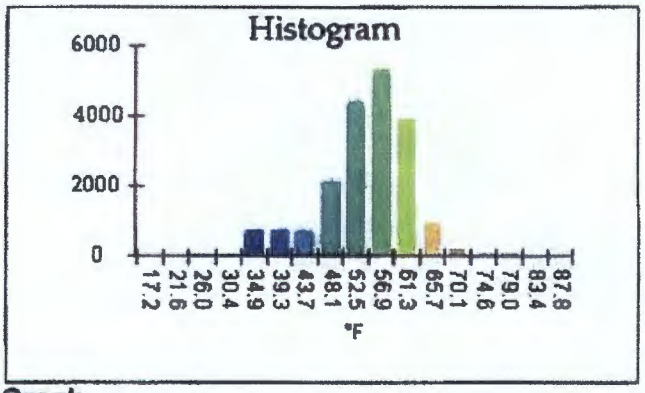
The thermal imager has the ability to display calibrated temperatures up to 1112°F. Areas in the thermal images that are white are areas where the burn temperature has exceeded the maximum display temperature of the Ti45FT (1148 °F). Note that on the following pages under Image Info, Average Temperature will not be representative of the actual average due to the temperatures being in excess of 1148 °F.

RCR00091.016



Visible Light Image

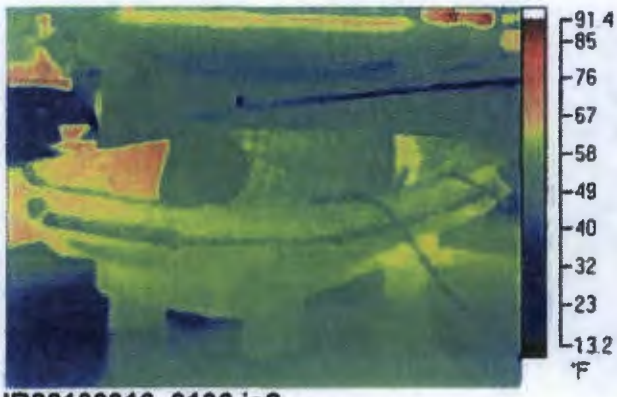
IR20100316_0135.is2
3/16/2010 2:16:22 PM



Graph

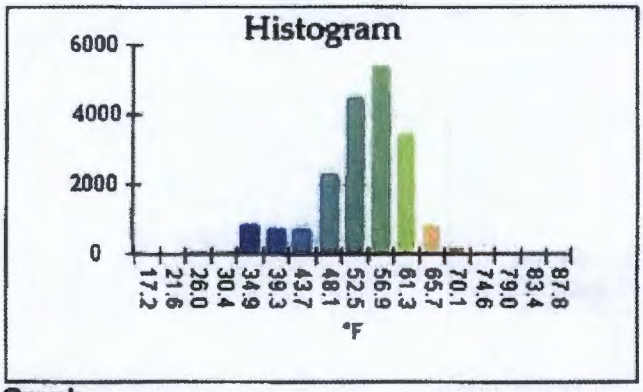
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~54.4°F
Image Range	~15.4°F to ~89.7°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:22 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0135.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0136.is2
3/16/2010 2:16:30 PM

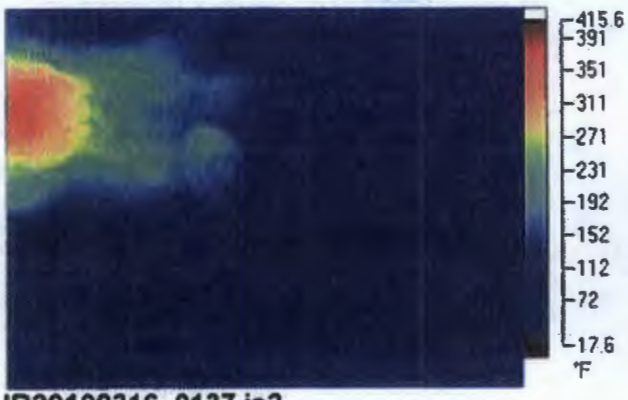
Visible Light Image



Graph

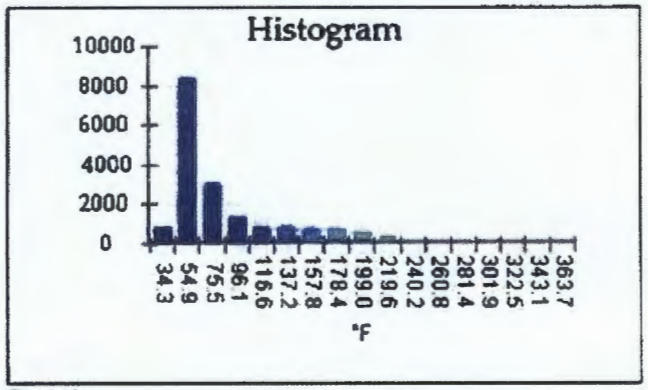
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~54.0°F
Image Range	~15.0°F to ~89.6°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:30 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0136.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

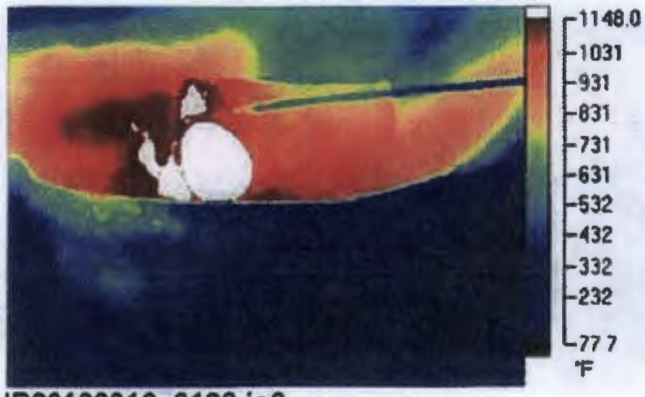
IR20100316_0137.is2
3/16/2010 2:16:38 PM



Graph

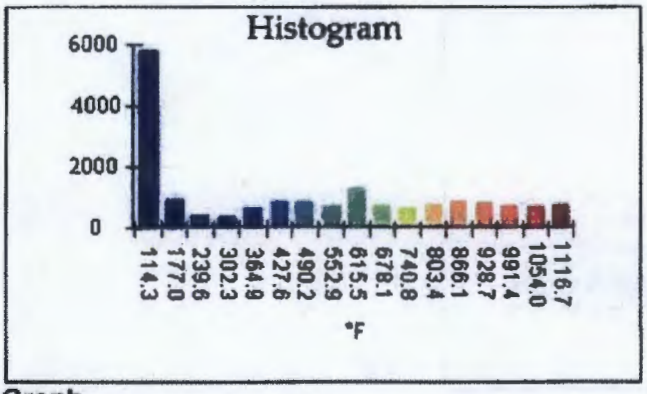
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~98.1°F
Image Range	~24.1°F to ~373.8°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:38 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0137.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

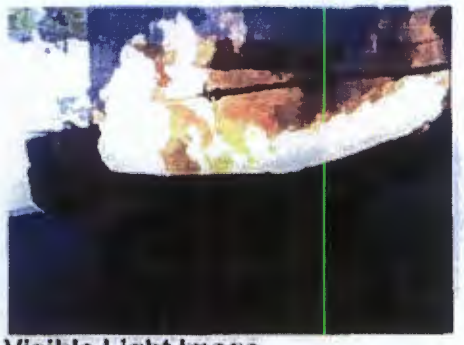
IR20100316_0138.is2
3/16/2010 2:16:45 PM



Graph

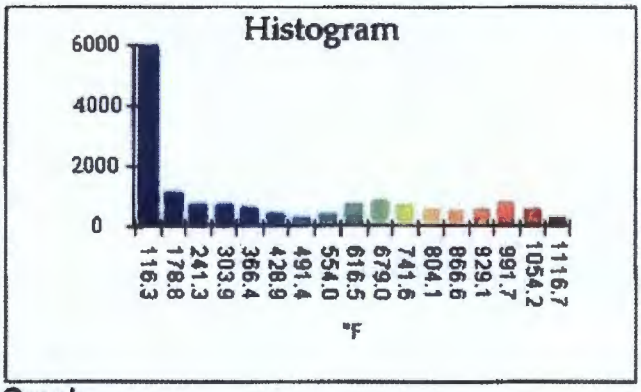
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	509.5°F
Image Range	~83.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:45 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0138.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

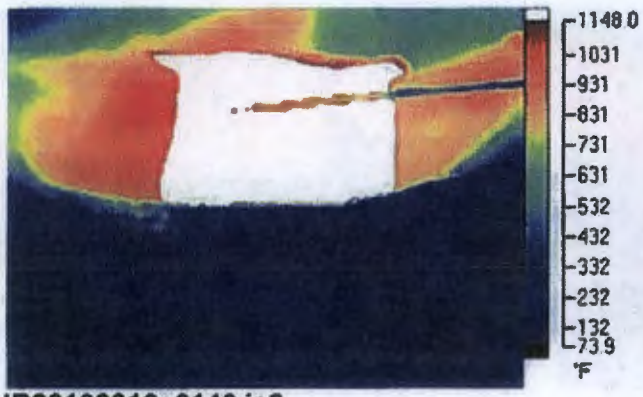
IR20100316_0139.is2
3/16/2010 2:16:51 PM



Graph

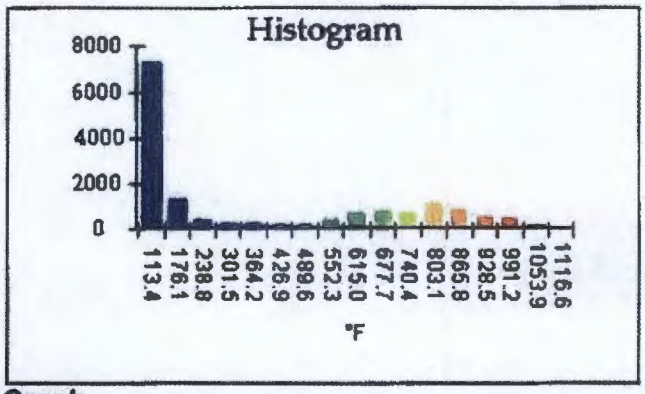
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	534.9°F
Image Range	~85.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:51 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0139.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

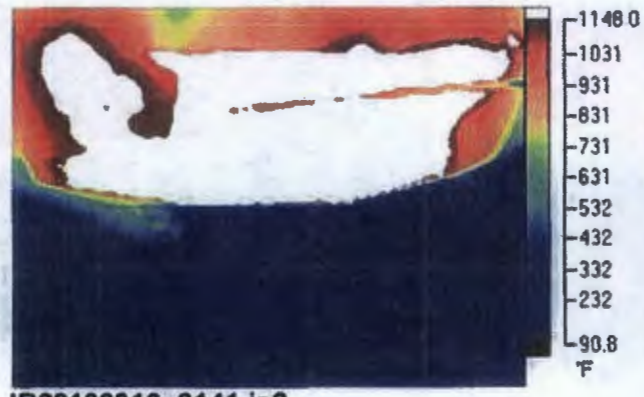
IR20100316_0140.is2
3/16/2010 2:16:58 PM

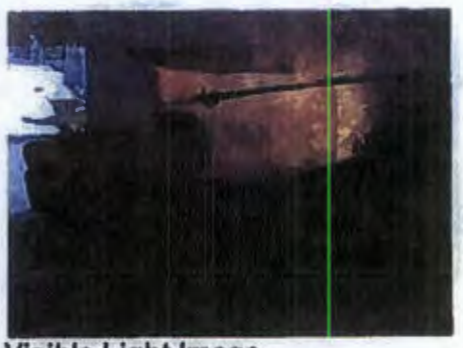


Graph

Image Info

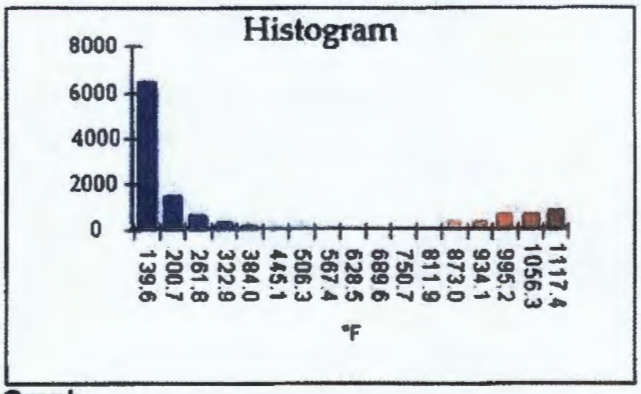
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	511.8°F
Image Range	~82.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:16:58 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0140.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

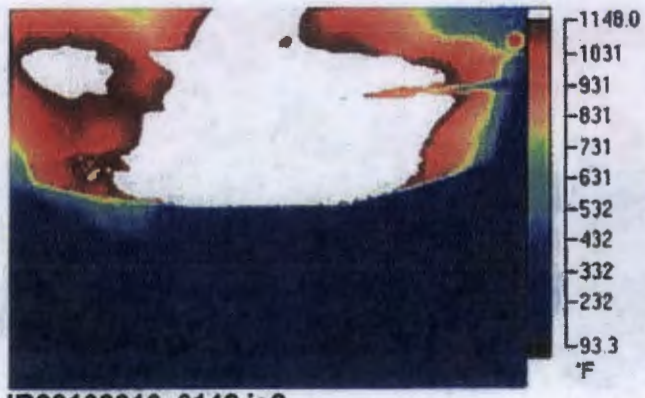
IR20100316_0141.is2
3/16/2010 2:17:05 PM



Graph

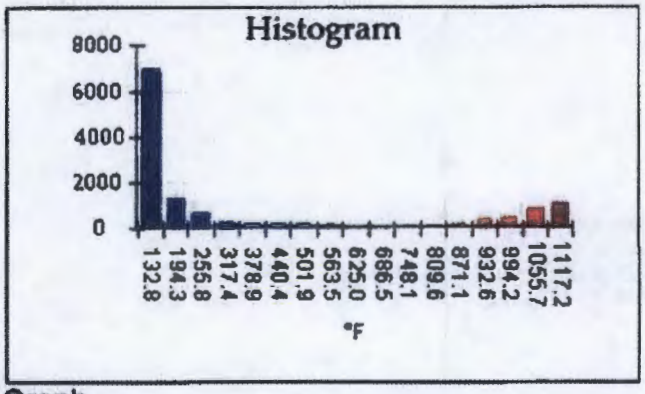
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	624.7°F
Image Range	~109.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:05 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0141.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0142.is2
3/16/2010 2:17:12 PM

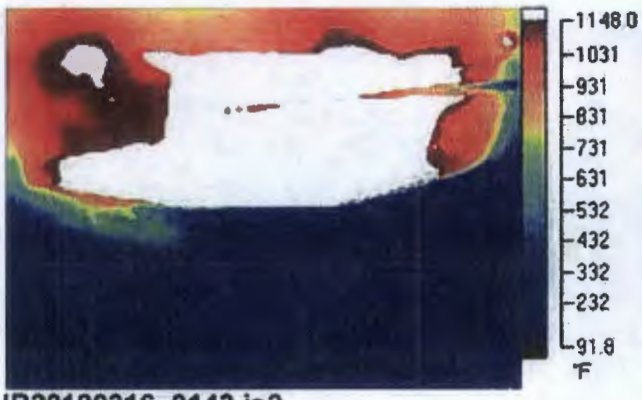
Visible Light Image

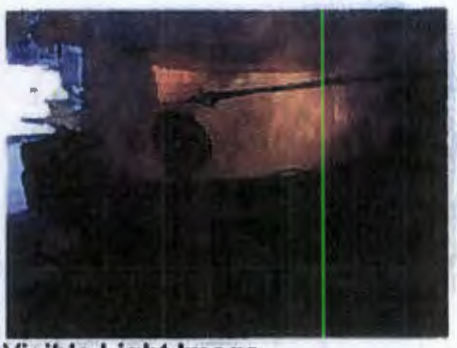


Graph

Image Info

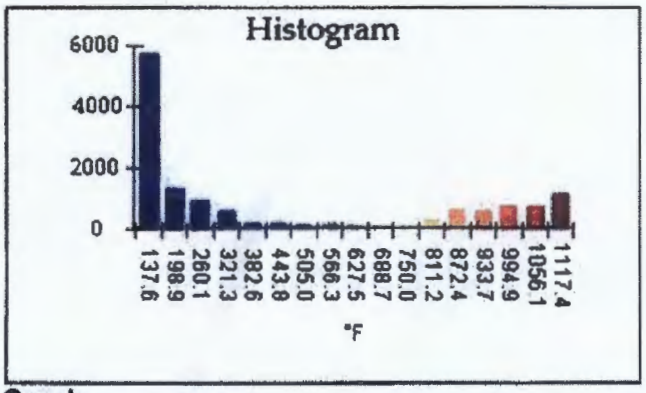
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	599.2°F
Image Range	~102.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:12 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0142.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

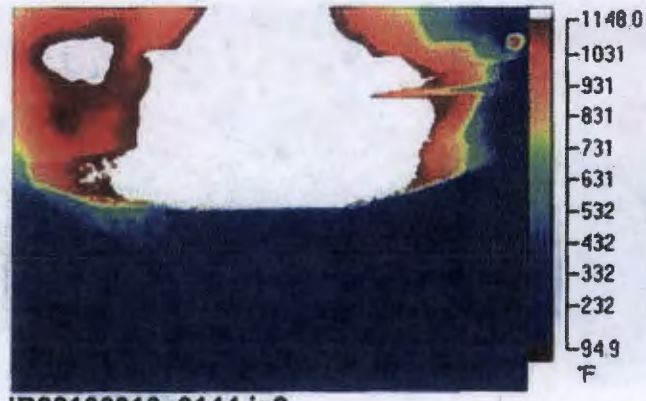
IR20100316_0143.is2
3/16/2010 2:17:20 PM



Graph

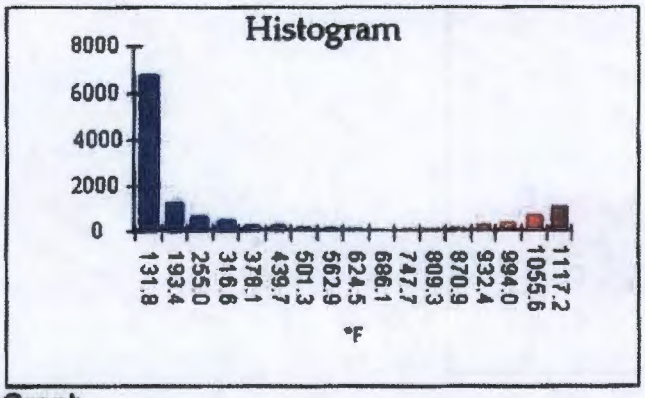
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	626.5°F
Image Range	~107.7°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:20 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0143.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

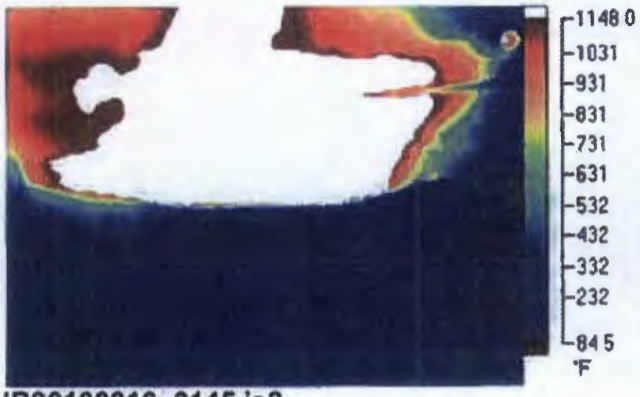
IR20100316_0144.is2
3/16/2010 2:17:26 PM



Graph

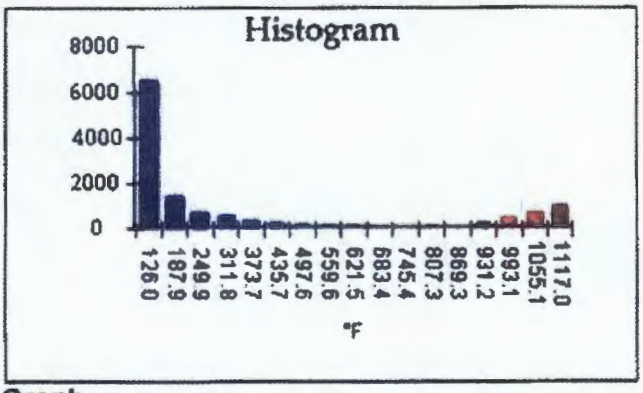
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	596.4°F
Image Range	~101.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:26 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0144.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

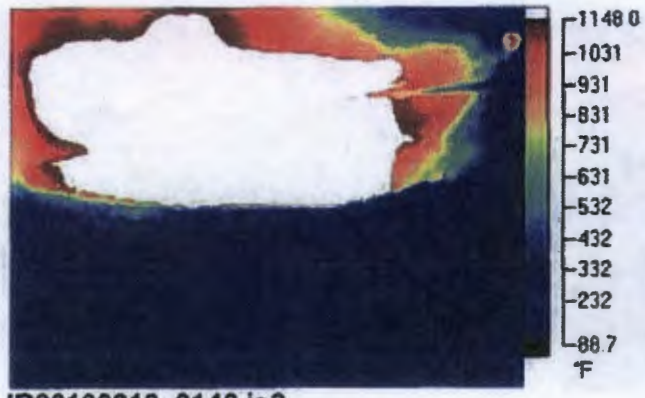
IR20100316_0145.is2
3/16/2010 2:17:33 PM



Graph

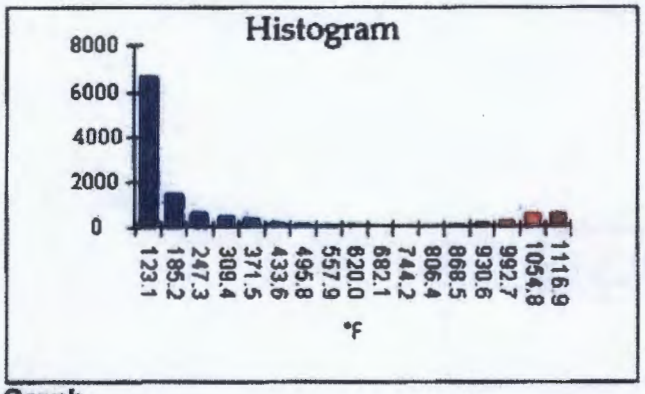
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	593.6°F
Image Range	~95.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:33 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0145.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

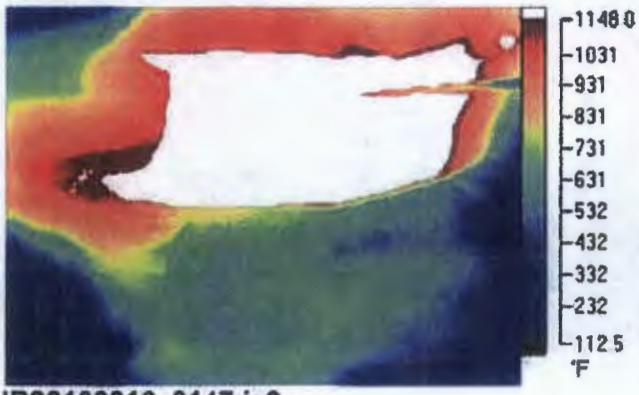
IR20100316_0146.is2
3/16/2010 2:17:40 PM

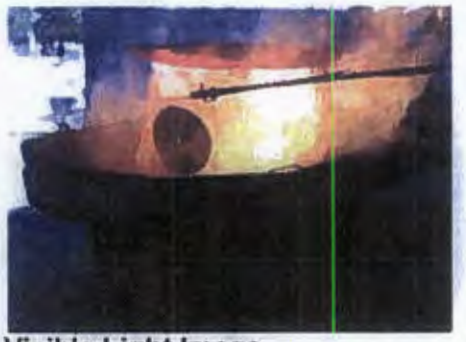


Graph

Image Info

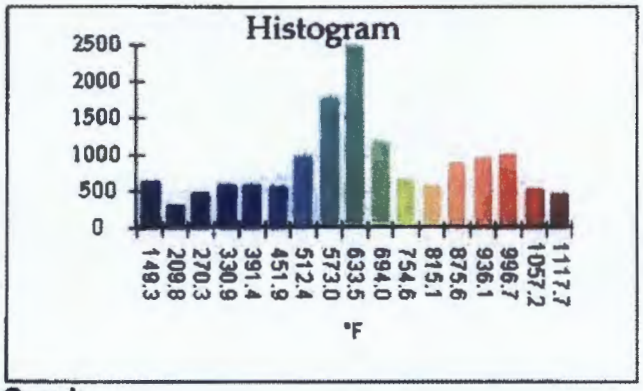
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	579.6°F
Image Range	~92.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:40 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0146.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

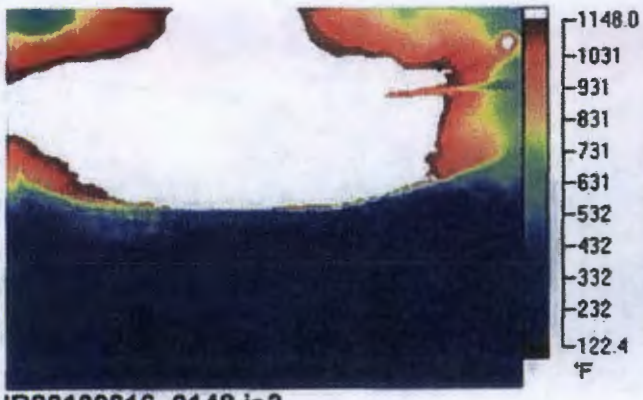
IR20100316_0147.is2
3/16/2010 2:17:47 PM



Graph

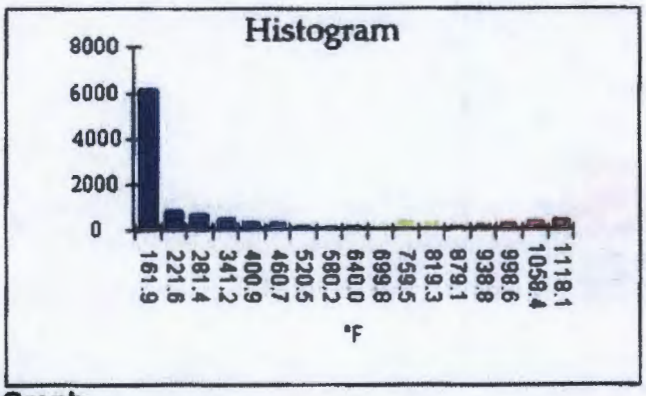
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	769.9°F
Image Range	~119.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:47 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0147.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

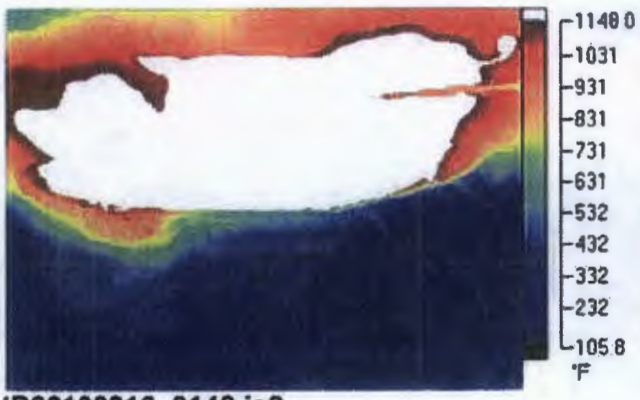
IR20100316_0148.is2
3/16/2010 2:17:54 PM



Graph

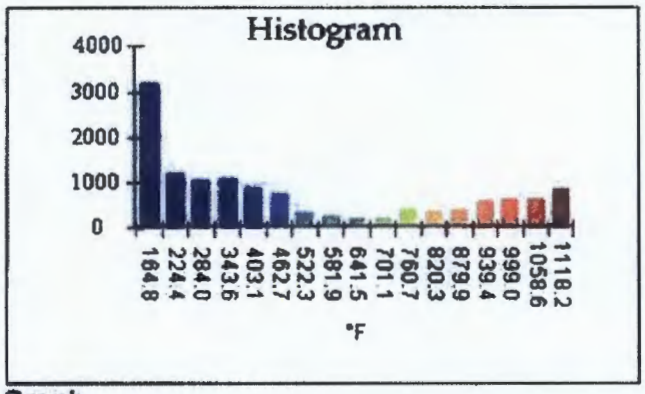
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	646.7°F
Image Range	~132.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:17:54 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0148.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

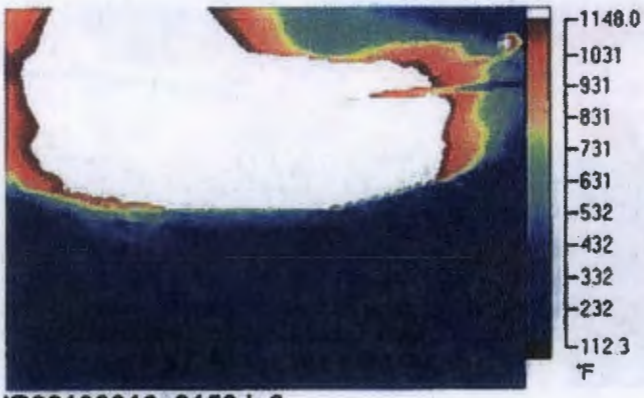
IR20100316_0149.is2
3/16/2010 2:18:01 PM



Graph

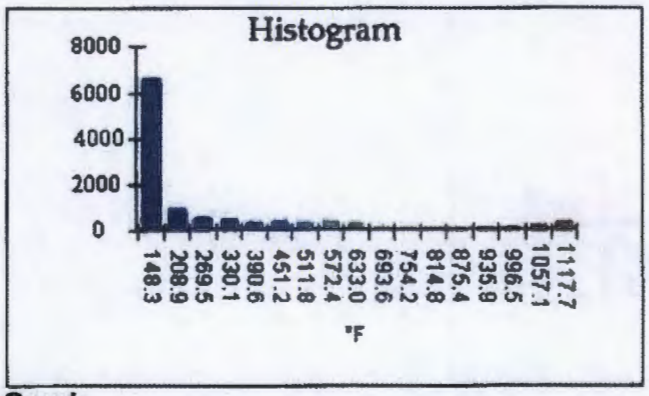
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	700.4°F
Image Range	~135.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:01 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0149.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0150.is2
3/16/2010 2:18:08 PM



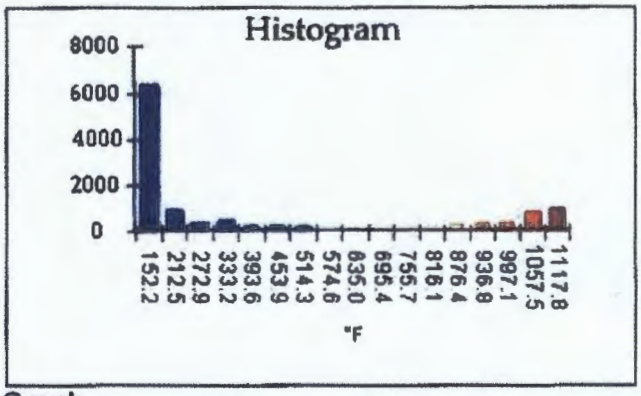
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	616.1°F
Image Range	~118.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:08 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0150.is2
Calibration Range	482.0°F to 1112.0°F

Visible Light Image

IR20100316_0151.is2
3/16/2010 2:18:15 PM



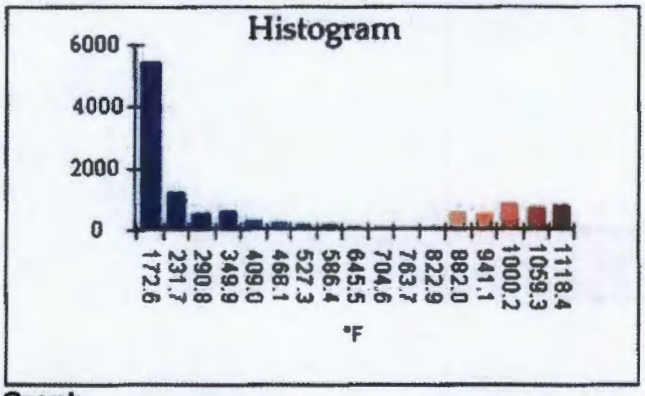
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	645.7°F
Image Range	~122.2°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:15 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0151.is2
Calibration Range	482.0°F to 1112.0°F

IR20100316_0152.is2
3/16/2010 2:18:25 PM

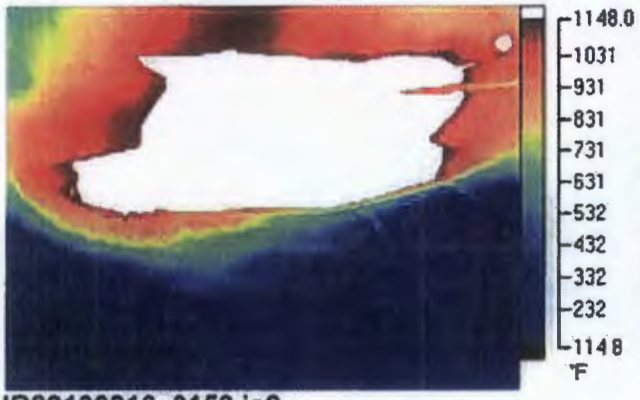
Visible Light Image

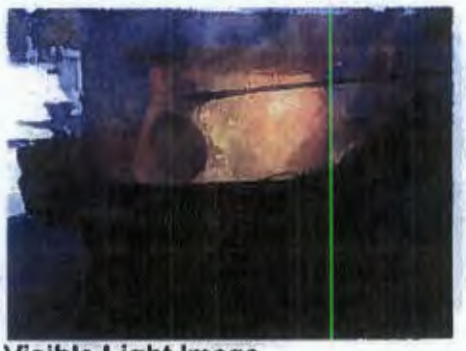


Graph

Image Info

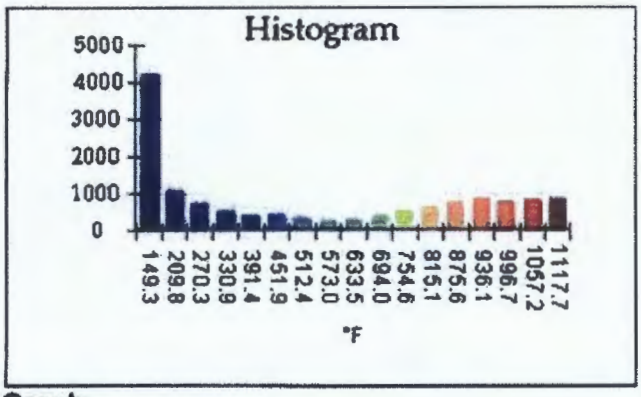
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	677.3°F
Image Range	~143.7°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:25 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0152.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

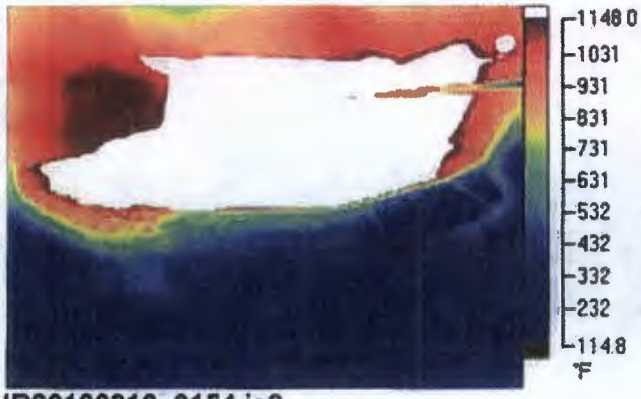
IR20100316_0153.is2
3/16/2010 2:18:31 PM

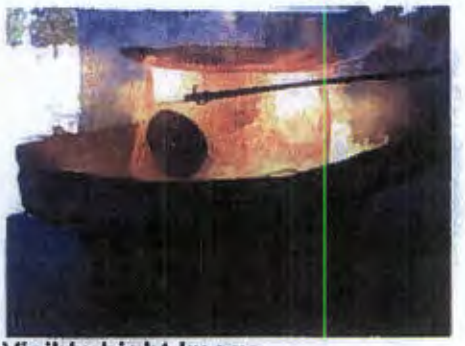


Graph

Image Info

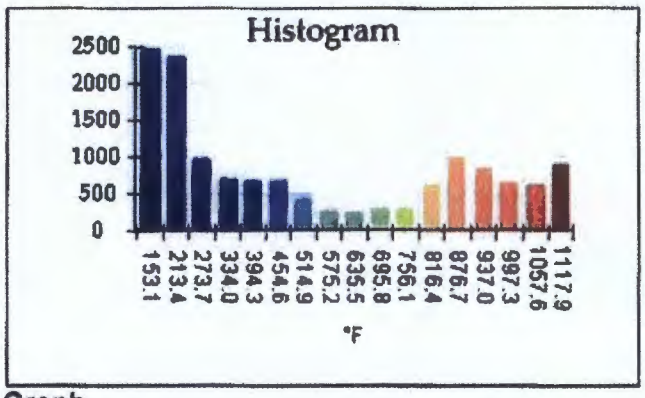
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	683.4°F
Image Range	~119.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:31 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0153.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

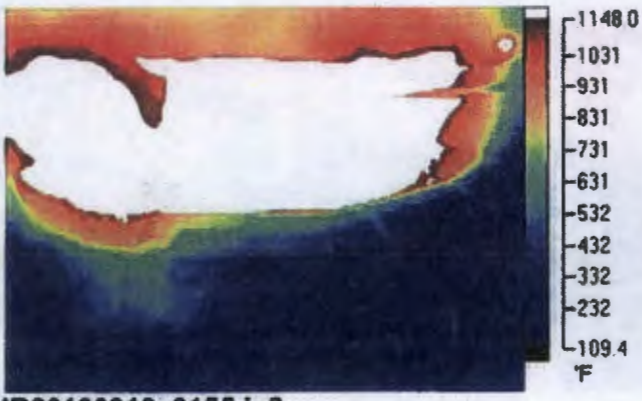
IR20100316_0154.is2
3/16/2010 2:18:38 PM



Graph

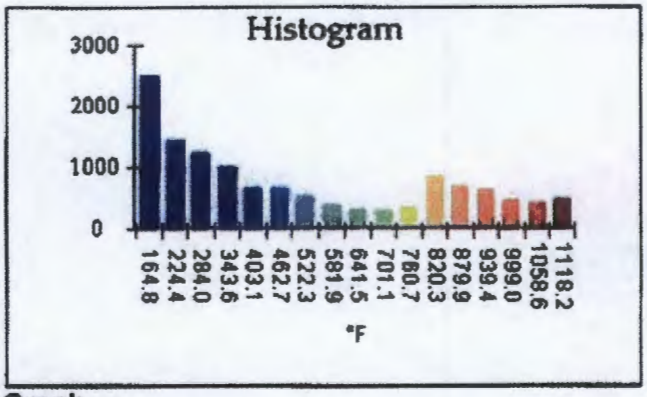
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	686.8°F
Image Range	~123.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:38 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0154.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

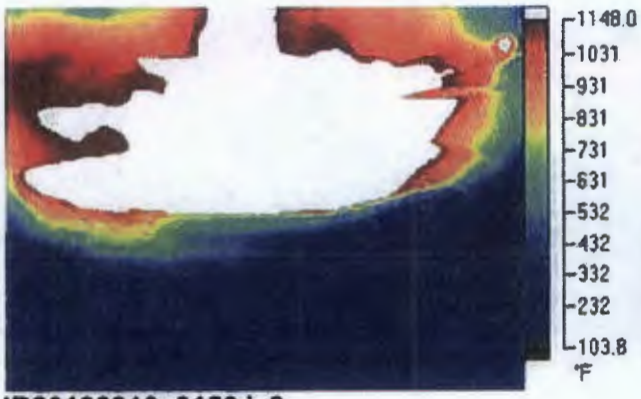
IR20100316_0155.is2
3/16/2010 2:18:45 PM



Graph

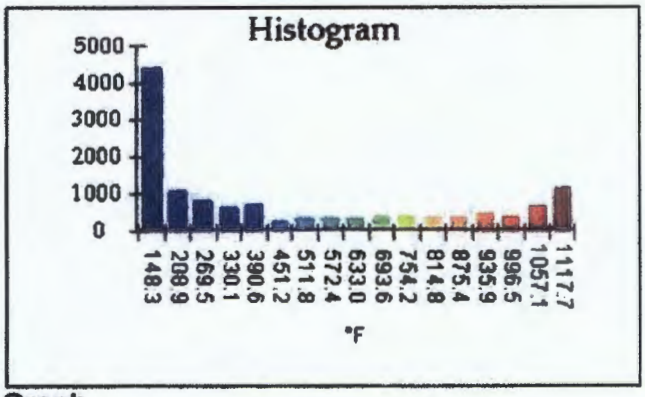
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	706.8°F
Image Range	~135.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:45 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0155.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

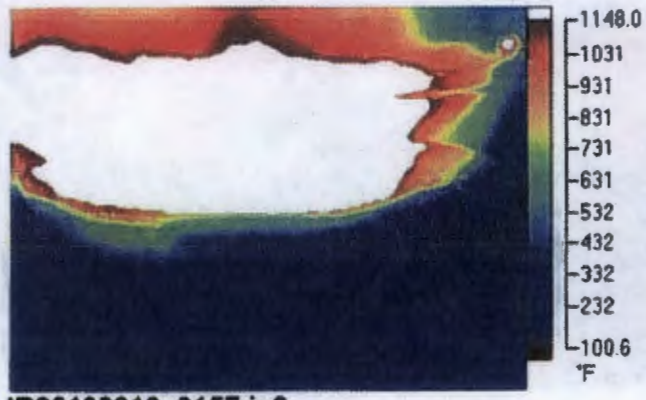
IR20100316_0156.is2
3/16/2010 2:18:52 PM



Graph

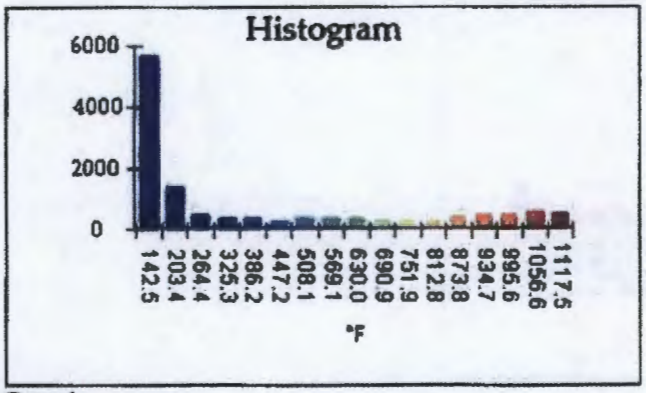
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	676.6°F
Image Range	~118.5°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:18:52 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0156.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0157.is2
3/16/2010 2:19:00 PM

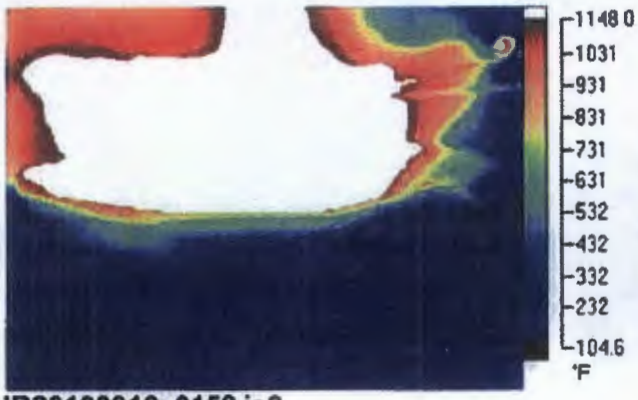


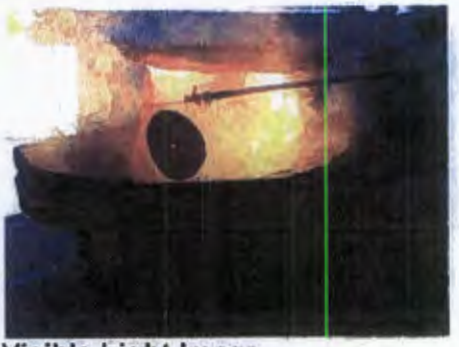
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	638.4°F
Image Range	~112.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:00 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0157.is2
Calibration Range	482.0°F to 1112.0°F

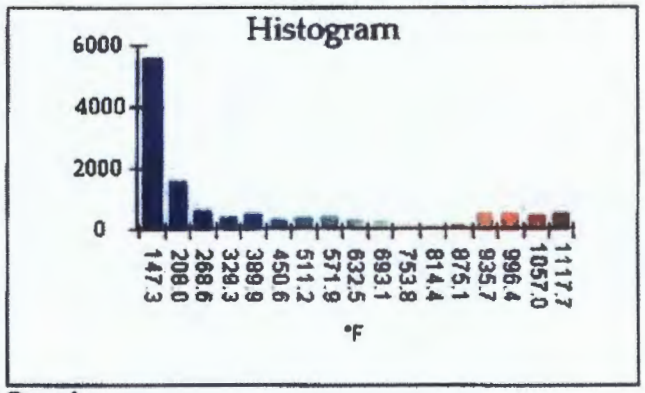
RCR00091 039





Visible Light Image

IR20100316_0158.is2
3/16/2010 2:19:08 PM



Graph

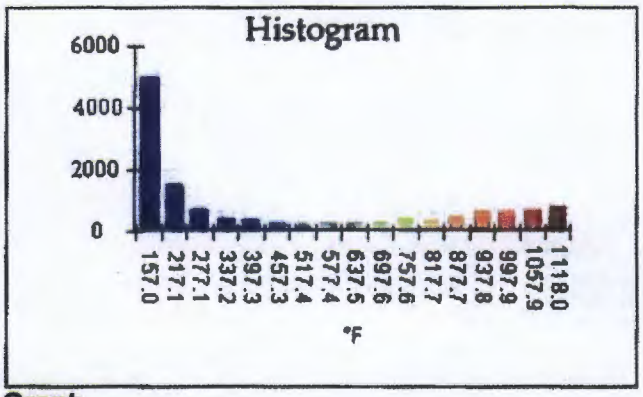
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	631.8°F
Image Range	~117.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:08 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0158.is2
Calibration Range	482.0°F to 1112.0°F

RCR00091.040

Visible Light Image

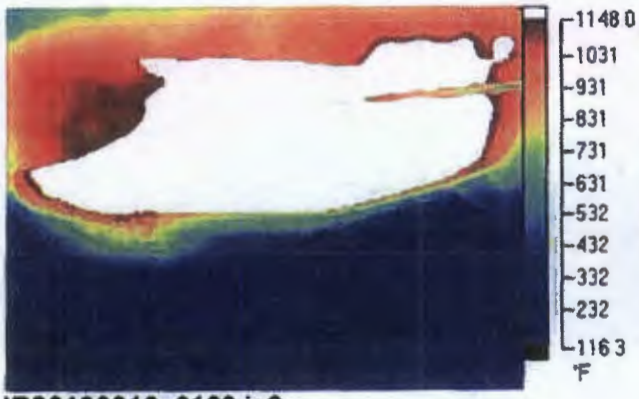
IR20100316_0159.is2
3/16/2010 2:19:16 PM

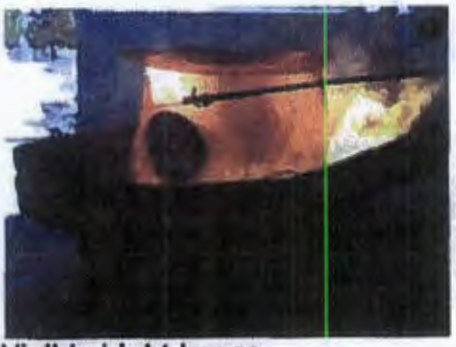


Graph

Image Info

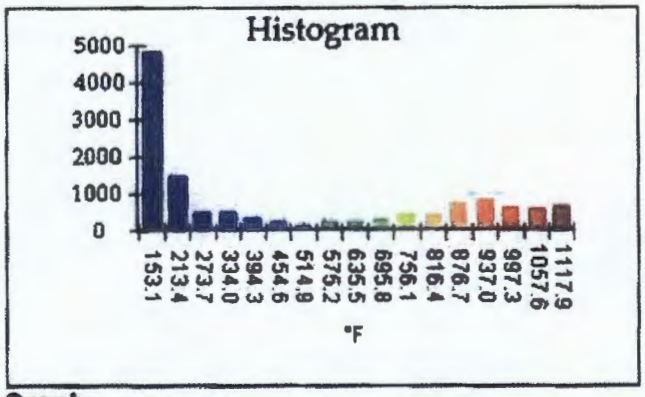
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	668.0°F
Image Range	~127.9°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:16 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0159.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

IR20100316_0160.is2
3/16/2010 2:19:22 PM

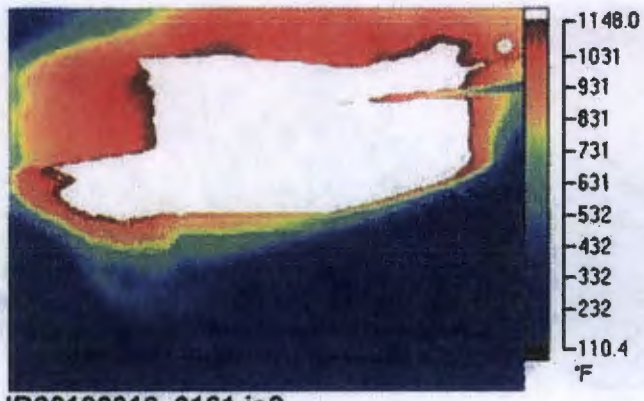


Graph

Image Info

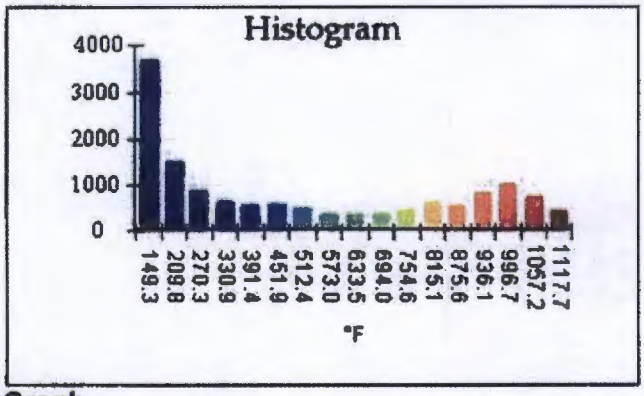
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	673.9°F
Image Range	~123.5°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:22 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0160.is2
Calibration Range	482.0°F to 1112.0°F

BCR00091.042



Visible Light Image

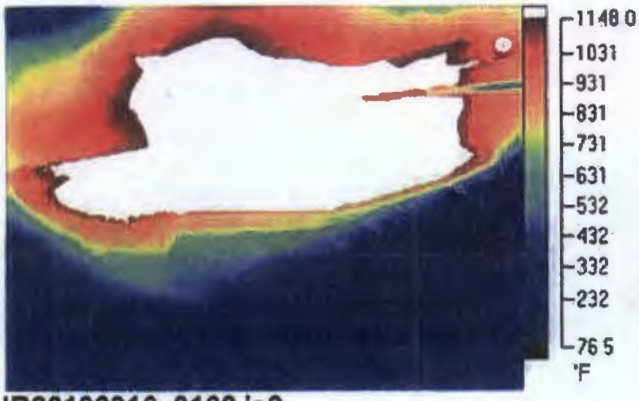
IR20100316_0161.is2
3/16/2010 2:19:29 PM



Graph

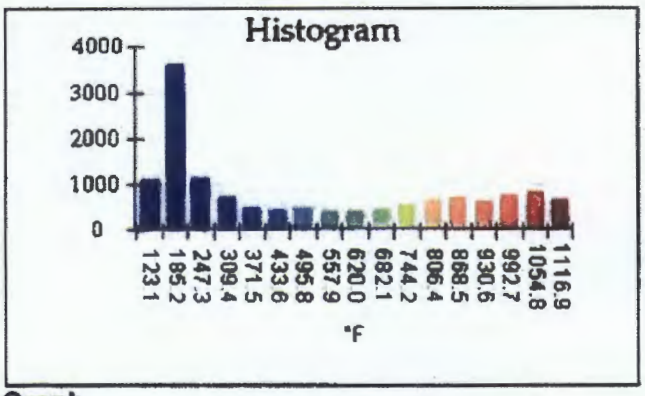
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	674.1°F
Image Range	~119.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:29 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0161.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

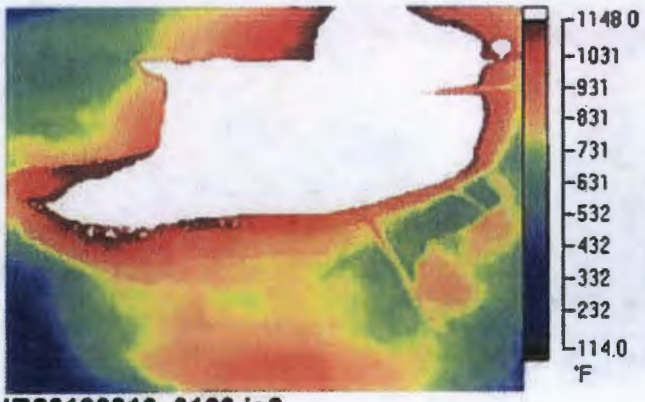
IR20100316_0162.is2
3/16/2010 2:19:36 PM



Graph

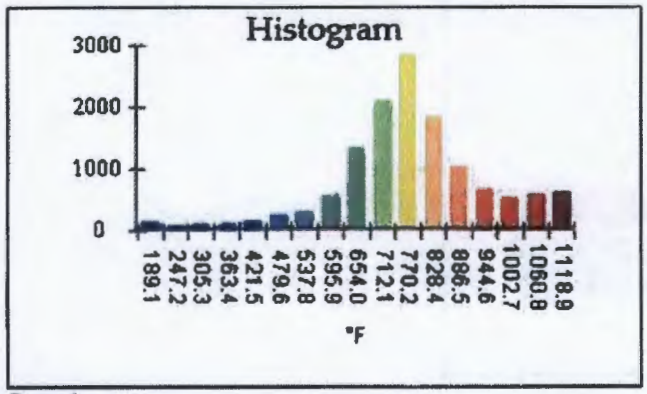
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	683.4°F
Image Range	~92.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:36 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0162.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

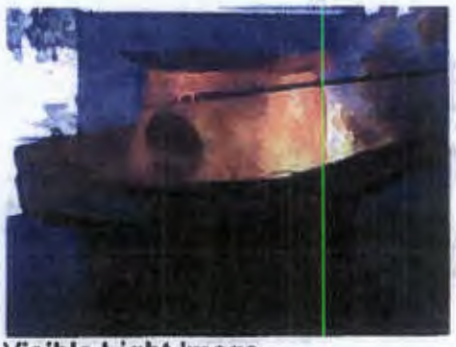
IR20100316_0163.is2
3/16/2010 2:19:46 PM



Graph

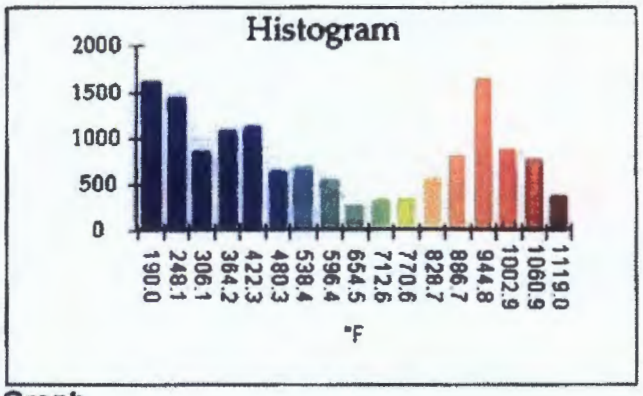
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	888.5°F
Image Range	~160.0°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:46 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0163.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0164.is2
3/16/2010 2:19:52 PM



Graph

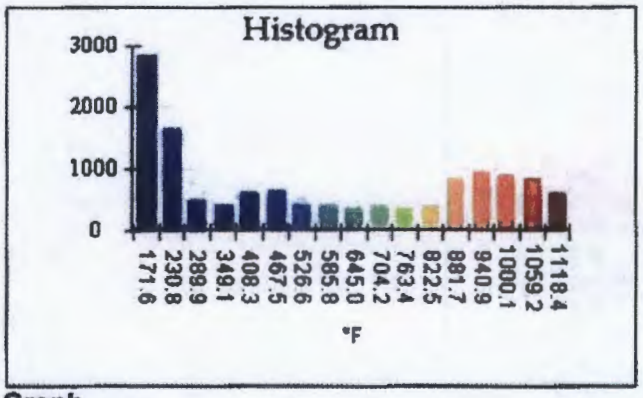
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	743.6°F
Image Range	~161.2°F to >1148.0°F
Camera Model	TI45FT
Camera Serial Number	TI45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:52 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0164.is2
Calibration Range	482.0°F to 1112.0°F

RCR00091 046

Visible Light Image

IR20100316_0165.is2
3/16/2010 2:19:59 PM

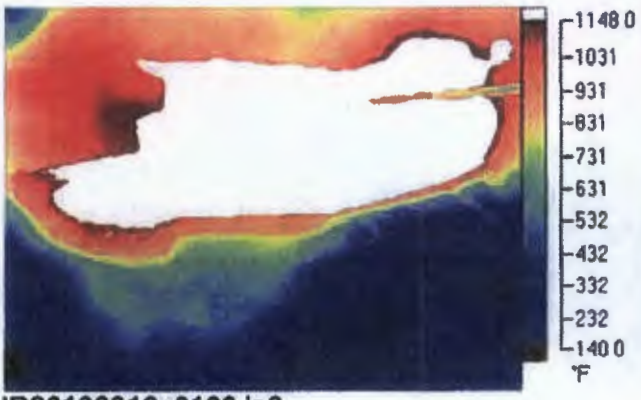


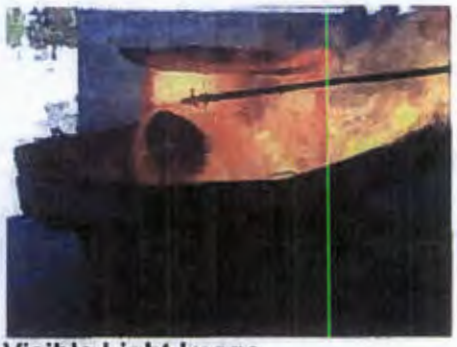
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	742.1°F
Image Range	~142.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:19:59 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0165.is2
Calibration Range	482.0°F to 1112.0°F

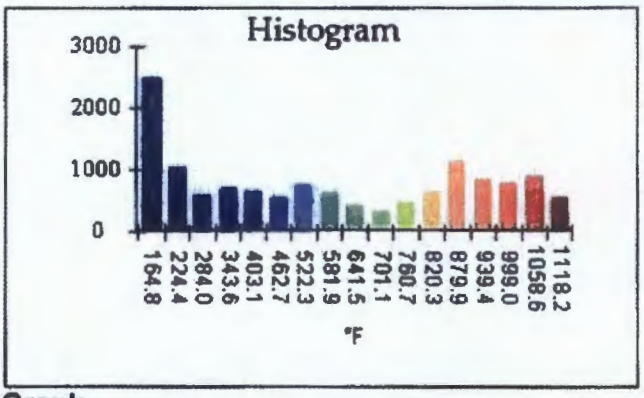
RCR00091 047





Visible Light Image

IR20100316_0166.is2
3/16/2010 2:20:06 PM



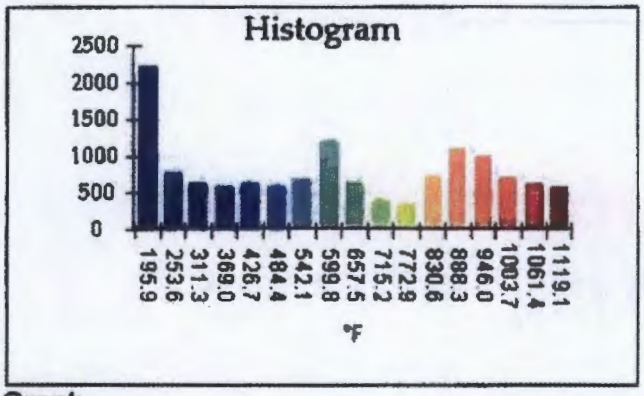
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	744.4°F
Image Range	~135.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:06 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0166.is2
Calibration Range	482.0°F to 1112.0°F

Visible Light Image

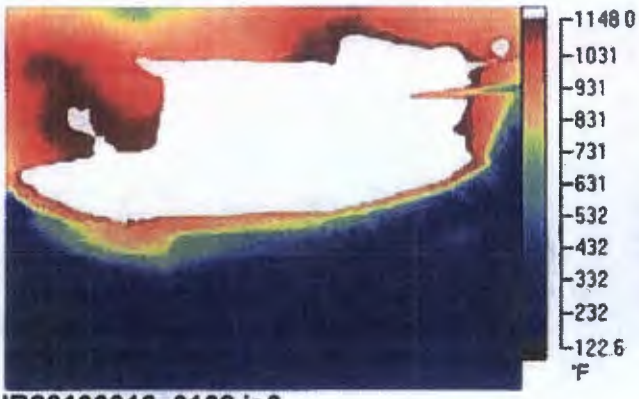
IR20100316_0167.is2
3/16/2010 2:20:15 PM

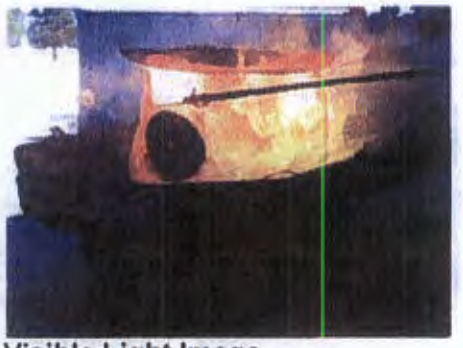


Graph

Image Info

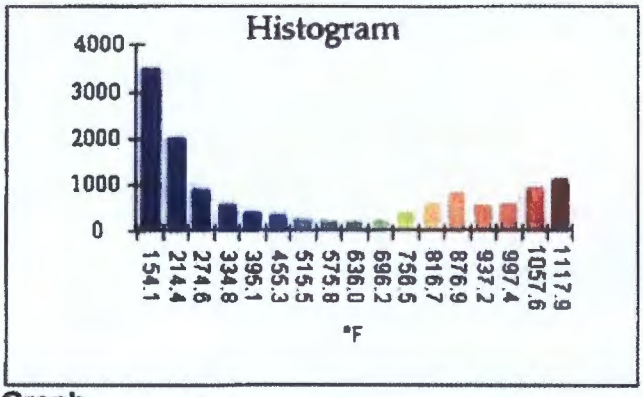
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	766.4°F
Image Range	~167.7°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:15 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0167.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

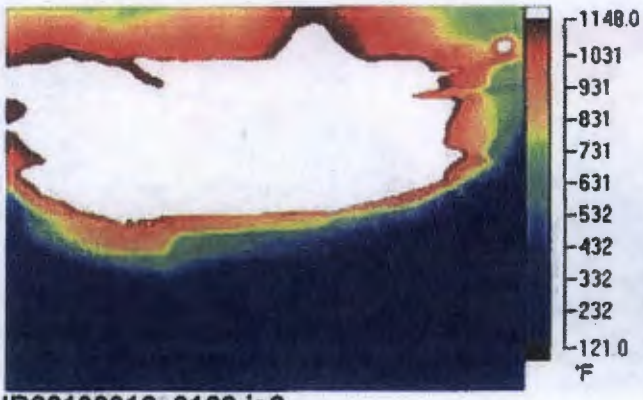
IR20100316_0168.is2
3/16/2010 2:20:22 PM



Graph

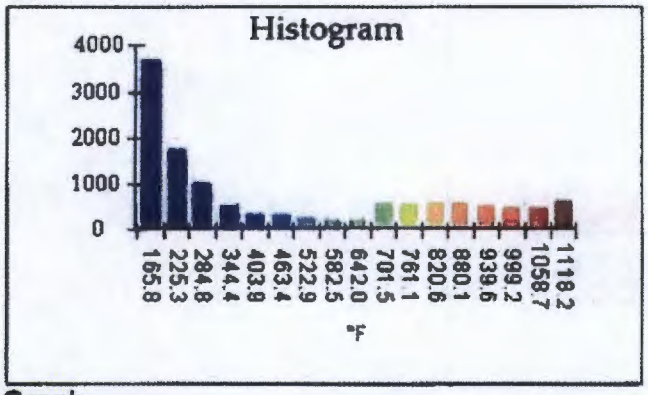
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	696.5°F
Image Range	~124.5°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:22 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0168.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

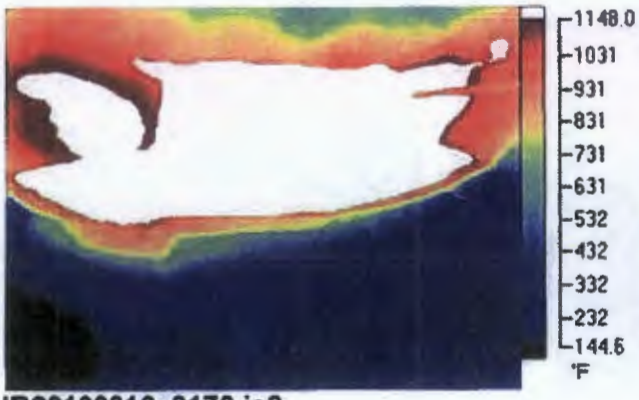
IR20100316_0169.is2
3/16/2010 2:20:30 PM

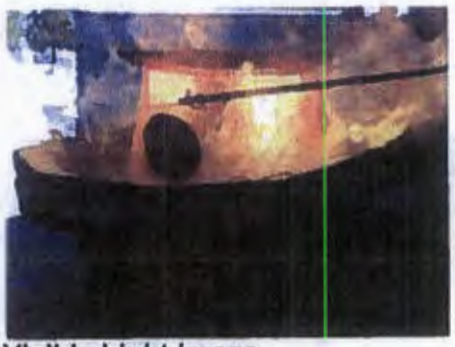


Graph

Image Info

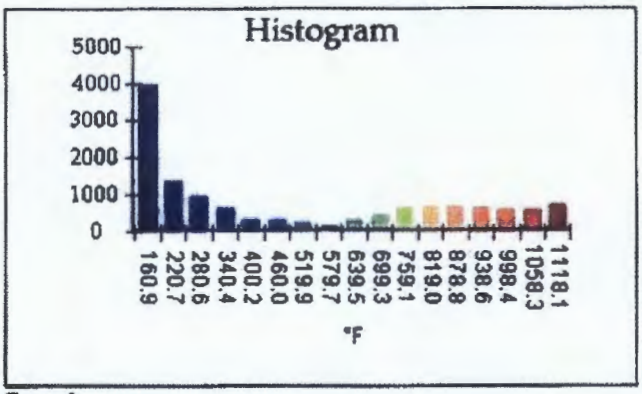
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	703.5°F
Image Range	~136.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:30 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0169.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

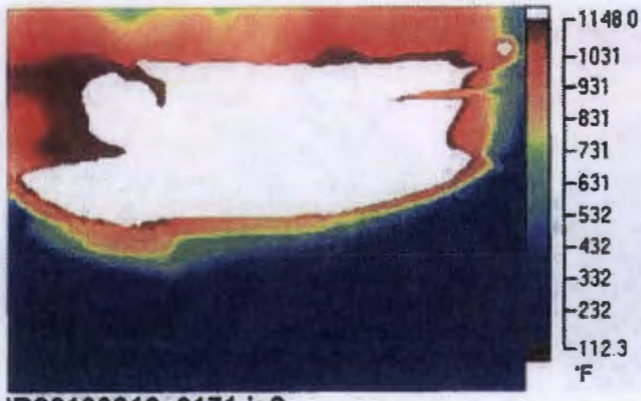
IR20100316_0170.is2
3/16/2010 2:20:36 PM



Graph

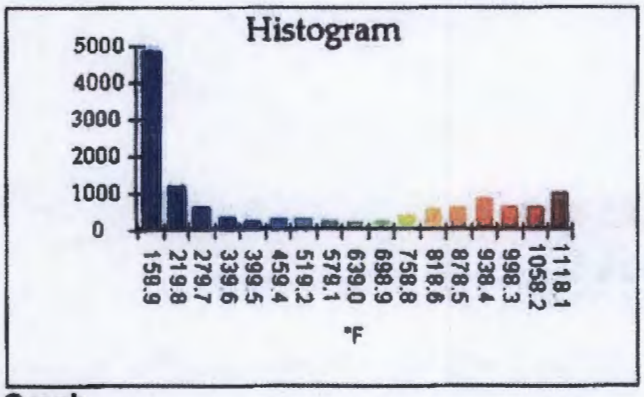
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	695.7°F
Image Range	~131.0°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:36 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0170.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

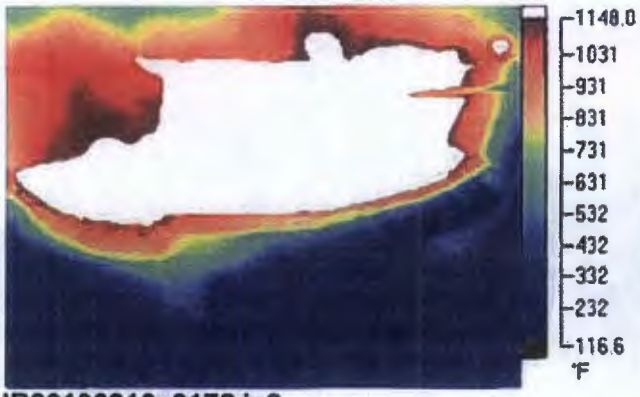
IR20100316_0171.is2
3/16/2010 2:20:45 PM



Graph

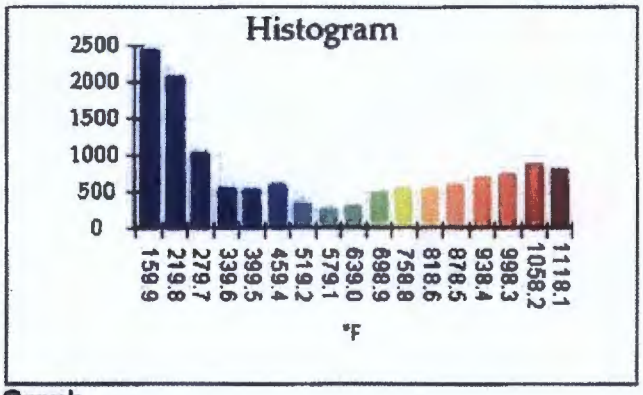
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	688.7°F
Image Range	~130.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:45 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0171.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0172.is2
3/16/2010 2:20:53 PM



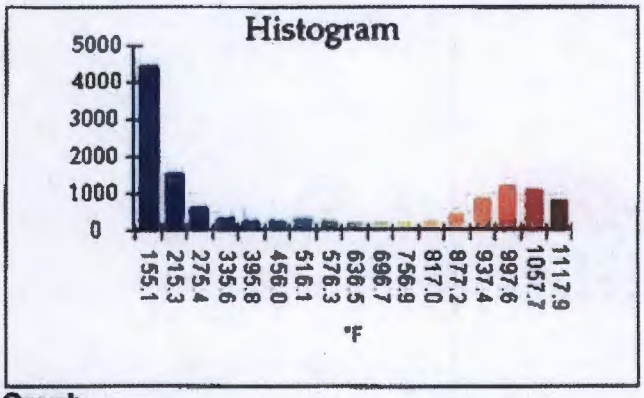
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	714.7°F
Image Range	~130.2°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:20:53 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0172.is2
Calibration Range	482.0°F to 1112.0°F

Visible Light Image

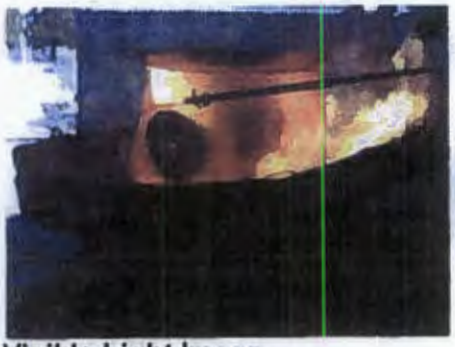
IR20100316_0173.is2
3/16/2010 2:21:01 PM



Graph

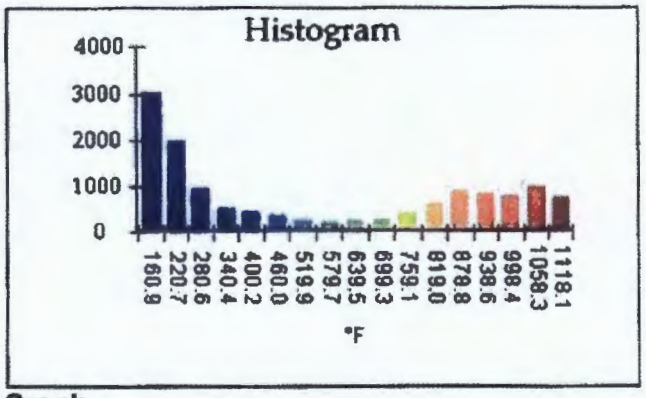
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	698.5°F
Image Range	~125.2°F to >1148.0°F
Camera Model	TI45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:01 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0173.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

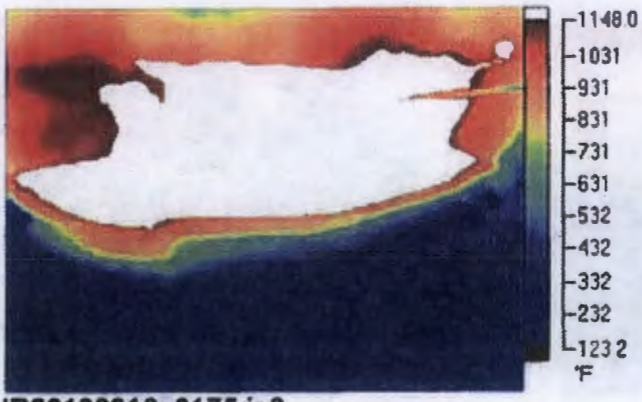
IR20100316_0174.is2
3/16/2010 2:21:08 PM



Graph

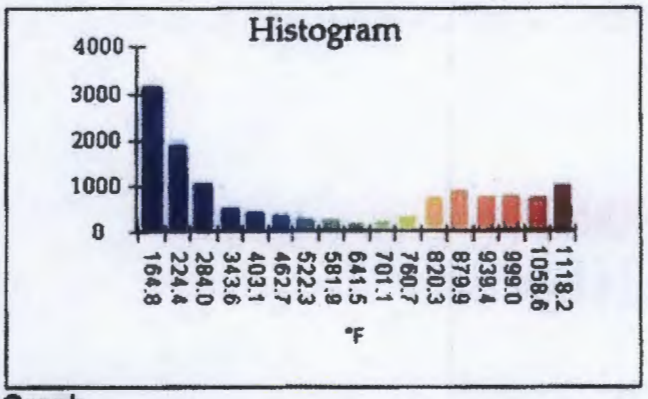
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	715.7°F
Image Range	~131.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:08 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0174.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0175.is2
3/16/2010 2:21:16 PM

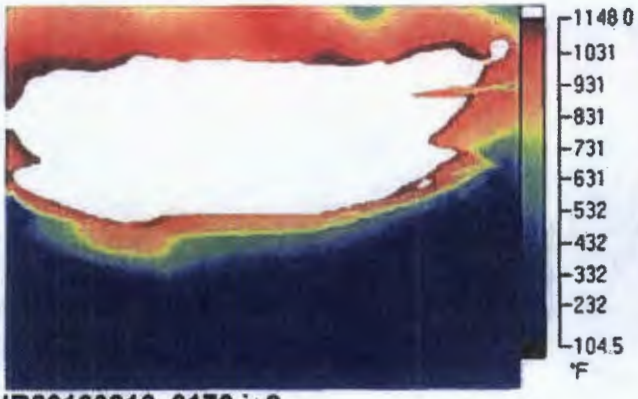
Visible Light Image



Graph

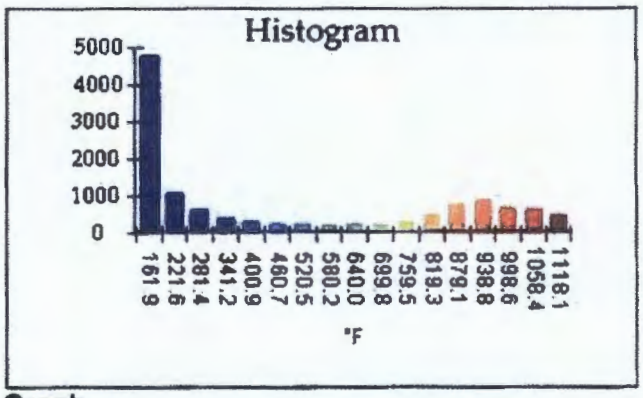
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	713.2°F
Image Range	~136.0°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:16 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0175.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0176.is2
3/16/2010 2:21:23 PM



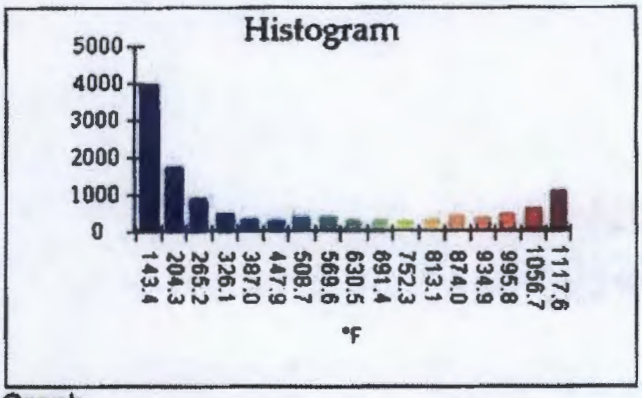
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	704.1°F
Image Range	~132.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:23 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0176.is2
Calibration Range	482.0°F to 1112.0°F

Visible Light Image

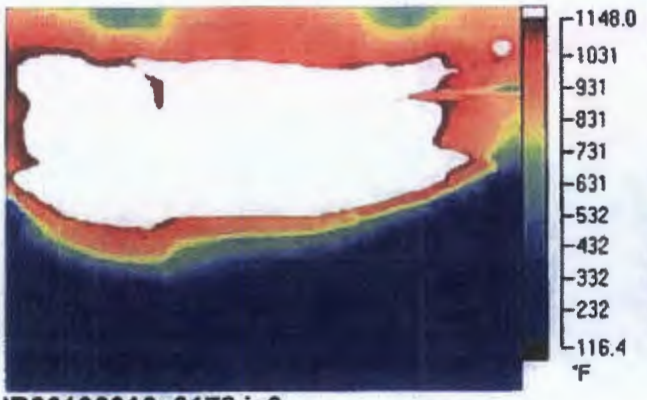
IR20100316_0177.is2
3/16/2010 2:21:31 PM



Graph

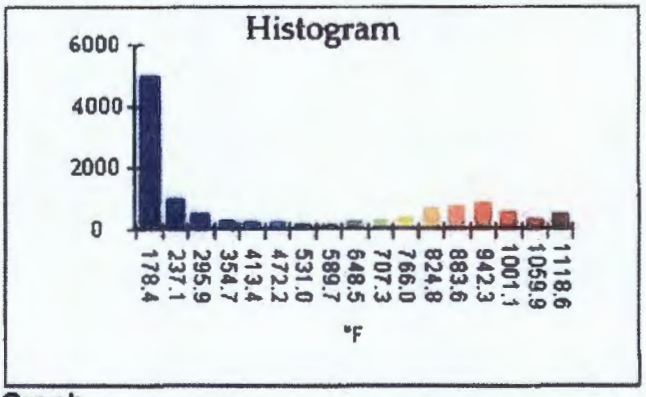
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	683.2°F
Image Range	~113.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:31 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0177.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0178.is2
3/16/2010 2:21:37 PM



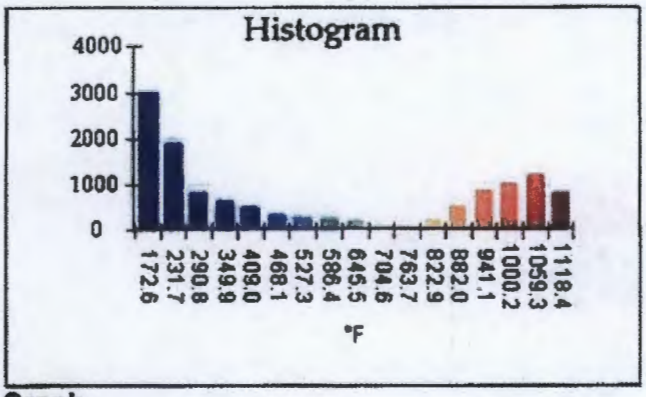
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	704.8°F
Image Range	~149.6°F to >1148.0°F
Camera Model	TI45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:37 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0178.is2
Calibration Range	482.0°F to 1112.0°F

Visible Light Image

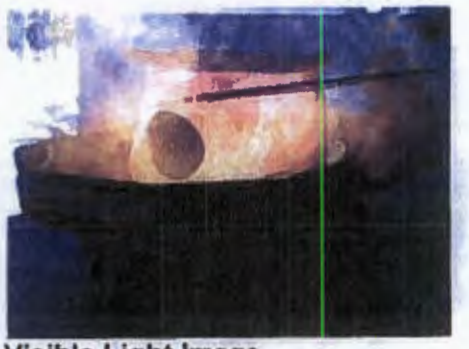
IR20100316_0179.is2
3/16/2010 2:21:46 PM



Graph

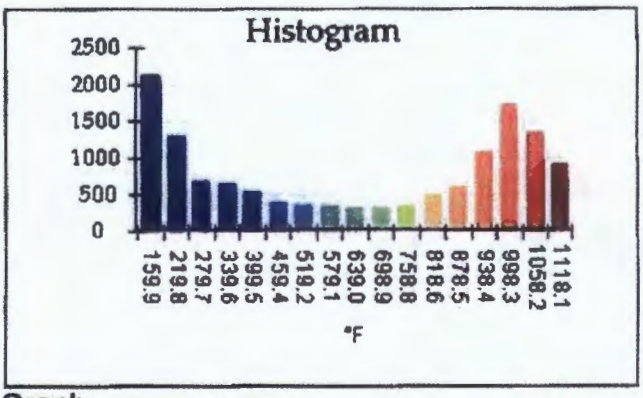
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	744.1°F
Image Range	~143.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:46 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0179.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

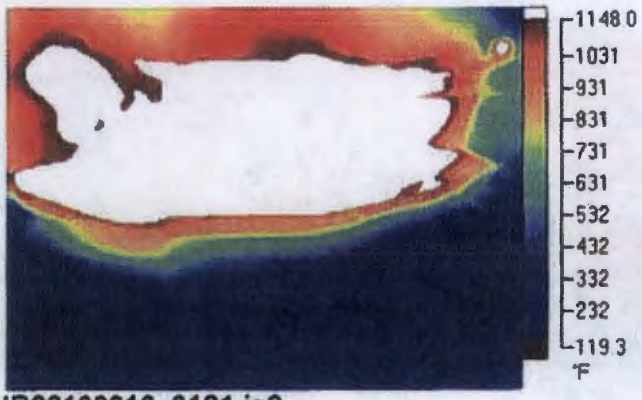
IR20100316_0180.is2
3/16/2010 2:21:54 PM



Graph

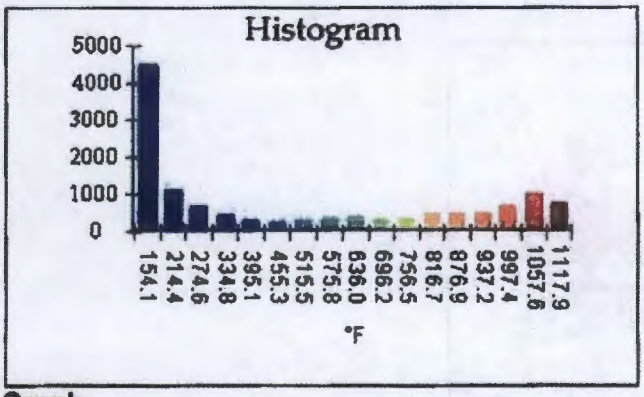
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	780.6°F
Image Range	~130.8°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:21:54 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0180.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

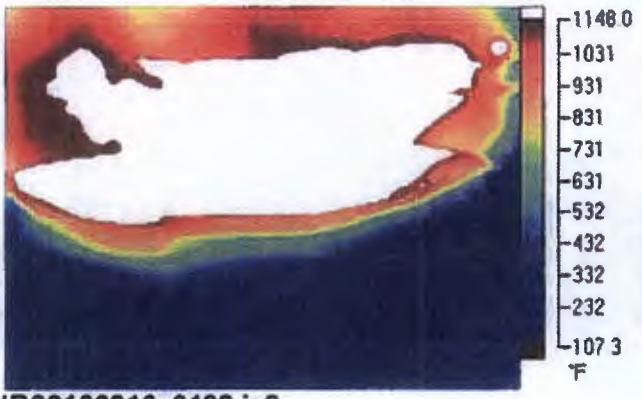
IR20100316_0181.is2
3/16/2010 2:22:00 PM



Graph

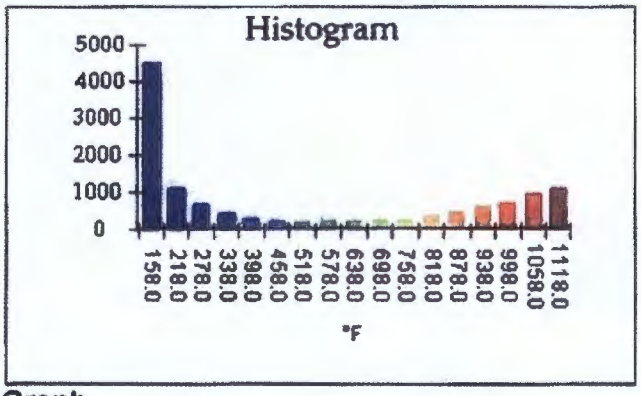
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	700.2°F
Image Range	~124.5°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:00 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0181.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

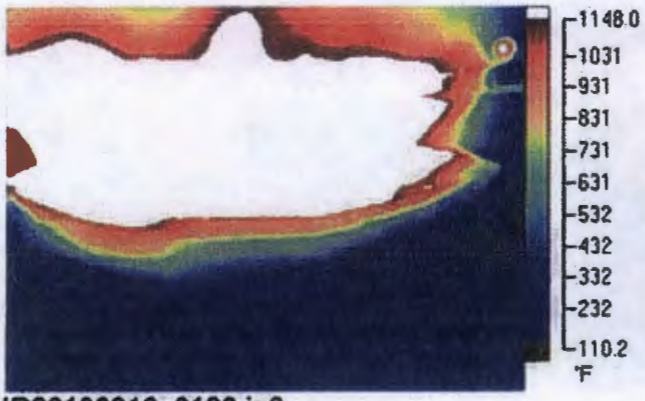
IR20100316_0182.is2
3/16/2010 2:22:09 PM



Graph

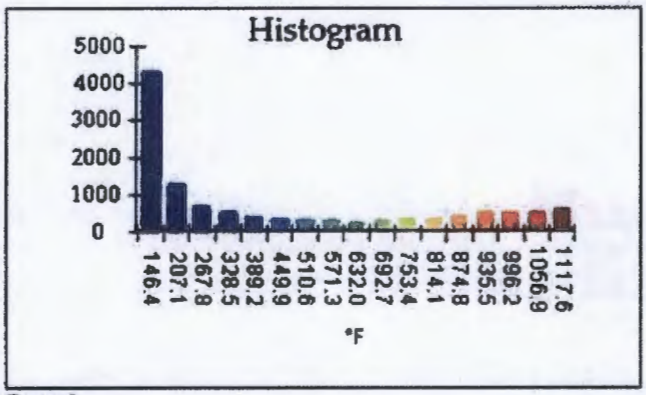
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	716.2°F
Image Range	~129.0°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:09 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0182.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

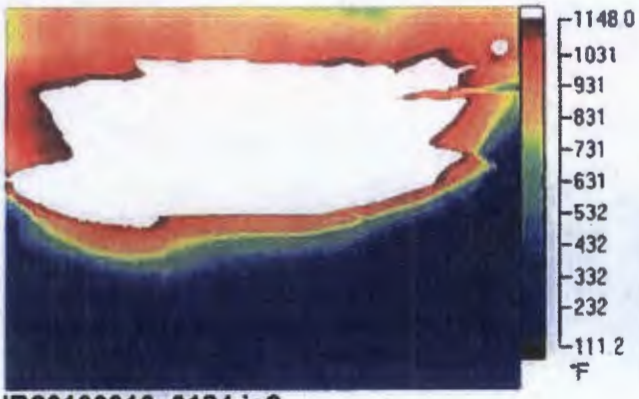
IR20100316_0183.is2
3/16/2010 2:22:17 PM

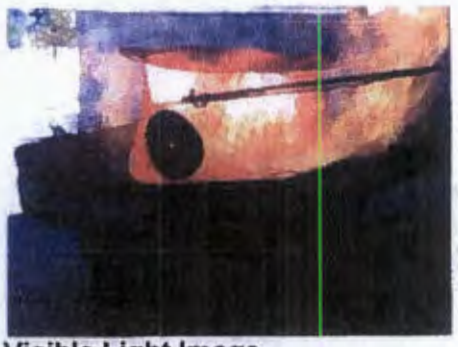


Graph

Image Info

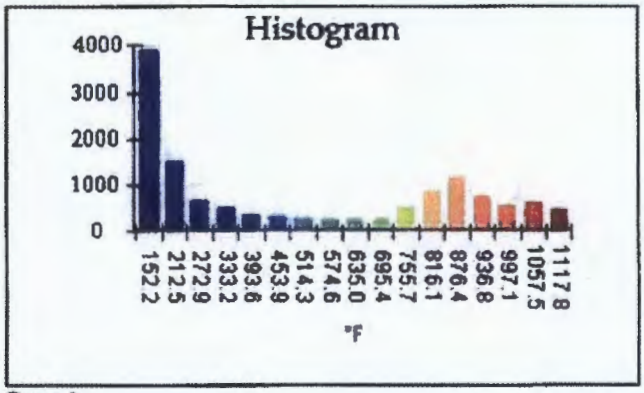
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	699.8°F
Image Range	~116.2°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:17 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0183.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

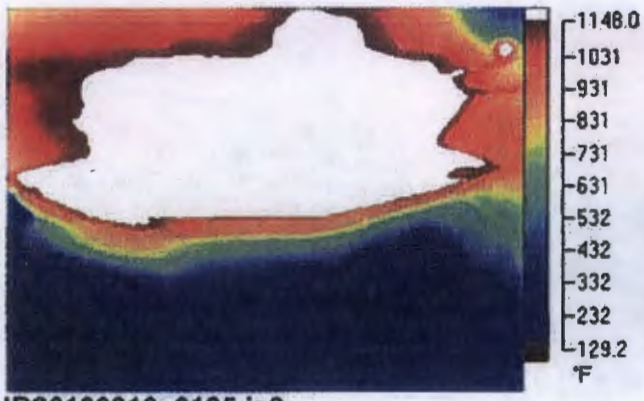
IR20100316_0184.is2
3/16/2010 2:22:24 PM



Graph

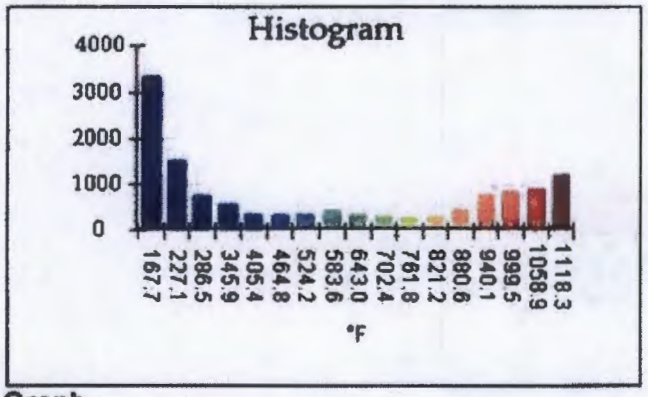
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	702.2°F
Image Range	~122.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:24 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0184.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

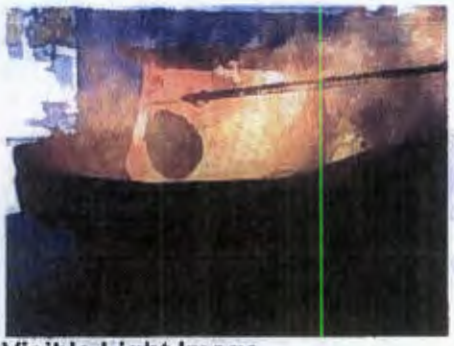
IR20100316_0185.is2
3/16/2010 2:22:33 PM



Graph

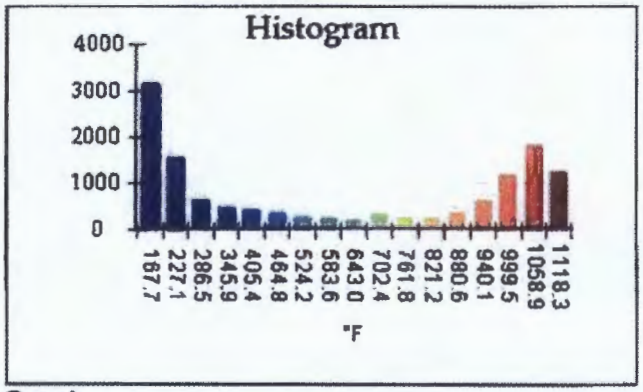
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	743.2°F
Image Range	~138.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:33 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0185.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

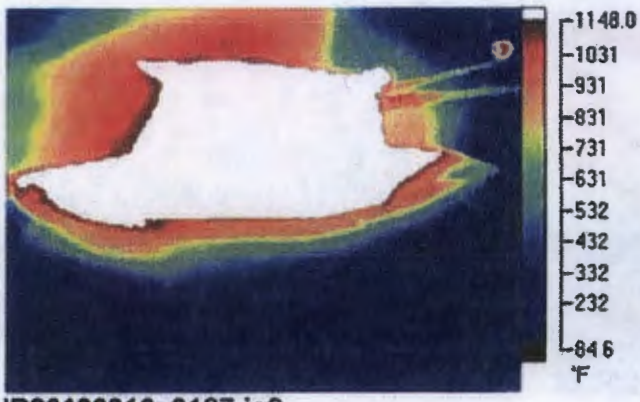
IR20100316_0186.is2
3/16/2010 2:22:39 PM



Graph

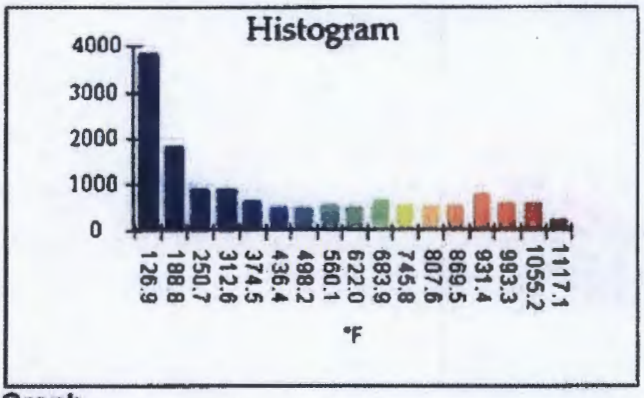
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	757.7°F
Image Range	~138.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:39 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0186.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

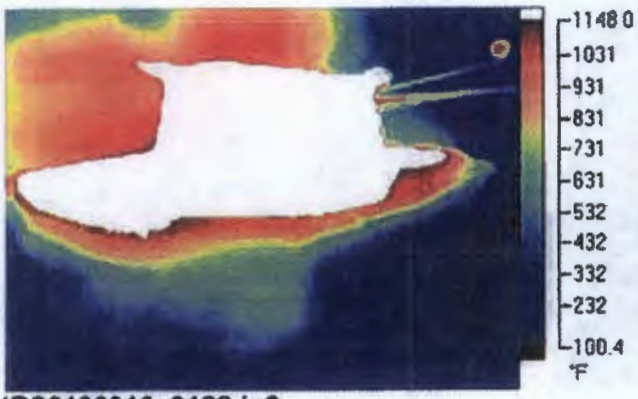
IR20100316_0187.is2
3/16/2010 2:22:46 PM

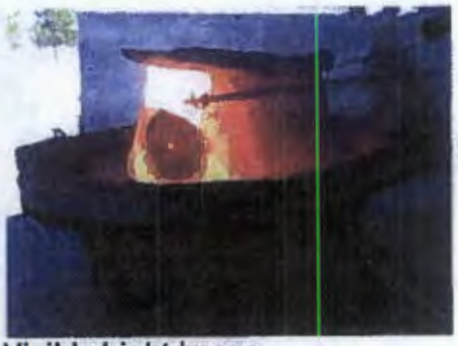


Graph

Image Info

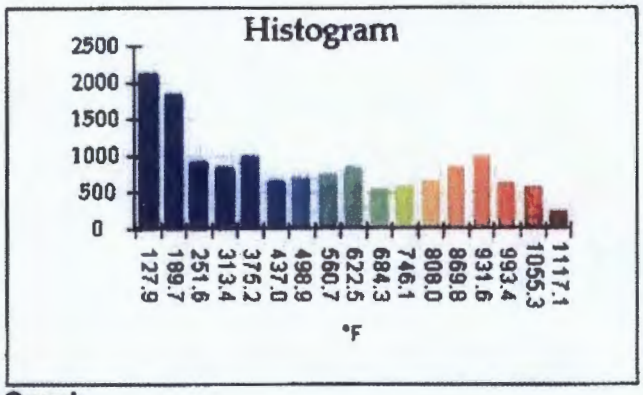
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	610.7°F
Image Range	~96.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:46 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0187.is2
Calibration Range	482.0°F to 1112.0°F





Visible Light Image

IR20100316_0188.is2
3/16/2010 2:22:55 PM

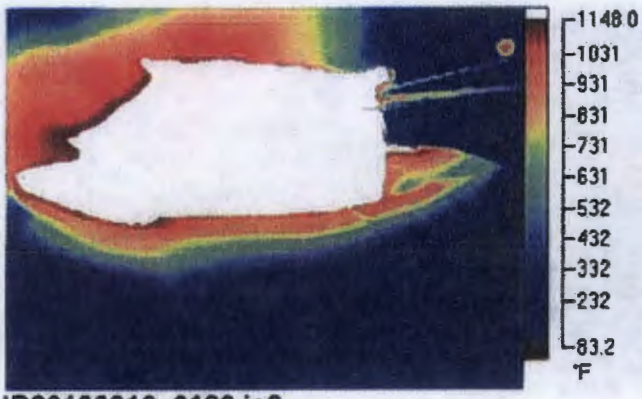


Graph

Image Info

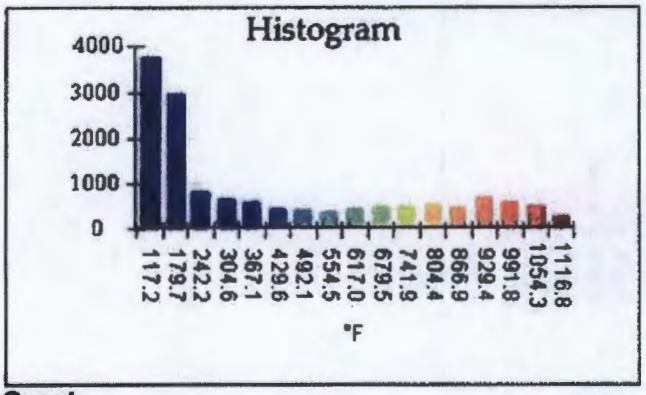
Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	655.5°F
Image Range	~97.9°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:22:55 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0188.is2
Calibration Range	482.0°F to 1112.0°F

RCR00091 070



IR20100316_0189.is2
3/16/2010 2:23:03 PM

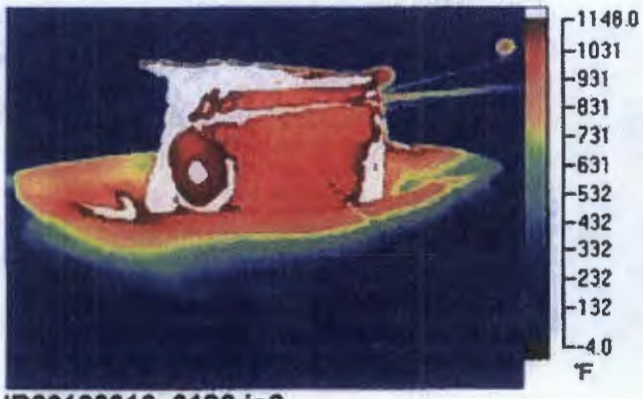
Visible Light Image



Graph

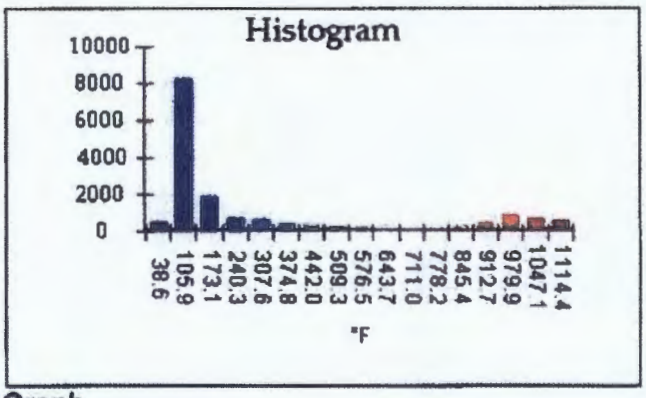
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	589.1°F
Image Range	~86.2°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:03 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0189.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

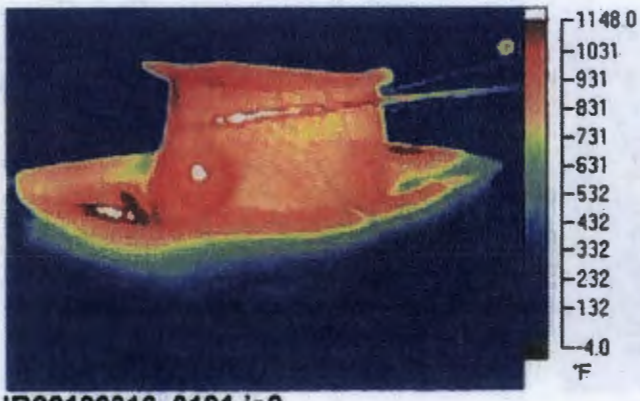
IR20100316_0190.is2
3/16/2010 2:23:11 PM



Graph

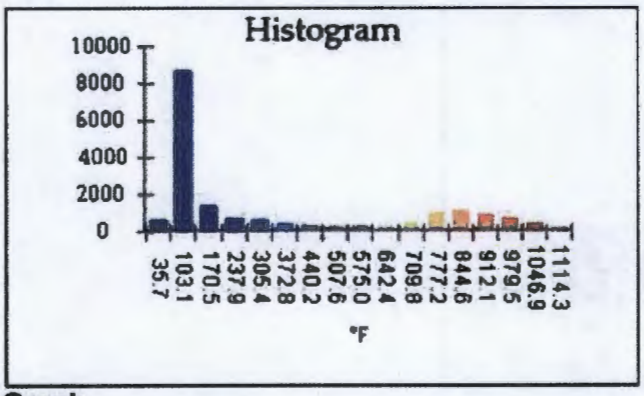
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~401.8°F
Image Range	~5.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:11 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0190.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

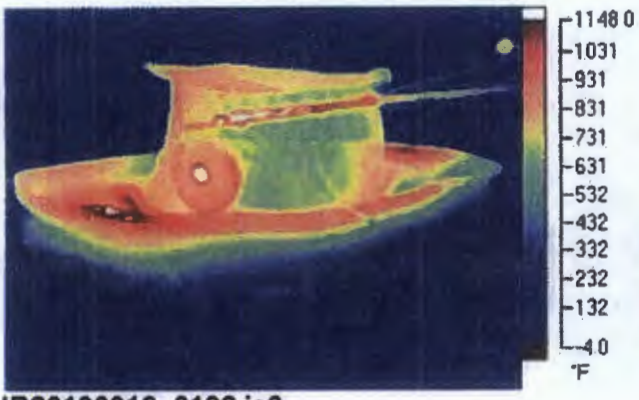
IR20100316_0191.is2
3/16/2010 2:23:18 PM



Graph

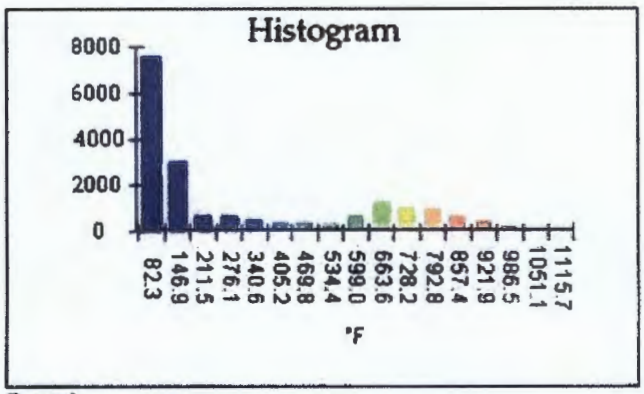
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~366.1°F
Image Range	~2.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:18 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0191.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

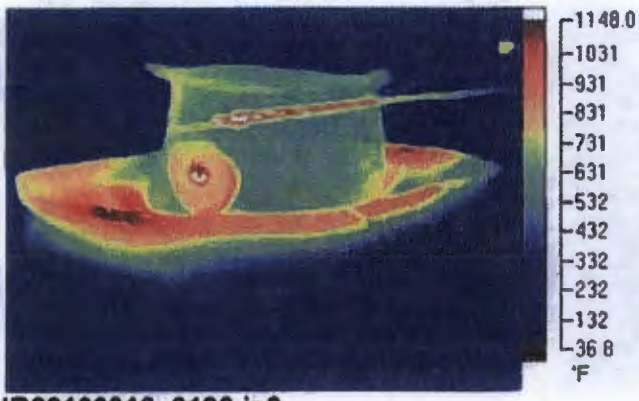
IR20100316_0192.is2
3/16/2010 2:23:26 PM



Graph

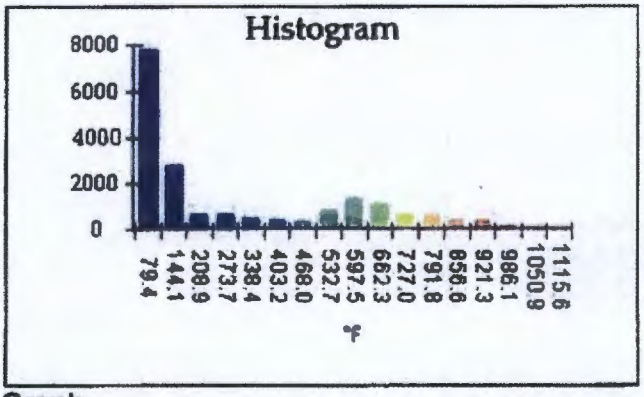
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~335.1°F
Image Range	~50.5°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:26 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0192.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

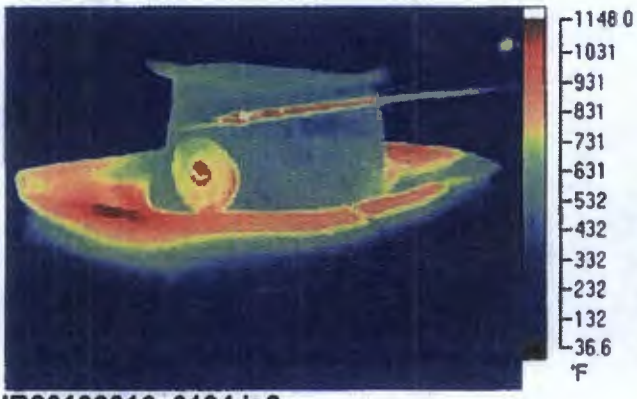
IR20100316_0193.is2
3/16/2010 2:23:33 PM



Graph

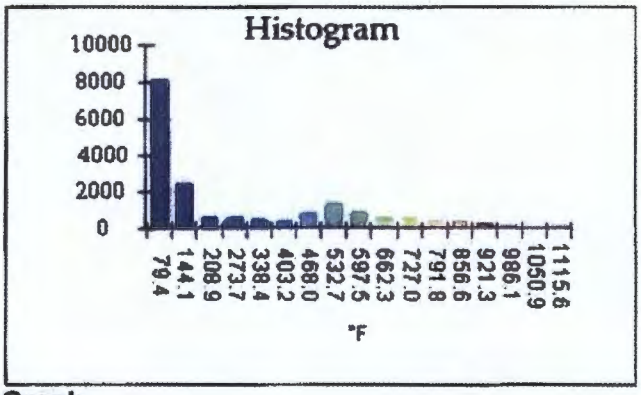
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~317.7°F
Image Range	~47.9°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:33 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0193.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0194.is2
3/16/2010 2:23:40 PM

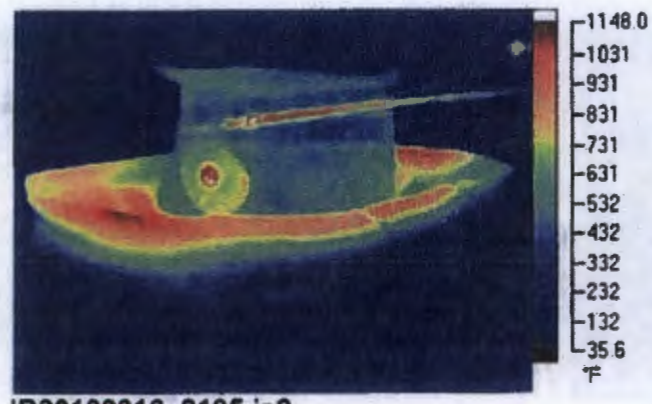
Visible Light Image



Graph

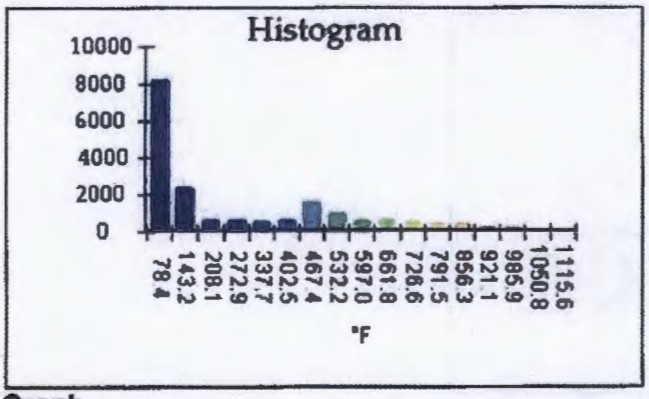
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~304.4°F
Image Range	~47.4°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:40 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0194.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

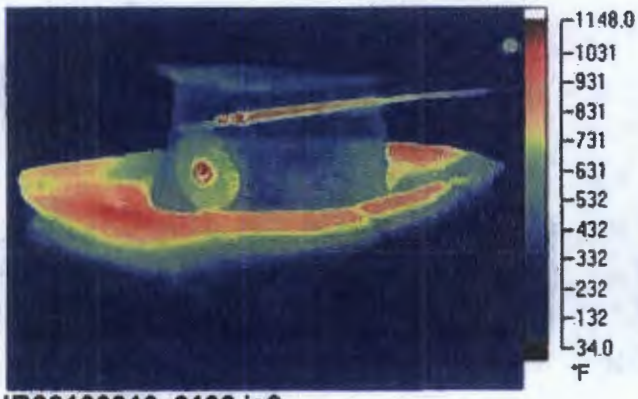
IR20100316_0195.is2
3/16/2010 2:23:48 PM



Graph

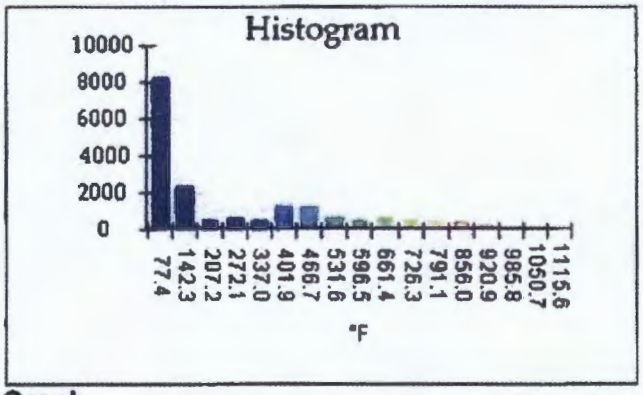
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~295.1°F
Image Range	~46.9°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:48 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0195.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0196.is2
3/16/2010 2:23:55 PM

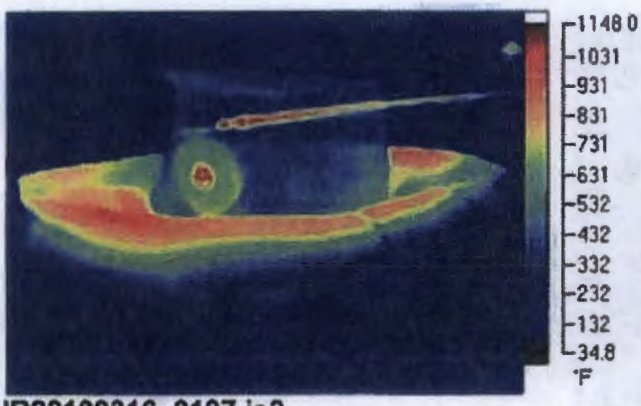
Visible Light Image



Graph

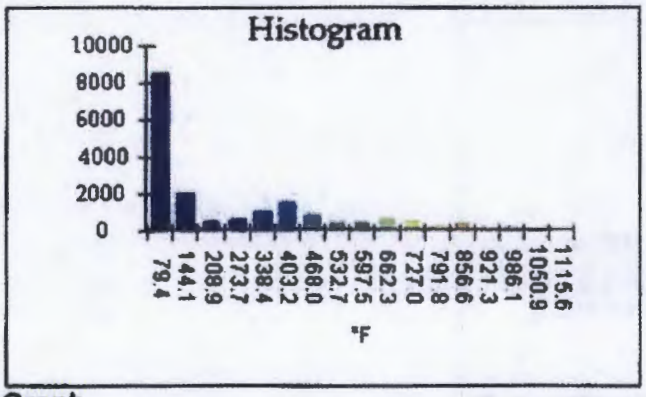
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~286.7°F
Image Range	~45.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:23:55 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0196.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

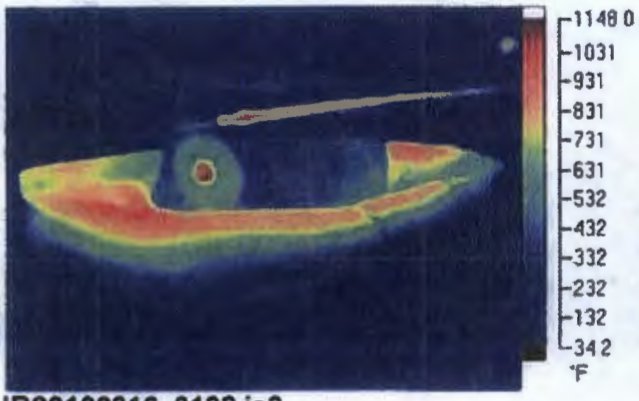
IR20100316_0197.is2
3/16/2010 2:24:03 PM



Graph

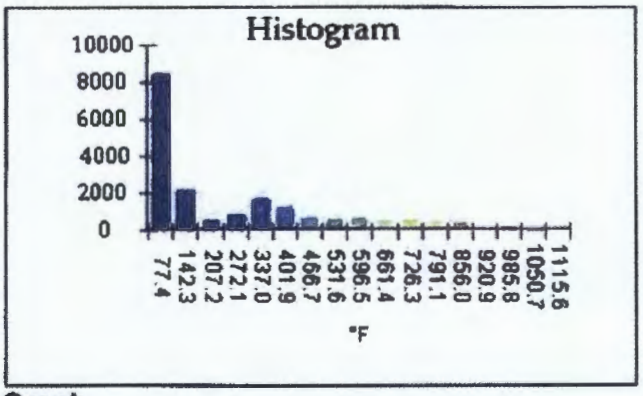
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~278.5°F
Image Range	~47.6°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:03 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0197.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

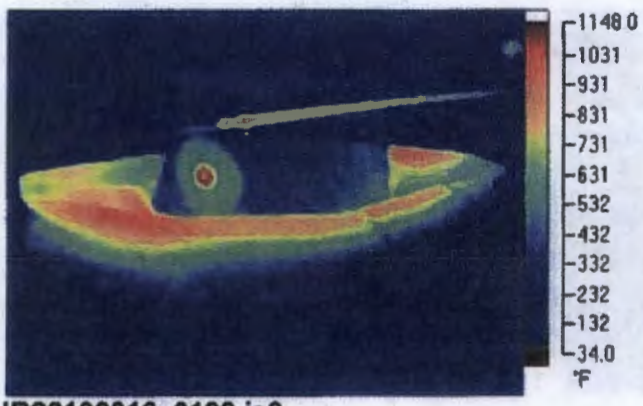
IR20100316_0198.is2
3/16/2010 2:24:10 PM



Graph

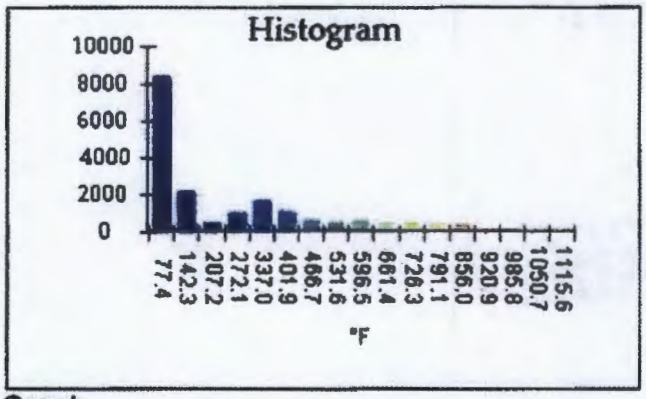
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~270.8°F
Image Range	~45.3°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:10 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0198.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

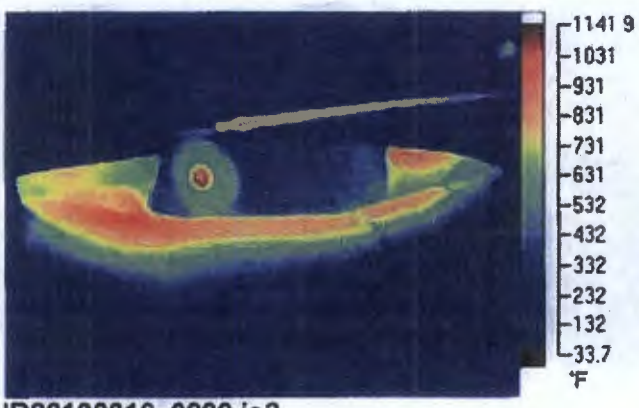
IR20100316_0199.is2
3/16/2010 2:24:17 PM



Graph

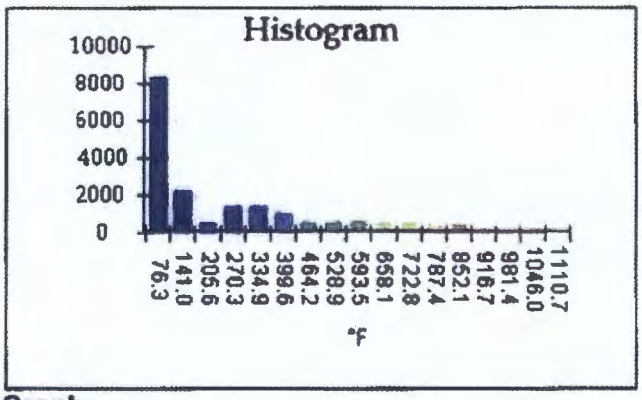
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~266.6°F
Image Range	~45.1°F to >1148.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:17 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0199.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0200.is2
3/16/2010 2:24:25 PM

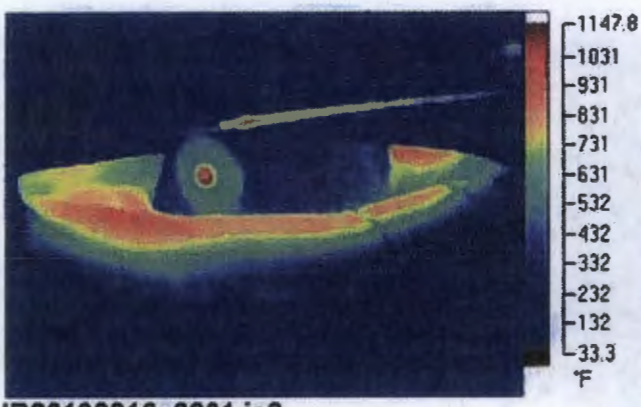
Visible Light Image



Graph

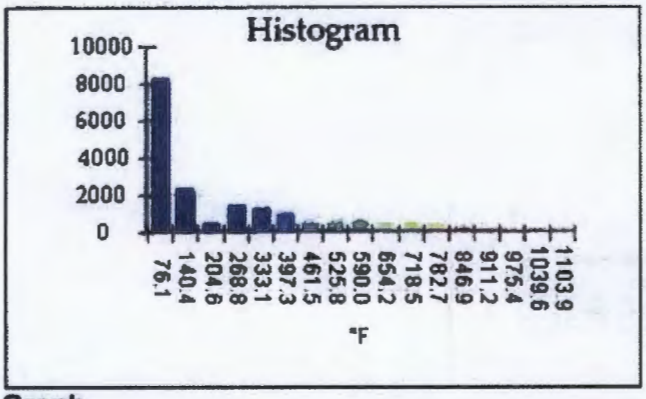
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~263.9°F
Image Range	~44.6°F to ~1142.4°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:25 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0200.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

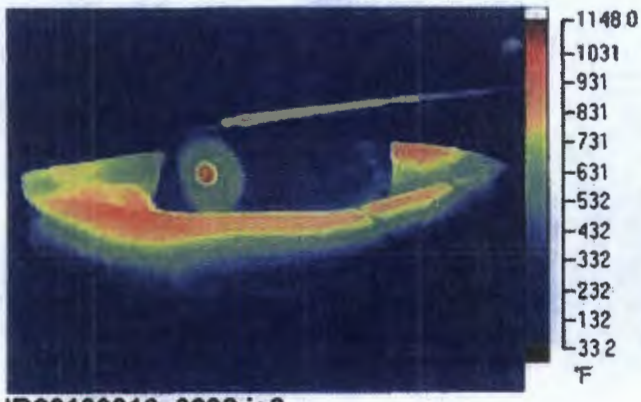
IR20100316_0201.is2
3/16/2010 2:24:32 PM



Graph

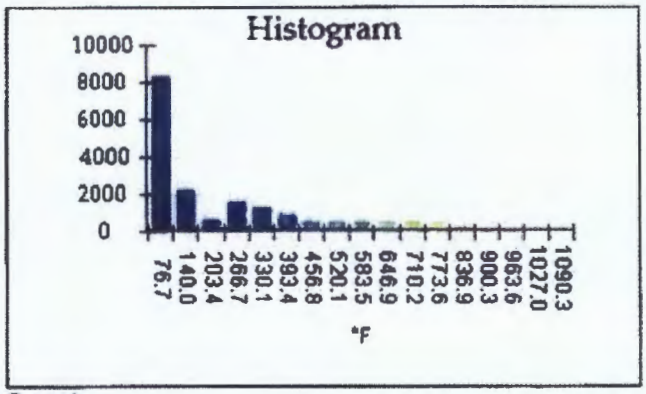
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~260.7°F
Image Range	~44.3°F to ~1135.4°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:32 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0201.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

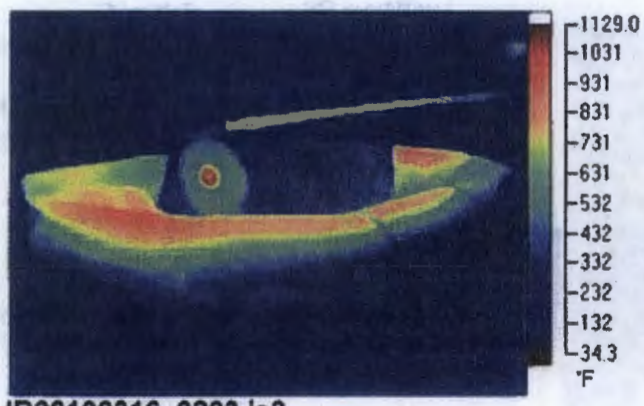
IR20100316_0202.is2
3/16/2010 2:24:40 PM



Graph

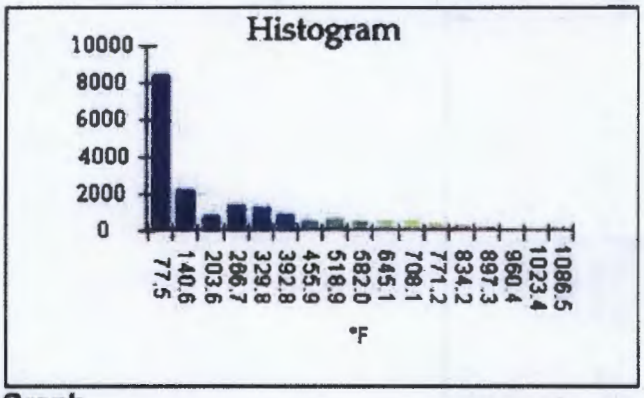
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~256.9°F
Image Range	~45.1°F to ~1121.2°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:40 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0202.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0203.is2
3/16/2010 2:24:47 PM

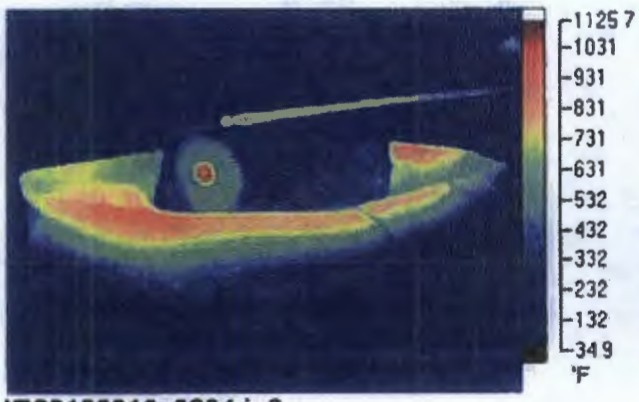
Visible Light Image



Graph

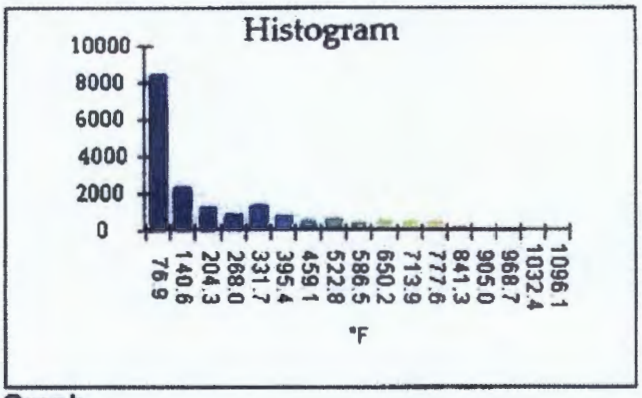
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~254.4°F
Image Range	~46.1°F to ~1117.9°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:47 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0203.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

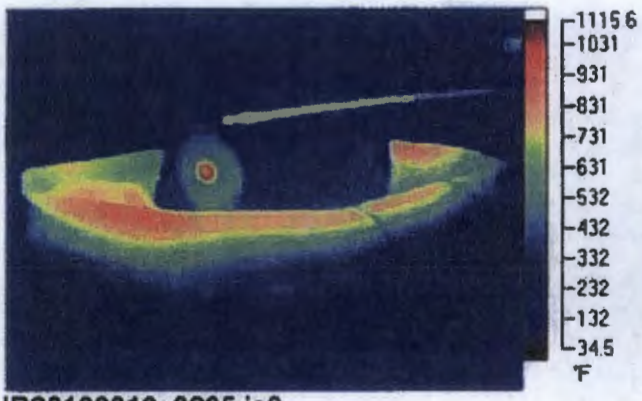
IR20100316_0204.is2
3/16/2010 2:24:53 PM



Graph

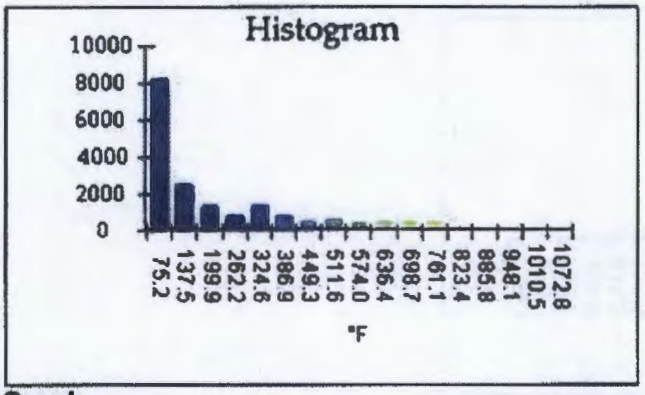
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~250.2°F
Image Range	~45.8°F to ~1127.4°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:24:53 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0204.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0205.is2
3/16/2010 2:25:01 PM

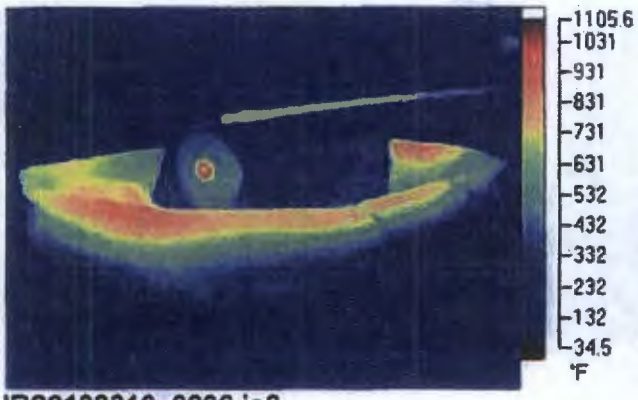
Visible Light Image



Graph

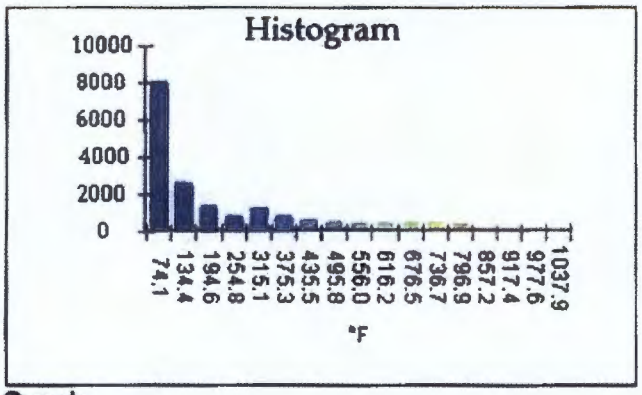
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~247.1°F
Image Range	~44.8°F to 1103.3°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:01 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0205.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

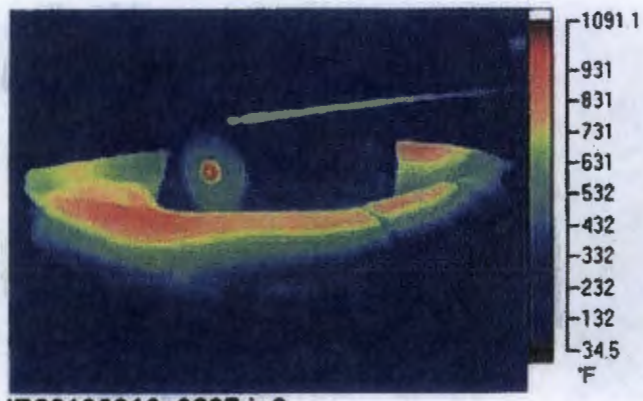
IR20100316_0206.is2
3/16/2010 2:25:08 PM



Graph

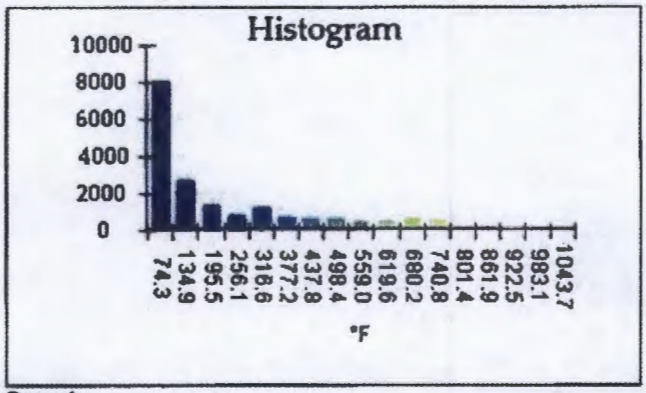
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~244.2°F
Image Range	~44.3°F to 1067.5°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:08 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0206.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0207.is2
3/16/2010 2:25:16 PM

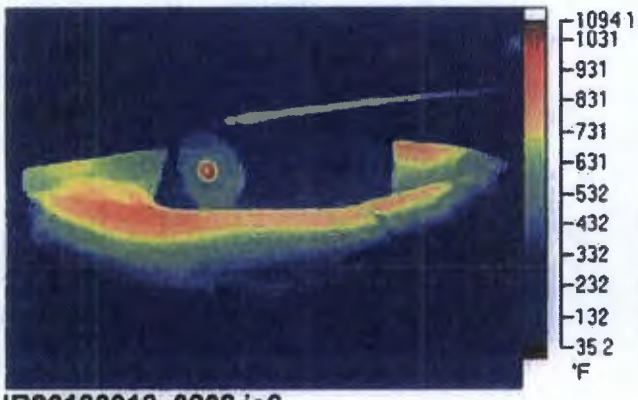
Visible Light Image



Graph

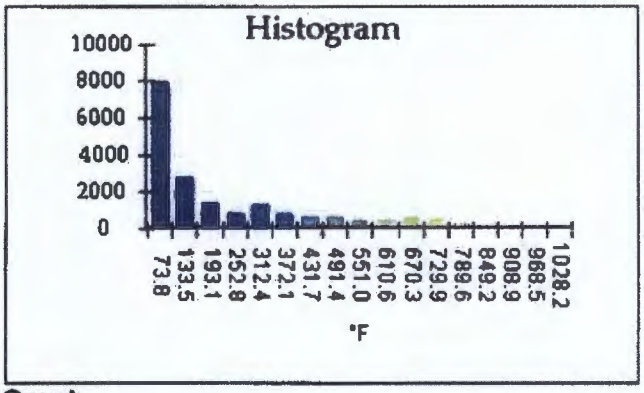
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~242.9°F
Image Range	~44.3°F to 1073.3°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:16 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0207.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0208.is2
3/16/2010 2:25:23 PM

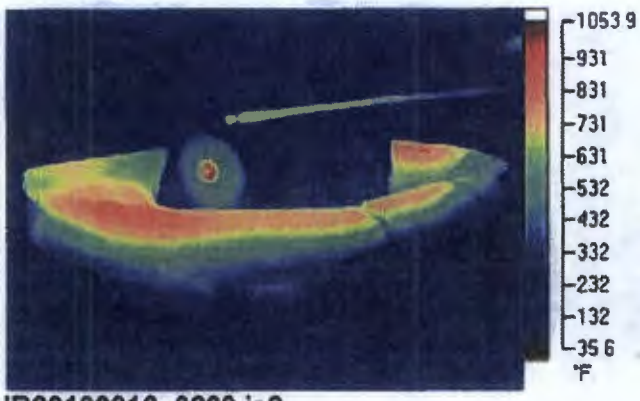
Visible Light Image



Graph

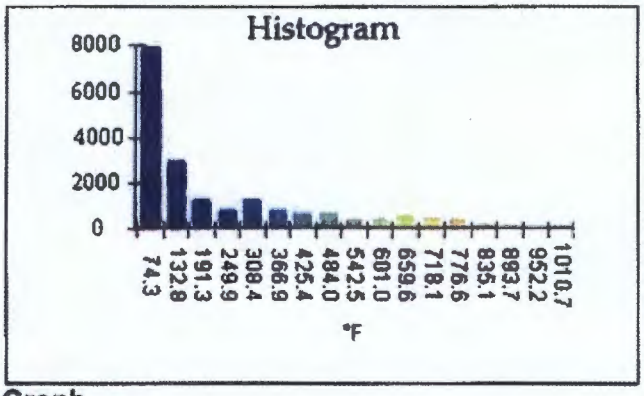
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~241.9°F
Image Range	~44.8°F to 1058.0°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:23 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0208.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

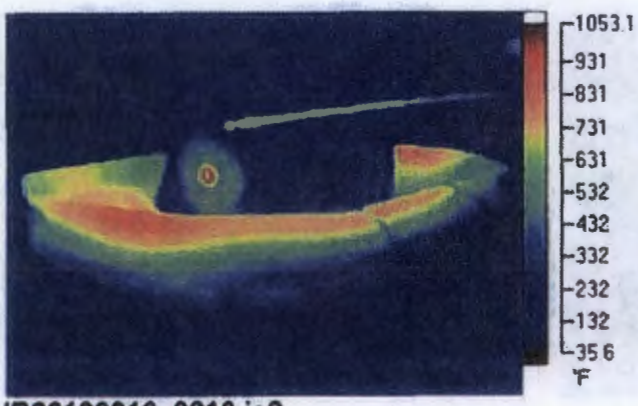
IR20100316_0209.is2
3/16/2010 2:25:30 PM



Graph

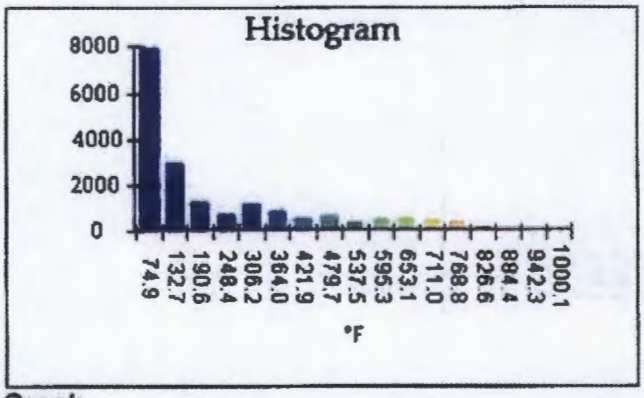
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~240.3°F
Image Range	~45.6°F to 1039.6°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:30 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0209.is2
Calibration Range	482.0°F to 1112.0°F



IR20100316_0210.is2
3/16/2010 2:25:38 PM

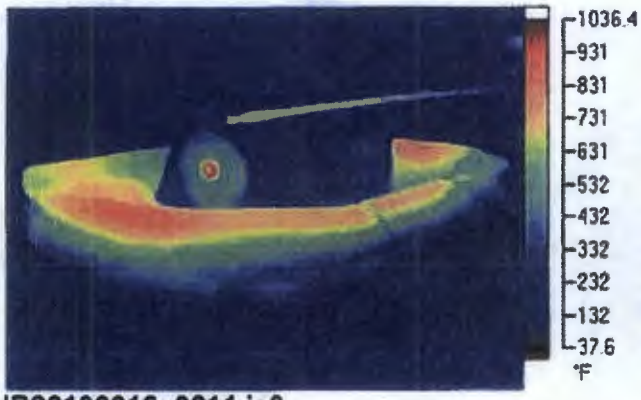
Visible Light Image



Graph

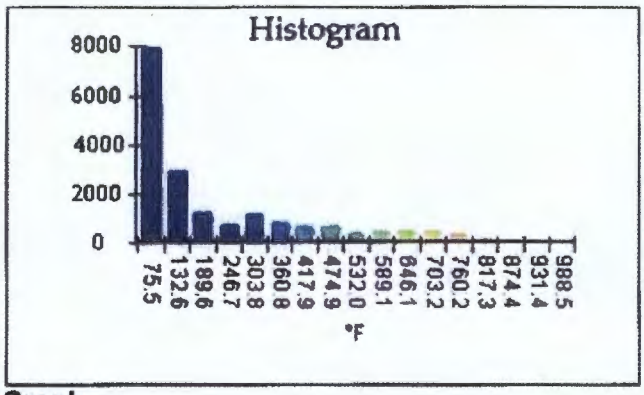
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~240.0°F
Image Range	~46.9°F to 1028.1°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:38 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0210.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

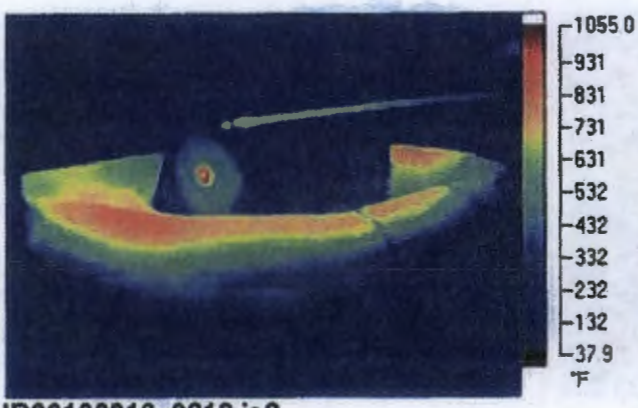
IR20100316_0211.is2
3/16/2010 2:25:45 PM



Graph

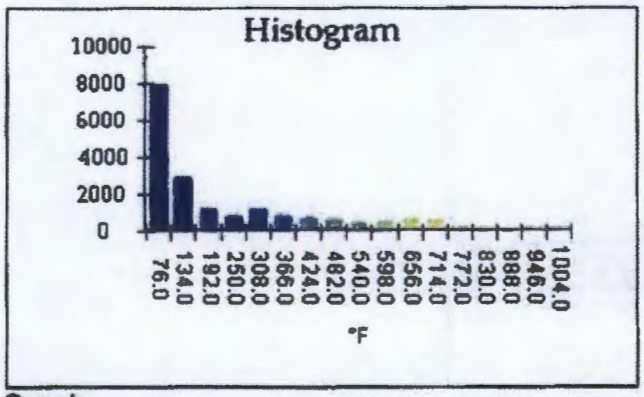
Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~239.6°F
Image Range	~47.4°F to 1016.7°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:45 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0211.is2
Calibration Range	482.0°F to 1112.0°F



Visible Light Image

IR20100316_0212.is2
3/16/2010 2:25:52 PM



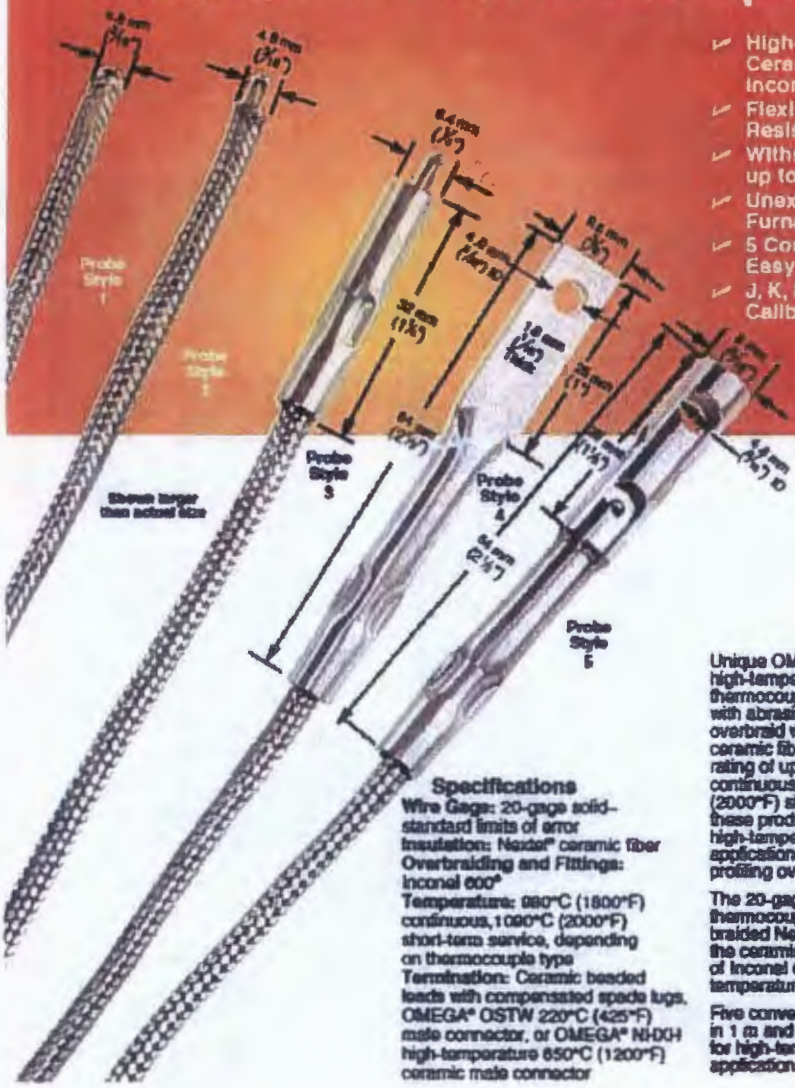
Graph

Image Info

Background Temperature	~58.0°F
Emissivity	0.92
Average Temperature	~238.6°F
Image Range	~47.9°F to 1032.7°F
Camera Model	Ti45FT
Camera Serial Number	Ti45FT-0809168
DSP Version	4.7.0.0
OCA Version	3.0.6.12
Manufacturer	Fluke
Lens Description	20mm/F0.8
Lens Serial Number	40948-9080
Image Time	3/16/2010 2:25:52 PM
File Location	C:\ Documents and Settings\ 109036\ Desktop\ 20100315_TA16-388\ images\ IR20100316_0212.is2
Calibration Range	482.0°F to 1112.0°F

Hi-Temperature Inconel Overbraided Ceramic Fiber Insulated Thermocouples

- High-Temperature Ceramic Insulation with Inconel Overbraid
- Flexible, Abrasion Resistant
- Withstand Temperatures up to 1090°C (2000°F)
- Unexcelled Oven and Furnace Profiling
- 5 Convenient Styles for Easy Application
- J, K, E, or N Thermocouple Calibrations



XCIB Series Starts at $35

Unique OMEGA® family of high-temperature types J, K, E, or N thermocouples are double-protected with abrasion-resistant Inconel overbraid with high-temperature ceramic fiber insulation. A temperature rating of up to 980°C (1800°F) continuous service and 1090°C (2000°F) short-term service makes these products ideal for many high-temperature measurement applications. They are unexcelled for profiling ovens and furnaces.

The 20-gage solid conductor thermocouple wires are insulated with braided Nextel® ceramic fiber. Over the ceramic fiber is a rugged overbraid of Inconel 600®—a tough, high-temperature, high nickel-content alloy.

Five convenient styles are available in 1 m and 3 m (3' and 10') lengths for high-temperature measurement applications.

Specifications

Wire Gage: 20-gage solid–standard limits of error
Insulation: Nextel® ceramic fiber
Overbraiding and Fittings: Inconel 600®
Temperature: 980°C (1800°F) continuous, 1090°C (2000°F) short-term service, depending on thermocouple type
Termination: Ceramic beaded leads with compensated spade lugs. OMEGA® OSTW 220°C (425°F) male connector, or OMEGA® NI-DGH high-temperature 650°C (1200°F) ceramic male connector

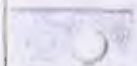
A-88

A

Style 1
Style 1 is a grounded junction thermocouple with the Inconel overbraid welded to form a smooth rounded tip for all general purpose applications.

Style 2
Style 2 is a general purpose, bead welded, exposed junction thermocouple.

Style 3
Style 3 is an exposed, bead welded junction thermocouple with an Inconel collar to clamp the probe to a surface, or to secure it into a hole or any fabrication.



Style 4
Style 4 is grounded. It can be bolted to a surface, or the Inconel eye can hook the thermocouple to a conveyor flight. Ungrounded units and special hole sizes are available. Contact Sales department for more information.

Style 5
Style 5 has an Inconel air hood to protect the exposed beaded wire junction. This design can be clamped to a surface, hooked to a conveyor flight, or bolted to a surface by using the through hole at the open end of the hood.

MOST POPULAR MODELS HIGHLIGHTED!

To Order *(Specify Model Number)*

Model Number	Probe Style	Termination Type	Price 1 m (3')	Price 3 m (10')	Model Number	Probe Style	Termination Type	Price 1 m (3')	Price 3 m (10')
XCIB-(*)-1-1-(**)	1	1	$43	$57	XCIB-(*)-4-1-(**)	4	1	$40	$62
XCIB-(*)-1-2-(**)		2	36	49	XCIB-(*)-4-2-(**)		2	46	60
XCIB-(*)-1-3-(**)		3	38	52	XCIB-(*)-4-3-(**)		3	49	63
XCIB-(*)-1-4-(**)		4	40	54	XCIB-(*)-4-4-(**)		4	46	60
XCIB-(*)-1-5-(**)		5	36	54	XCIB-(*)-4-5-(**)		5	46	60
XCIB-(*)-1-6-(**)		6	36	49	XCIB-(*)-4-6-(**)		6	46	60
XCIB-(*)-1-7-(**)		7	38	52	XCIB-(*)-4-7-(**)		7	49	63
XCIB-(*)-2-1-(**)	2	1	43	57	XCIB-(*)-5-1-(**)	5	1	51	65
XCIB-(*)-2-2-(**)		2	36	49	XCIB-(*)-5-2-(**)		2	51	65
XCIB-(*)-2-3-(**)		3	38	52	XCIB-(*)-5-3-(**)		3	54	68
XCIB-(*)-2-4-(**)		4	40	54	XCIB-(*)-5-4-(**)		4	49	63
XCIB-(*)-2-5-(**)		5	36	54	XCIB-(*)-5-5-(**)		5	51	63
XCIB-(*)-2-6-(**)		6	36	49	XCIB-(*)-5-6-(**)		6	51	65
XCIB-(*)-2-7-(**)		7	38	52	XCIB-(*)-5-7-(**)		7	54	68
XCIB-(*)-3-1-(**)	3	1	40	60					
XCIB-(*)-3-2-(**)		2	40	54					
XCIB-(*)-3-3-(**)		3	43	57					
XCIB-(*)-3-4-(**)		4	44	58					
XCIB-(*)-3-5-(**)		5	40	58					
XCIB-(*)-3-6-(**)		6	40	54					
XCIB-(*)-3-7-(**)		7	43	57					

** Specify thermocouple Type: J: Iron-Constantan, K: CHROMEGA®-ALOMEGA®, E: CHROMEGA®-Constantan, N: OMEGALOY®-NICROSIL-NISIL.*

Use prefix of "CAL-" for assemblies to be supplied with calibration data at specified temperatures. Check Sales department for pricing.

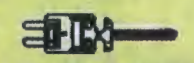
*** Specify length in feet: 3' or 10' standard. Price per additional 1', up to 50': $3.69. Price per additional 1', over 50': $3.69.*

Note: Available with silica insulation. Change "XCIB" to model number to "XSIB". No extra charge.

Ordering Example: XCIB-K-1-3-10, XCIB Type K probe, probe style 1 with termination Type 3 in (10') length, $52.

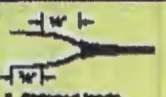
Termination Types

1. Ceramic beaded leads with compensated spade lugs.



2. Type OSTW male standard thermocouple connector to 220°C (425°F).
2. Type NHXN male ceramic connector to 650°C (1200°F).

4. Nexbe® insulated leads with compensated spade lugs.



5. Stripped leads.

6. SSPW mini-male connector to 220°C (425°F) max.
7. SHX mini-male ceramic connector to 650°C (1200°F) max.

A-38

Thermocouple Tolerances
(Reference Junction at 0°C)

American Limits of Error ASTM E230-ANSI MC 96.1

ANSI Code		Standard Limits[1]		Special Limits[1]	
J	Temp Range Tolerance Value	>0 to 750°C 2.2°C or 0.75%	>32 to 1382°F 4.0°F or 0.75%	0 to 760°C 1.1°C or 0.4%	32 to 1382°F 2.0°F or 0.4%
K	Temp Range Tolerance Value Temp. Range* Tolerance Value	>0 to 1250°C 2.2°C or 0.75% -200 to 0°C 2.2°C or 2.0%	>32 to 2282°F 4.0°F or 0.75% -328 to 32°F 4.0°F or 2.0%	0 to 1250°C 1.1°C or 0.4%	32 to 2282°F 2.0°F or 0.4%
T	Temp Range Tolerance Value Temp. Range* Tolerance Value	>0 to 350°C 1.0°C or 0.75% -200 to 0°C 1.0°C or 1.5%	>32 to 662°F 1.8°F or 0.75% -328 to 32°F 1.8°F or 1.5%	0 to 350°C 0.5°C or 0.4%	32 to 662°F 1°F or 0.4%
E	Temp Range Tolerance Value Temp. Range* Tolerance Value	>0 to 900°C 1.7°C or 0.5% -200 to 0°C 1.7°C or 1.0%	>32 to 1652 3°F or 0.5% -328 to 32°F 3°F or 1.0%	0 to 900°C 1.0°C or 0.4%	32 to 1652°F 1.8°F or 0.4%
N	Temp Range Tolerance Value Temp. Range* Tolerance Value	>0 to 1300°C 2.2°C or 0.75% -270 to 0°C 2.2°C or 2.0%	>32 to 2372°F 4.0°F or 0.75% -454 to 32°F 4.0°F or 2.0%	0 to 1300°C 1.1°C or 0.4%	32 to 2372°F 2.0°F or 0.4%
R S	Temp Range Tolerance Value	0 to 1450°C 1.5°C or 0.25%	32 to 2642°F 2.7°F or 0.25%	0 to 1450°C 0.6°C or 0.1%	32 to 2642°F 1°F or 0.1%
B	Temp Range Tolerance Value	800 to 1700°C 0.5%	1472 to 3092°F 0.9°F	Not Established	
G*C*D*	Temp Range Tolerance Value	0 to 2320°C 4.5°C or 1.0%	32 to 4208°F 0.9°F	Not Established	

*Not circled symbol or standard designation [1] Whichever value is greater.

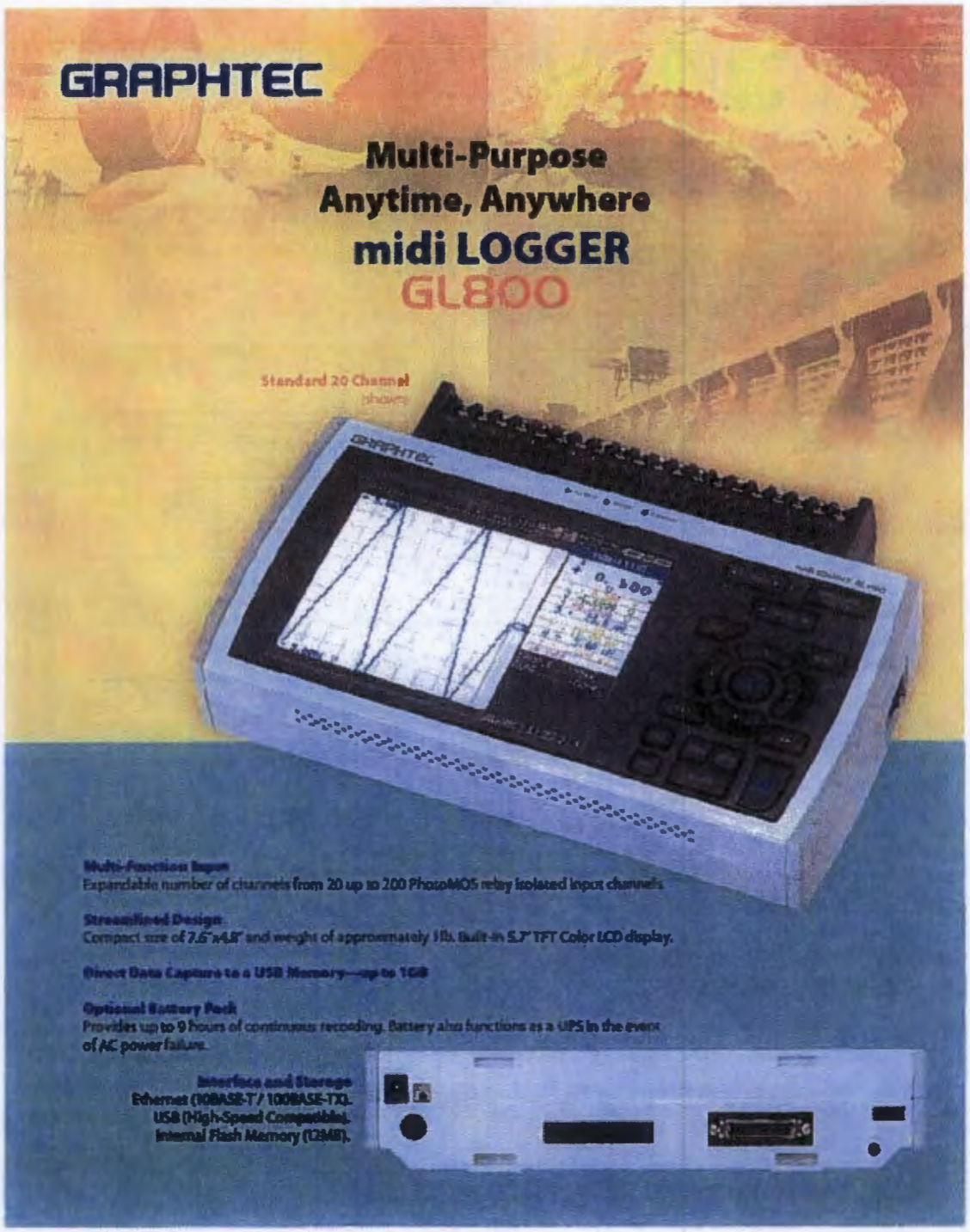
Note: Material is normally selected to meet tolerances above 0°C. If thermocouples are needed to meet tolerances below 0°C, the purchaser shall state this, as selection of material is usually required.

IEC Tolerance Class EN 60584-2; JIS C 1602

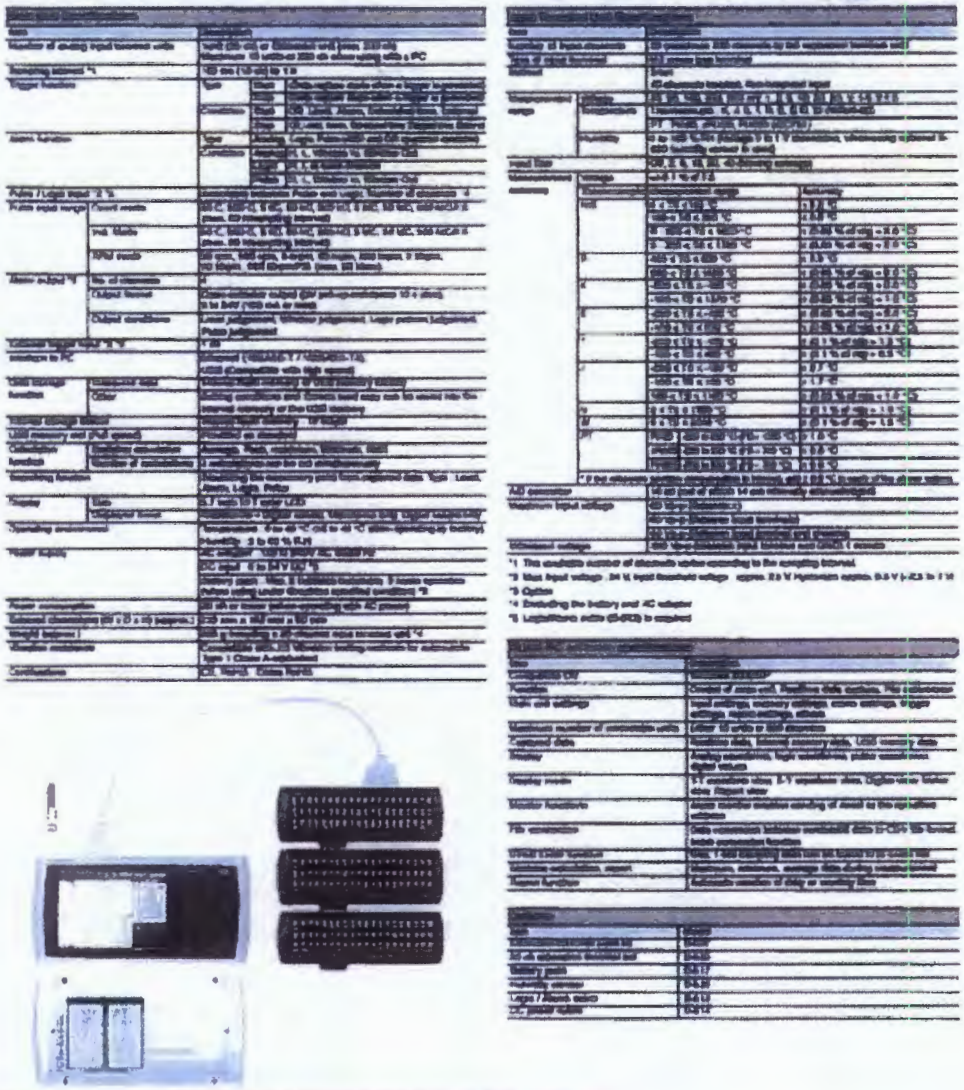
IEC Code		Class 1	Class 2	Class 3[1]
J	Temp Range Tolerance Value Temp. Range Tolerance Value	-40 to 375°C ±1.5°C 375 to 750°C ±0.4% Reading	-40 to 333°C ±2.5°C 333 to 750°C ±0.75% Reading	Not Established
K N	Temp Range Tolerance Value Temp. Range Tolerance Value	-40 to 375°C ±1.5°C 375 to 1000°C ±0.4%	-40 to 333°C ±2.5°C 333 to 1200°C ±0.75% Reading	-167 to 40°C ±2.5°C -200 to -167°C ±1.5% Reading
T	Temp Range Tolerance Value Temp. Range Tolerance Value	-40 to 125°C ±0.5°C 125 to 350°C ±0.4% Reading	-40 to 133°C ±1°C 133 to 350°C ±0.75% Reading	-67 to 40°C ±1°C -200 to -67°C ±1.5% Reading
E	Temp Range Tolerance Value Temp. Range Tolerance Value	-40 to 375°C ±1.5°C 375 to 800°C ±0.4% Reading	-40 to 333°C ±2.5°C 333 to 900°C ±0.75% Reading	-167 to 40°C ±2.5°C -200 to -167°C ±1.5% Reading
R S	Temp Range Tolerance Value Temp. Range Tolerance Value	0 to 1100°C ±1°C 1100 to 1600°C ±[1 + 0.3% x (Rdg-1100)]°C	0 to 600°C ±1.5°C 600 to 1600°C ±0.25% Reading	Not Established
B	Temp Range Tolerance Value Temp. Range Tolerance Value	Not Established	600 to 1700°C ±0.25% Reading	600 to 800°C +4°C 800 to 1700°C ±0.5% Reading

[1] Material is normally selected to meet tolerances above -40°C. If thermocouples are needed to meet limits of Class 3, as well as those of Class 1 or 2, the purchaser shall state this, as selection of material is usually required.

H


GRAPHTEC
Multi-Purpose
Anytime, Anywhere
midi LOGGER
GL800
Standard 20 Channel
shown
Multi-Function Input
Expandable number of channels from 20 up to 200 PhotoMOS relay isolated input channels
Streamlined Design
Compact size of 7.6"x4.8" and weight of approximately 1lb. Built-in 5.7" TFT Color LCD display.
Direct Data Capture to a USB Memory—up to 1GB
Optional Battery Pack
Provides up to 9 hours of continuous recording. Battery also functions as a UPS in the event of AC power failure.
Interface and Storage
Ethernet (10BASE-T / 100BASE-TX),
USB (High-Speed Compatible),
Internal Flash Memory (128MB).

midi LOGGER GL800



GRAPHTEC
GRAPHTEC AMERICA, INC.
1281 East Dyer Rd., Ste. 110, Santa Ana, CA 92705
Toll Free: 800.854.8388
Fax: 949.855.9896
http://www.graphtecinstruments.com

CE

Vendor	GRAPHTEC Corporation	
Model	GL800	
Version	Ver1.62	
Sampling interval	500ms	
Total data points	2893.0	
Start time	40252.0	0.6
End time	40252.0	0.6
Trigger time	40252.0	0.6

Date&Time	Burner 1 Type K Thermocouple °F	Burner 3 Type K Thermocouple °F	Pyrometer-West Side °F	Thermocouple behind rear wall °F	Thermocouple behind rear wall °F
3/15/2010 14:44	45.7	47.7	659.8	39.2	40.3
3/15/2010 14:44	45.7	47.8	659.6	39.2	40.3
3/15/2010 14:44	45.7	47.8	659.6	39.2	40.3
3/15/2010 14:44	45.7	48.0	659.6	39.2	40.3
3/15/2010 14:44	45.5	48.0	659.6	39.2	40.1
3/15/2010 14:44	45.5	48.0	659.6	39.2	40.3
3/15/2010 14:44	45.7	48.0	659.8	39.2	40.1
3/15/2010 14:44	45.7	48.0	659.8	39.0	40.1
3/15/2010 14:44	45.7	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.7	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.7	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.5	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.3	48.0	659.8	38.8	39.9
3/15/2010 14:44	45.3	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.5	48.2	659.8	38.8	40.1
3/15/2010 14:44	45.3	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.5	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.3	48.0	659.8	38.8	40.1
3/15/2010 14:44	45.3	48.2	659.8	38.8	40.1
3/15/2010 14:44	45.3	48.0	659.8	38.8	39.9
3/15/2010 14:44	45.3	47.8	659.8	38.8	39.9
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3/15/2010 14:44	45.1	47.7	659.8	38.8	39.7
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3/15/2010 14:44	45.1	47.7	659.6	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.8	38.8	39.9
3/15/2010 14:44	45.3	47.7	659.8	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.8	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.6	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.6	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.6	38.8	39.7
3/15/2010 14:44	45.3	47.7	659.6	38.8	39.7

3/15/2010 14:44	61.3	47.7	659.6	38.7	39.7
3/15/2010 14:44	67.1	47.8	659.6	38.8	39.7
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3/15/2010 14:44	65.3	47.7	659.8	38.7	39.6
3/15/2010 14:44	64.8	48.0	659.8	38.8	39.7
3/15/2010 14:44	64.4	48.0	659.8	38.8	39.7
3/15/2010 14:44	63.9	48.0	659.8	38.8	39.7
3/15/2010 14:44	70.2	48.0	659.8	38.8	39.7
3/15/2010 14:44	72.9	48.0	659.8	38.8	39.7
3/15/2010 14:44	72.7	48.0	659.6	38.7	39.6
3/15/2010 14:44	72.3	48.0	659.8	38.7	39.6
3/15/2010 14:44	82.4	48.0	659.8	38.7	39.6
3/15/2010 14:44	96.3	48.0	659.8	38.8	39.6
3/15/2010 14:44	93.2	48.0	659.8	38.8	39.6
3/15/2010 14:44	91.0	48.0	659.8	38.8	39.6
3/15/2010 14:44	89.8	48.2	659.8	38.8	39.6
3/15/2010 14:44	88.5	48.2	659.8	38.8	39.7
3/15/2010 14:44	87.4	48.2	659.8	38.8	39.6
3/15/2010 14:44	86.5	48.2	659.6	38.8	39.6
3/15/2010 14:44	85.1	48.0	659.6	38.8	39.6
3/15/2010 14:44	204.1	57.7	1843.6	38.7	39.8
3/15/2010 14:44	349.9	142.3	862.0	38.8	39.6
3/15/2010 14:44	453.7	145.0	659.8	38.8	39.6
3/15/2010 14:44	704.7	253.4	659.6	38.8	39.7
3/15/2010 14:44	865.9	374.4	659.6	38.8	39.7
3/15/2010 14:44	979.5	487.0	1862.0	38.8	39.7
3/15/2010 14:44	1020.6	482.5	2169.2	38.8	40.1
3/15/2010 14:44	1091.8	502.3	659.6	39.0	40.1
3/15/2010 14:44	1181.7	568.0	659.6	38.8	40.1
3/15/2010 14:44	1291.5	594.7	2501.1	39.0	40.1
3/15/2010 14:44	1369.4	660.4	2501.3	39.0	40.1
3/15/2010 14:44	1443.0	684.5	2501.5	39.2	40.1
3/15/2010 14:44	1549.0	803.8	2497.4	39.2	40.1
3/15/2010 14:44	1631.5	910.9	2378.5	39.2	40.1
3/15/2010 14:44	1694.8	1010.7	2175.1	39.2	40.1
3/15/2010 14:44	1741.8	1105.7	2312.3	39.2	40.1
3/15/2010 14:44	1790.2	1191.0	2440.6	39.2	40.3
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3/15/2010 14:44	1964.5	1524.0	2301.1	39.2	40.5

3/15/2010 14:44	1993.1	1585.4	2240.9	39.4	40.5
3/15/2010 14:44	2021.9	1613.5	2177.4	39.4	40.5
3/15/2010 14:44	2036.1	1646.4	2269.4	39.4	40.6
3/15/2010 14:44	2047.8	1673.2	2233.8	39.4	40.5
3/15/2010 14:44	2041.9	1658.5	2372.0	39.6	40.6
3/15/2010 14:44	2016.5	1620.1	2045.6	39.6	40.6
3/15/2010 14:44	2023.9	1639.0	2164.9	39.6	40.6
3/15/2010 14:44	2036.5	1646.4	2214.3	39.6	40.6
3/15/2010 14:44	2057.4	1686.2	2208.6	39.6	40.6
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3/15/2010 14:44	2102.2	1804.8	2440.2	39.6	40.6
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3/15/2010 14:44	2088.9	1765.2	2192.7	39.7	40.8
3/15/2010 14:44	2102.2	1762.3	2323.6	39.7	40.6
3/15/2010 14:44	2105.8	1780.9	2296.2	39.7	40.6
3/15/2010 14:44	2087.4	1768.8	2267.0	39.7	40.6
3/15/2010 14:44	2097.0	1806.1	2500.1	39.7	40.6
3/15/2010 14:44	2095.9	1870.0	2477.3	39.7	40.6
3/15/2010 14:44	2097.0	1914.3	2505.3	39.7	40.6
3/15/2010 14:44	2117.1	1953.9	2268.4	39.7	40.6
3/15/2010 14:44	2125.9	1989.7	2254.1	39.7	40.6
3/15/2010 14:44	2140.5	2010.6	2210.6	39.6	40.6
3/15/2010 14:44	2146.8	2025.5	2480.8	39.6	40.6
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3/15/2010 14:44	2136.0	2049.1	2485.1	39.6	40.6
3/15/2010 14:44	2136.7	2063.6	2224.7	39.6	40.6
3/15/2010 14:44	2117.1	2068.5	2273.8	39.6	40.6
3/15/2010 14:44	2121.1	2072.1	2243.5	39.6	40.6
3/15/2010 14:44	2131.3	2077.2	2151.7	39.6	41.0
3/15/2010 14:44	2134.6	2079.1	2173.0	39.6	41.2
3/15/2010 14:44	2129.4	2081.3	2221.4	39.6	41.2
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3/15/2010 14:44	2125.4	2085.3	2175.6	39.6	41.4
3/15/2010 14:44	2131.0	2084.9	2146.7	39.6	41.4
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3/15/2010 14:45	2049.6	2068.0	2109.8	39.7	41.5

3/15/2010 14:45	2028.7	2057.0	2236.2	39.7	41.5
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3/15/2010 14:45	2004.4	2081.1	2150.7	39.7	41.5
3/15/2010 14:45	2022.3	2074.5	2004.1	39.7	41.5
3/15/2010 14:45	2032.9	2084.2	2137.4	39.7	41.5
3/15/2010 14:45	2013.4	2082.4	2202.7	39.7	41.5
3/15/2010 14:45	2029.8	2108.3	2167.0	39.7	41.5
3/15/2010 14:45	2041.9	2127.9	2157.7	39.7	41.5
3/15/2010 14:45	2040.4	2140.3	2195.1	39.7	41.5
3/15/2010 14:45	2064.6	2145.6	2143.8	39.7	41.4
3/15/2010 14:45	2070.0	2148.6	2197.9	39.6	41.4
3/15/2010 14:45	2080.9	2147.2	2118.7	39.6	41.2
3/15/2010 14:45	2082.7	2152.0	2106.5	39.6	41.2
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3/15/2010 14:45	2097.3	2153.5	2102.2	39.6	41.4
3/15/2010 14:45	2096.2	2153.7	2156.3	39.6	41.5
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3/15/2010 14:45	2133.0	2151.1	2034.2	39.7	41.9
3/15/2010 14:45	2127.0	2149.5	2216.5	39.6	41.9
3/15/2010 14:45	2136.4	2145.2	2124.2	39.6	41.9
3/15/2010 14:45	2140.2	2142.9	2104.6	39.7	41.9
3/15/2010 14:45	2144.5	2144.5	2232.1	39.6	41.9
3/15/2010 14:45	2150.8	2143.9	2180.5	39.6	41.9
3/15/2010 14:45	2163.0	2144.3	2185.1	39.7	42.1
3/15/2010 14:45	2173.8	2153.1	2195.4	39.7	42.1
3/15/2010 14:45	2171.7	2146.3	2163.7	39.7	42.1
3/15/2010 14:45	2163.9	2147.5	2198.9	39.7	42.1
3/15/2010 14:45	2159.6	2125.0	2148.3	39.7	42.1
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3/15/2010 14:45	2138.4	2078.2	2148.1	39.7	42.1
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3/15/2010 14:45	2161.4	2031.1	2218.8	39.7	42.3
3/15/2010 14:45	2165.2	2030.7	2268.4	39.7	42.3
3/15/2010 14:45	2171.8	2023.0	2242.7	39.7	42.1
3/15/2010 14:45	2163.9	2033.2	2246.0	39.7	42.1
3/15/2010 14:45	2167.7	2027.3	2269.0	39.7	42.1
3/15/2010 14:45	2175.1	2042.6	2296.7	39.7	42.1
3/15/2010 14:45	2172.4	2069.1	2220.6	39.7	42.3

3/15/2010 14:45	2128.8	2094.8	2110.4	39.9	42.3
3/15/2010 14:45	2068.9	2106.3	2032.1	40.1	42.4
3/15/2010 14:45	1998.9	2112.3	2132.6	40.1	42.4
3/15/2010 14:45	1938.6	2106.5	2214.6	40.1	42.4
3/15/2010 14:45	1901.1	2099.5	1895.8	40.1	42.4
3/15/2010 14:45	1887.3	2080.6	1912.1	40.1	42.6
3/15/2010 14:45	1876.5	2092.6	1936.6	40.1	42.8
3/15/2010 14:45	1885.3	2088.9	2117.5	40.1	42.8
3/15/2010 14:45	1911.4	2115.3	2039.4	40.1	42.8
3/15/2010 14:45	1944.1	2128.6	2155.9	40.1	42.8
3/15/2010 14:45	1975.8	2118.9	1995.2	40.1	42.8
3/15/2010 14:45	1981.2	2115.1	1992.0	40.3	42.8
3/15/2010 14:45	1937.3	2107.6	2153.5	40.1	42.8
3/15/2010 14:45	1928.5	2085.6	2226.0	40.3	43.0
3/15/2010 14:45	1914.8	2066.0	2205.0	40.5	43.0
3/15/2010 14:45	1910.8	2058.6	2056.9	40.5	43.0
3/15/2010 14:45	1913.7	2049.6	2380.2	40.5	43.0
3/15/2010 14:45	1872.0	2039.0	2196.3	40.5	42.8
3/15/2010 14:45	1839.7	2026.6	2223.4	40.5	42.8
3/15/2010 14:45	1816.3	2016.1	2115.5	40.5	42.8
3/15/2010 14:45	1776.9	1999.2	2415.9	40.5	42.8
3/15/2010 14:45	1761.4	1994.2	2278.9	40.5	42.8
3/15/2010 14:45	1736.4	1982.8	2461.2	40.6	43.0
3/15/2010 14:45	1701.5	2001.6	2048.0	40.6	43.0
3/15/2010 14:45	1662.4	2029.1	2377.7	40.6	43.0
3/15/2010 14:45	1642.1	2045.3	2502.3	40.5	43.0
3/15/2010 14:45	1654.5	2047.5	2433.9	40.5	43.0
3/15/2010 14:45	1654.7	2021.2	2342.6	40.5	43.0
3/15/2010 14:45	1672.5	2013.4	2205.6	40.3	43.0
3/15/2010 14:45	1695.2	2039.0	2391.7	40.3	43.0
3/15/2010 14:45	1687.1	2057.9	2502.1	40.3	42.8
3/15/2010 14:45	1726.5	2082.4	2499.4	40.3	42.8
3/15/2010 14:45	1756.6	2103.4	2414.5	40.3	42.8
3/15/2010 14:45	1776.0	2112.4	2477.5	40.3	43.0
3/15/2010 14:45	1806.3	2129.7	2221.5	40.5	43.0
3/15/2010 14:45	1835.8	2151.7	2111.0	40.5	42.8
3/15/2010 14:45	1846.8	2154.7	2140.6	40.5	43.0
3/15/2010 14:45	1917.9	2144.7	2213.0	40.3	42.8
3/15/2010 14:45	1898.2	2144.3	2197.9	40.3	42.6
3/15/2010 14:45	1899.5	2149.5	2221.7	40.1	42.6
3/15/2010 14:45	1891.9	2162.8	2069.1	40.1	42.4
3/15/2010 14:45	1832.5	2170.2	1986.8	40.1	42.4
3/15/2010 14:45	1800.0	2176.3	1927.0	40.1	42.4
3/15/2010 14:45	1738.6	2148.8	1825.0	40.1	42.4
3/15/2010 14:45	1709.6	2139.6	2227.8	40.1	42.4
3/15/2010 14:45	1695.6	2103.3	1849.8	40.1	42.4
3/15/2010 14:45	1651.1	2077.7	1836.4	40.1	42.3

3/15/2010 14:45	1636.5	2058.1	2207.1	40.1	42.3
3/15/2010 14:45	1642.1	2057.0	2010.2	39.9	42.3
3/15/2010 14:45	1639.0	2046.0	2325.4	39.9	42.3
3/15/2010 14:45	1668.2	2032.5	2422.6	39.9	42.1
3/15/2010 14:45	1747.6	2021.4	1860.0	39.7	42.1
3/15/2010 14:45	1779.1	2008.9	1997.2	39.7	42.1
3/15/2010 14:45	1822.1	2032.3	2051.1	39.7	42.1
3/15/2010 14:45	1810.0	2029.8	2084.9	39.9	42.1
3/15/2010 14:45	1880.1	2020.5	2344.9	39.7	42.1
3/15/2010 14:45	1869.6	2008.4	2396.6	39.7	41.9
3/15/2010 14:45	1886.4	2001.0	2187.6	39.7	42.1
3/15/2010 14:45	1850.4	2002.8	2146.7	39.7	42.1
3/15/2010 14:45	1864.9	1986.4	2403.5	39.7	42.1
3/15/2010 14:45	1890.5	1982.8	1967.5	39.7	42.1
3/15/2010 14:45	1861.0	1996.7	2083.0	39.7	42.1
3/15/2010 14:45	1891.2	2017.0	1969.2	39.7	42.1
3/15/2010 14:45	1872.0	2030.0	2170.9	39.7	42.1
3/15/2010 14:45	1852.2	2052.3	2189.1	39.7	42.3
3/15/2010 14:45	1857.4	2047.1	2501.9	39.7	42.3
3/15/2010 14:45	1821.2	2048.9	2126.9	39.6	42.1
3/15/2010 14:46	1832.2	2059.9	2057.1	39.6	42.1
3/15/2010 14:46	1834.7	2031.1	1983.2	39.6	42.1
3/15/2010 14:46	1897.9	2021.4	1949.0	39.6	42.1
3/15/2010 14:46	1949.9	2006.2	1987.1	39.6	42.4
3/15/2010 14:46	1982.7	2005.5	1962.9	39.6	42.4
3/15/2010 14:46	2007.1	1981.6	2113.1	39.6	42.6
3/15/2010 14:46	2023.7	1978.9	2143.9	39.6	43.0
3/15/2010 14:46	2029.5	1984.5	2184.4	39.6	43.3
3/15/2010 14:46	2060.2	1977.6	2220.2	39.6	43.7
3/15/2010 14:46	2048.2	1991.1	2315.0	39.9	44.1
3/15/2010 14:46	2052.9	2016.9	2031.8	39.7	43.9
3/15/2010 14:46	2047.5	2024.6	2058.3	39.7	44.2
3/15/2010 14:46	2065.6	2014.9	2220.2	39.7	44.4
3/15/2010 14:46	2083.3	2021.9	2206.1	39.7	44.8
3/15/2010 14:46	2105.1	2030.7	2209.3	39.7	44.8
3/15/2010 14:46	2117.7	2057.5	2416.2	39.7	45.3
3/15/2010 14:46	2110.5	2074.5	2110.3	40.1	46.0
3/15/2010 14:46	2086.7	2069.8	2260.6	40.1	46.2
3/15/2010 14:46	2109.4	2067.8	2179.3	40.1	46.4
3/15/2010 14:46	2108.3	2057.0	2196.6	40.1	46.8
3/15/2010 14:46	2116.8	2066.7	2199.3	40.1	46.9
3/15/2010 14:46	2111.9	2069.2	2107.4	39.9	47.5
3/15/2010 14:46	2124.5	2063.5	2188.2	40.1	47.7
3/15/2010 14:46	2111.9	2059.5	2177.3	39.9	48.0
3/15/2010 14:46	2120.2	2037.6	2237.8	40.1	48.2
3/15/2010 14:46	2106.9	2047.1	2070.2	40.1	48.2
3/15/2010 14:46	2104.9	2012.0	2232.6	40.1	48.4

3/15/2010 14:46	2088.7	1998.7	2210.4	40.1	48.6
3/15/2010 14:46	2051.8	1982.5	2114.5	40.3	48.6
3/15/2010 14:46	2067.1	1965.6	1997.0	40.3	48.6
3/15/2010 14:46	2089.4	1963.0	2104.8	40.6	48.7
3/15/2010 14:46	2097.1	1958.5	2176.7	40.6	49.1
3/15/2010 14:46	2100.7	1986.8	2128.0	40.8	48.9
3/15/2010 14:46	2114.1	1983.2	2138.1	41.0	49.1
3/15/2010 14:46	2123.4	1972.0	2134.5	41.0	48.9
3/15/2010 14:46	2123.1	1961.6	2183.0	41.2	48.9
3/15/2010 14:46	2134.8	1979.6	2241.9	41.2	48.9
3/15/2010 14:46	2141.8	1973.7	2187.6	41.2	48.9
3/15/2010 14:46	2156.0	1975.6	2244.8	41.4	48.9
3/15/2010 14:46	2158.9	1969.5	2165.5	41.5	49.1
3/15/2010 14:46	2152.4	1978.5	2503.3	41.5	49.3
3/15/2010 14:46	2148.8	1975.6	2226.9	41.5	49.3
3/15/2010 14:46	2138.7	1978.2	2206.6	41.5	49.3
3/15/2010 14:46	2138.5	1976.9	2194.5	41.5	49.3
3/15/2010 14:46	2144.1	1994.5	2213.5	41.5	49.3
3/15/2010 14:46	2158.5	2008.9	2168.4	41.4	49.3
3/15/2010 14:46	2152.9	2014.2	2237.7	41.2	49.3
3/15/2010 14:46	2157.6	2003.0	2238.8	41.2	49.3
3/15/2010 14:46	2160.1	2004.1	2210.2	41.4	49.5
3/15/2010 14:46	2164.3	2027.3	2157.4	41.4	49.5
3/15/2010 14:46	2149.9	2029.6	2235.2	41.5	49.3
3/15/2010 14:46	2143.6	2032.5	2160.9	41.5	49.3
3/15/2010 14:46	2163.9	2037.9	2262.9	41.5	49.3
3/15/2010 14:46	2174.0	2027.5	2288.5	41.5	49.3
3/15/2010 14:46	2161.6	2039.4	2204.3	41.7	49.3
3/15/2010 14:46	2149.5	2044.0	2175.8	41.7	49.1
3/15/2010 14:46	2158.5	2053.0	2283.9	41.9	49.1
3/15/2010 14:46	2178.3	2061.9	2274.9	41.9	49.1
3/15/2010 14:46	2172.7	2074.8	2193.3	41.9	49.1
3/15/2010 14:46	2168.6	2097.0	2267.9	42.1	49.1
3/15/2010 14:46	2178.5	2091.0	2205.4	41.9	48.9
3/15/2010 14:46	2176.5	2064.2	2263.7	42.1	48.9
3/15/2010 14:46	2172.4	2044.6	2160.5	42.1	48.9
3/15/2010 14:46	2164.6	2056.5	2211.9	42.1	48.9
3/15/2010 14:46	2169.5	2068.7	2208.4	42.1	48.7
3/15/2010 14:46	2180.5	2078.4	2237.6	42.1	48.7
3/15/2010 14:46	2178.5	2082.6	2236.4	42.1	48.6
3/15/2010 14:46	2184.3	2073.7	2169.8	42.1	48.6
3/15/2010 14:46	2185.7	2090.5	2182.5	42.1	48.6
3/15/2010 14:46	2171.1	2090.1	2308.2	42.1	48.4
3/15/2010 14:46	2181.2	2082.7	2299.3	42.1	48.4
3/15/2010 14:46	2184.3	2081.5	2231.6	42.1	48.0
3/15/2010 14:46	2176.2	2099.1	2254.7	42.1	48.0
3/15/2010 14:46	2174.0	2089.0	2325.6	42.1	48.0

3/15/2010 14:46	2183.0	2084.5	2278.2	42.1	48.0
3/15/2010 14:46	2171.8	2078.1	2195.8	42.1	48.2
3/15/2010 14:46	2182.5	2087.4	2240.3	42.1	48.4
3/15/2010 14:46	2190.9	2081.3	2196.5	42.3	48.4
3/15/2010 14:46	2196.5	2067.8	2278.2	42.3	48.4
3/15/2010 14:46	2184.3	2088.1	2263.4	42.3	48.4
3/15/2010 14:46	2189.7	2101.6	2217.7	42.3	48.4
3/15/2010 14:46	2186.4	2121.4	2247.5	42.3	48.2
3/15/2010 14:46	2180.5	2095.9	2229.9	42.4	48.0
3/15/2010 14:46	2201.2	2094.8	2238.7	42.4	48.0
3/15/2010 14:46	2206.0	2111.2	2229.3	42.6	47.8
3/15/2010 14:46	2198.3	2105.1	2237.6	42.8	47.7
3/15/2010 14:46	2205.7	2108.1	2176.4	43.0	47.7
3/15/2010 14:46	2207.7	2095.3	2292.5	43.0	47.7
3/15/2010 14:46	2193.6	2071.2	2263.0	43.0	47.5
3/15/2010 14:46	2192.2	2066.0	2265.6	43.0	47.5
3/15/2010 14:46	2189.8	2066.4	2252.6	43.0	47.3
3/15/2010 14:46	2170.2	2088.3	2229.2	43.2	47.1
3/15/2010 14:46	2177.2	2095.9	2307.0	43.2	46.8
3/15/2010 14:46	2185.7	2079.1	2208.2	43.2	46.8
3/15/2010 14:46	2183.7	2101.8	2193.3	43.0	46.6
3/15/2010 14:46	2185.2	2093.7	2226.3	43.0	46.6
3/15/2010 14:46	2169.5	2069.6	2162.2	43.0	46.6
3/15/2010 14:46	2181.7	2058.1	2321.4	43.0	46.6
3/15/2010 14:46	2174.7	2046.4	2240.2	43.0	46.6
3/15/2010 14:46	2181.9	2035.0	2194.7	43.0	46.6
3/15/2010 14:46	2190.2	2036.8	2264.7	43.0	46.6
3/15/2010 14:46	2202.4	2033.6	2287.0	43.2	46.6
3/15/2010 14:46	2201.2	2026.2	2301.4	43.0	46.6
3/15/2010 14:46	2197.0	2030.2	2217.0	43.0	46.8
3/15/2010 14:46	2209.3	2028.7	2215.3	43.0	46.6
3/15/2010 14:46	2216.3	2032.2	2216.2	43.0	46.8
3/15/2010 14:46	2209.3	2031.1	2192.0	43.0	46.8
3/15/2010 14:46	2201.2	2050.7	2267.8	43.0	46.9
3/15/2010 14:46	2205.7	2079.1	2302.0	43.2	46.9
3/15/2010 14:46	2209.8	2096.6	2259.2	43.3	47.1
3/15/2010 14:46	2202.3	2096.6	2233.9	43.3	47.3
3/15/2010 14:46	2195.8	2100.0	2234.9	43.3	47.3
3/15/2010 14:46	2185.9	2076.3	2200.9	43.3	47.3
3/15/2010 14:46	2189.5	2080.9	2234.8	43.3	47.3
3/15/2010 14:46	2186.6	2075.4	2306.0	43.3	47.5
3/15/2010 14:46	2205.7	2058.8	2272.9	43.3	47.3
3/15/2010 14:46	2193.8	2084.5	2221.3	43.3	47.3
3/15/2010 14:46	2191.3	2089.4	2290.7	43.3	47.1
3/15/2010 14:46	2172.4	2097.1	2249.4	43.3	47.1
3/15/2010 14:46	2182.8	2095.9	2242.5	43.3	47.1
3/15/2010 14:47	2174.7	2104.5	2225.9	43.3	47.1

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3/15/2010 14:47	2147.2	2128.6	2234.2	43.3	46.9
3/15/2010 14:47	2140.9	2131.2	2178.7	43.3	46.8
3/15/2010 14:47	2144.8	2120.9	2263.6	43.5	46.8
3/15/2010 14:47	2134.6	2107.2	2233.2	43.7	46.8
3/15/2010 14:47	2136.2	2084.4	2304.9	43.7	46.6
3/15/2010 14:47	2154.9	2091.9	2367.7	43.7	46.6
3/15/2010 14:47	2153.1	2105.6	2259.0	43.7	46.6
3/15/2010 14:47	2143.9	2113.0	2219.2	43.7	46.4
3/15/2010 14:47	2141.8	2096.8	2363.1	43.9	46.4
3/15/2010 14:47	2149.5	2072.5	2245.7	43.7	46.2
3/15/2010 14:47	2143.4	2060.1	2187.6	43.7	46.2
3/15/2010 14:47	2142.9	2053.6	2195.9	43.7	46.0
3/15/2010 14:47	2133.1	2041.2	2185.6	43.7	46.0
3/15/2010 14:47	2126.3	2061.1	2234.2	43.7	46.0
3/15/2010 14:47	2121.6	2084.9	2275.4	43.3	45.7
3/15/2010 14:47	2146.8	2094.1	2309.6	43.3	45.5
3/15/2010 14:47	2149.2	2094.6	2238.7	43.3	45.3
3/15/2010 14:47	2146.6	2084.9	2218.2	43.0	45.0
3/15/2010 14:47	2144.8	2066.4	2203.6	43.0	45.0
3/15/2010 14:47	2149.9	2059.7	2254.4	43.2	45.1
3/15/2010 14:47	2141.4	2054.3	2271.9	43.0	44.8
3/15/2010 14:47	2149.9	2039.5	2157.0	43.0	44.8
3/15/2010 14:47	2145.2	2038.6	2225.2	43.0	44.8
3/15/2010 14:47	2136.0	2047.3	2274.7	42.8	44.8
3/15/2010 14:47	2136.6	2067.8	2216.2	42.8	44.6
3/15/2010 14:47	2140.7	2087.8	2158.4	42.6	44.2
3/15/2010 14:47	2149.9	2088.7	2220.0	42.4	44.2
3/15/2010 14:47	2143.8	2077.7	2198.3	42.3	44.1
3/15/2010 14:47	2149.2	2053.0	2270.6	42.3	43.9
3/15/2010 14:47	2161.0	2037.0	2321.1	42.3	43.9
3/15/2010 14:47	2160.0	2036.1	2262.3	42.3	44.1
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3/15/2010 14:47	2164.5	2022.3	2255.8	42.1	44.2
3/15/2010 14:47	2160.5	2039.0	2158.5	42.1	44.2
3/15/2010 14:47	2151.1	2050.0	2181.5	42.1	44.2
3/15/2010 14:47	2152.8	2027.8	2209.4	41.9	44.2
3/15/2010 14:47	2160.1	2018.5	2191.6	41.9	44.2
3/15/2010 14:47	2161.4	2034.1	2229.3	41.7	44.1
3/15/2010 14:47	2152.4	2044.6	2251.4	41.7	44.1
3/15/2010 14:47	2147.9	2039.4	2168.5	41.7	44.1
3/15/2010 14:47	2145.9	2052.9	2175.4	41.7	44.1
3/15/2010 14:47	2155.5	2055.4	2260.9	41.5	44.1
3/15/2010 14:47	2150.2	2029.3	2266.1	41.5	43.9
3/15/2010 14:47	2143.2	2023.3	2151.2	41.5	43.9

3/15/2010 14:47	2145.2	2034.0	2240.8	41.5	43.9
3/15/2010 14:47	2151.3	2009.8	2258.1	41.5	43.9
3/15/2010 14:47	2152.4	2003.5	2242.9	41.5	43.7
3/15/2010 14:47	2145.9	1986.8	2176.0	41.4	43.9
3/15/2010 14:47	2131.9	1986.8	2185.9	41.2	43.7
3/15/2010 14:47	2145.0	2004.6	2191.2	41.2	43.7
3/15/2010 14:47	2137.3	2011.6	2298.6	41.2	43.9
3/15/2010 14:47	2148.8	1999.4	2304.5	41.2	43.9
3/15/2010 14:47	2158.5	2018.5	2239.0	41.2	44.1
3/15/2010 14:47	2166.4	2030.2	2392.9	41.2	44.1
3/15/2010 14:47	2169.5	2038.5	2227.7	41.2	44.1
3/15/2010 14:47	2151.0	2048.4	2213.2	41.0	44.2
3/15/2010 14:47	2158.7	2042.6	2199.4	41.0	44.2
3/15/2010 14:47	2156.4	2015.2	2233.8	41.0	44.2
3/15/2010 14:47	2140.5	2002.1	2188.1	41.0	44.2
3/15/2010 14:47	2138.2	1993.6	2245.5	41.0	44.4
3/15/2010 14:47	2147.4	1985.4	2318.8	41.0	44.4
3/15/2010 14:47	2140.0	1997.6	2136.8	41.0	44.6
3/15/2010 14:47	2154.4	2031.3	2177.0	41.0	45.1
3/15/2010 14:47	2163.0	2046.7	2226.5	41.0	45.1
3/15/2010 14:47	2152.4	2036.7	2207.6	41.2	45.3
3/15/2010 14:47	2140.0	2014.0	2127.0	41.2	45.3
3/15/2010 14:47	2129.7	2001.0	2213.0	41.0	45.3
3/15/2010 14:47	2134.2	1989.0	2260.7	41.0	45.3
3/15/2010 14:47	2144.8	1991.7	2210.7	41.0	45.5
3/15/2010 14:47	2142.5	2011.3	2269.9	41.2	45.5
3/15/2010 14:47	2145.4	2040.8	2212.0	41.2	45.7
3/15/2010 14:47	2143.4	2069.2	2141.0	41.2	45.7
3/15/2010 14:47	2136.0	2066.5	2268.1	41.2	45.7
3/15/2010 14:47	2152.8	2048.9	2187.4	41.2	45.7
3/15/2010 14:47	2162.5	2055.9	2341.0	41.2	45.9
3/15/2010 14:47	2164.5	2084.0	2271.3	41.2	45.9
3/15/2010 14:47	2161.0	2099.5	2281.5	41.4	46.0
3/15/2010 14:47	2167.3	2089.8	2174.7	41.5	45.9
3/15/2010 14:47	2182.1	2068.5	2273.4	41.5	45.9
3/15/2010 14:47	2178.9	2063.8	2184.6	41.5	45.7
3/15/2010 14:47	2163.2	2049.3	2150.7	41.5	45.7
3/15/2010 14:47	2153.1	2048.2	2217.0	41.5	45.7
3/15/2010 14:47	2163.6	2057.2	2253.2	41.2	45.9
3/15/2010 14:47	2156.4	2038.6	2238.6	41.2	46.0
3/15/2010 14:47	2140.0	2014.7	2136.7	41.2	46.0
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3/15/2010 14:47	2139.3	2007.3	2281.7	41.2	46.2
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3/15/2010 14:47	2194.9	2060.8	2217.7	41.0	45.7
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3/15/2010 14:47	2172.7	2004.3	2261.8	41.2	45.5
3/15/2010 14:47	2175.1	2013.1	2266.0	41.4	45.5
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3/15/2010 14:47	2161.4	2031.3	2314.0	41.2	45.7
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3/15/2010 14:48	2175.8	2018.8	2357.8	41.2	45.7
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3/15/2010 14:48	2169.9	1988.4	2244.7	41.0	45.7
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3/15/2010 14:48	2194.3	1988.4	2122.3	41.4	47.1
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3/15/2010 14:48	2166.6	1985.2	2130.6	41.5	47.5
3/15/2010 14:48	2166.3	1964.1	2241.1	41.2	47.5
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3/15/2010 14:48	2184.4	2010.2	2296.2	41.0	47.5
3/15/2010 14:48	2184.3	2055.4	2172.7	41.0	47.5
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3/15/2010 14:48	1976.9	1962.9	2210.9	41.0	46.8
3/15/2010 14:48	1937.5	1970.6	2134.3	41.0	46.8
3/15/2010 14:48	1892.7	1960.9	1927.2	41.0	46.6
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3/15/2010 14:48	1847.7	1964.8	1863.5	41.0	46.4
3/15/2010 14:48	1843.0	1957.6	2082.4	41.0	46.4
3/15/2010 14:48	1819.2	1943.2	2074.6	41.0	46.6
3/15/2010 14:48	1819.4	1927.4	1882.1	40.8	46.6
3/15/2010 14:48	1798.3	1911.9	2485.2	40.8	46.8
3/15/2010 14:48	1765.8	1905.8	2501.7	40.8	46.8
3/15/2010 14:48	1753.5	1900.9	2159.2	40.8	46.8
3/15/2010 14:48	1767.6	1890.9	2510.0	40.6	46.8
3/15/2010 14:48	1755.3	1873.0	2172.4	40.8	46.8
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3/15/2010 14:48	1740.7	1892.3	2095.9	40.8	46.9
3/15/2010 14:48	1701.5	1909.9	2502.0	40.8	46.9
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3/15/2010 14:48	1728.9	1953.0	2455.5	41.0	46.8
3/15/2010 14:48	1753.5	1990.8	2502.2	41.0	46.8
3/15/2010 14:48	1763.4	2016.3	2502.1	41.0	46.8
3/15/2010 14:48	1749.0	1988.6	2114.2	41.0	46.9
3/15/2010 14:48	1719.0	2003.4	1831.0	41.0	46.9
3/15/2010 14:48	1709.4	2008.0	2100.0	41.0	46.6
3/15/2010 14:48	1676.5	2023.3	2459.2	41.0	46.4

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3/15/2010 14:48	1646.6	2039.7	2272.4	41.0	46.0
3/15/2010 14:48	1635.3	2032.5	1742.9	41.0	45.7
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3/15/2010 14:48	1562.9	1930.5	1720.8	41.0	45.7
3/15/2010 14:48	1583.2	1935.5	1957.3	41.0	45.7
3/15/2010 14:48	1552.5	1910.1	2305.3	41.0	45.7
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3/15/2010 14:48	1469.5	1889.6	2089.5	41.0	45.3
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3/15/2010 14:48	1417.6	1882.9	2442.9	41.0	45.1
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3/15/2010 14:48	1611.5	1918.4	2502.2	40.8	44.2
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3/15/2010 14:48	1612.6	1935.5	2281.8	40.6	44.2
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3/15/2010 14:48	1634.2	1957.8	2501.9	40.6	44.2
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3/15/2010 14:49	1663.0	1929.2	1935.6	40.6	44.4
3/15/2010 14:49	1667.7	1929.4	2304.2	40.8	44.4
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3/15/2010 14:49	1834.9	2078.8	2161.0	40.1	43.3
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3/15/2010 14:49	1834.3	2071.4	1833.8	40.1	43.7
3/15/2010 14:49	1831.3	2077.0	2072.9	40.3	43.5
3/15/2010 14:49	1861.0	2060.2	2034.8	40.1	43.5
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3/15/2010 14:49	1842.6	2013.8	1607.0	40.1	43.3
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3/15/2010 14:49	1710.5	1904.9	1515.1	39.9	43.0
3/15/2010 14:49	1667.3	1861.3	1485.6	39.9	43.0
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3/15/2010 14:49	1596.2	1778.0	1428.8	39.7	43.0
3/15/2010 14:49	1568.5	1740.0	1403.2	39.7	43.0
3/15/2010 14:49	1542.9	1703.7	1380.3	39.7	43.0
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3/15/2010 14:49	1492.7	1638.9	1317.3	39.7	42.8
3/15/2010 14:49	1469.3	1606.8	1305.1	39.7	42.8
3/15/2010 14:49	1446.3	1580.5	1280.7	39.7	42.4
3/15/2010 14:49	1424.5	1557.3	1260.5	39.7	42.4
3/15/2010 14:49	1404.5	1531.6	1238.1	39.7	42.4
3/15/2010 14:49	1383.8	1503.7	1217.8	39.7	42.4
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3/15/2010 14:49	1345.6	1446.3	1172.2	39.7	42.4
3/15/2010 14:49	1327.5	1403.2	1139.4	39.9	42.8
3/15/2010 14:49	1301.9	1375.7	1115.2	40.1	42.8
3/15/2010 14:49	1276.9	1361.7	1080.4	40.1	43.0
3/15/2010 14:49	1245.9	1349.1	1064.1	40.1	43.3
3/15/2010 14:49	1220.7	1326.2	1048.0	40.3	43.5
3/15/2010 14:49	1202.4	1292.7	1031.1	40.1	43.5
3/15/2010 14:49	1182.7	1267.5	1019.2	40.3	43.7
3/15/2010 14:49	1165.5	1241.4	1007.2	40.5	43.9
3/15/2010 14:49	1152.0	1217.8	993.2	40.5	43.9
3/15/2010 14:49	1140.6	1192.6	982.1	40.5	44.1
3/15/2010 14:49	1127.3	1168.9	970.7	40.5	44.1
3/15/2010 14:49	1115.8	1153.4	951.6	40.8	44.2
3/15/2010 14:49	1102.6	1128.4	940.1	41.0	44.2
3/15/2010 14:49	1089.7	1104.6	914.3	41.0	44.2
3/15/2010 14:49	1078.2	1084.5	913.0	41.2	44.2
3/15/2010 14:49	1063.9	1064.7	893.1	41.2	44.4
3/15/2010 14:49	1051.5	1048.3	876.6	41.4	44.4
3/15/2010 14:49	1038.2	1029.2	866.9	41.4	44.4
3/15/2010 14:49	1028.8	1012.3	859.9	41.5	44.4
3/15/2010 14:49	1020.9	1005.1	855.6	41.5	44.4
3/15/2010 14:49	1013.0	1003.8	846.1	41.5	44.4
3/15/2010 14:49	1004.2	1002.7	840.9	41.5	44.4
3/15/2010 14:49	995.0	995.0	837.3	41.7	44.4
3/15/2010 14:49	986.7	991.0	831.7	41.9	44.4
3/15/2010 14:49	978.8	984.9	822.4	42.1	44.4
3/15/2010 14:49	969.1	976.8	824.1	42.1	44.4
3/15/2010 14:49	959.2	969.1	809.1	42.1	44.2

3/15/2010 14:49	949.1	964.2	794.1	42.1	43.9
3/15/2010 14:49	930.9	957.6	789.6	42.1	43.7
3/15/2010 14:49	912.0	953.4	786.0	42.1	43.3
3/15/2010 14:49	901.6	950.0	786.1	42.1	43.3
3/15/2010 14:49	895.5	944.1	772.0	42.1	43.0
3/15/2010 14:49	890.4	939.0	786.6	42.1	42.8
3/15/2010 14:49	885.4	926.1	780.3	42.1	42.8
3/15/2010 14:49	878.7	915.3	787.5	42.1	42.8
3/15/2010 14:49	872.1	903.4	781.2	42.1	42.4
3/15/2010 14:49	865.4	897.6	792.1	42.1	42.4
3/15/2010 14:49	859.8	890.4	784.4	42.1	42.4
3/15/2010 14:49	850.1	881.8	789.3	42.1	42.4
3/15/2010 14:49	836.8	876.0	799.3	41.9	42.4
3/15/2010 14:49	828.7	872.6	799.9	41.9	42.4
3/15/2010 14:49	818.6	864.1	812.3	41.9	42.4
3/15/2010 14:49	806.2	857.7	808.8	41.9	42.4
3/15/2010 14:49	798.3	847.6	824.8	41.7	42.4
3/15/2010 14:49	790.7	842.0	842.7	41.7	42.4
3/15/2010 14:49	781.5	834.8	851.9	41.7	42.4
3/15/2010 14:49	773.8	829.9	832.7	41.5	42.4
3/15/2010 14:49	768.9	820.9	834.3	41.5	42.3
3/15/2010 14:49	762.8	819.5	867.4	41.5	42.3
3/15/2010 14:49	757.2	812.5	856.5	41.5	42.4
3/15/2010 14:49	752.0	800.4	859.0	41.5	42.3
3/15/2010 14:49	743.5	794.1	863.4	41.5	42.4
3/15/2010 14:49	735.4	783.1	884.8	41.5	42.4
3/15/2010 14:49	727.0	778.1	909.8	41.5	42.4
3/15/2010 14:49	718.5	775.2	933.5	41.5	42.4
3/15/2010 14:49	704.1	768.2	931.8	41.4	42.3
3/15/2010 14:49	696.0	761.4	925.6	41.5	42.3
3/15/2010 14:50	690.6	752.0	660.0	41.4	42.3
3/15/2010 14:50	685.0	744.4	855.3	41.4	42.3
3/15/2010 14:50	681.3	744.1	659.9	41.4	42.3
3/15/2010 14:50	676.2	742.8	659.6	41.2	42.1
3/15/2010 14:50	671.7	740.5	659.6	41.2	42.1
3/15/2010 14:50	666.7	738.0	659.9	41.2	42.1
3/15/2010 14:50	660.7	730.2	659.9	41.0	42.1
3/15/2010 14:50	654.8	729.1	659.9	41.0	42.1
3/15/2010 14:50	648.3	729.1	659.9	41.0	42.1
3/15/2010 14:50	640.8	726.4	659.9	41.0	42.1
3/15/2010 14:50	634.5	723.9	659.9	41.0	41.9
3/15/2010 14:50	629.4	718.2	660.0	41.0	41.9
3/15/2010 14:50	625.8	710.4	659.9	41.0	41.9
3/15/2010 14:50	622.6	707.0	659.8	41.0	41.9
3/15/2010 14:50	618.4	703.2	659.8	41.0	41.9
3/15/2010 14:50	614.3	698.9	659.8	41.0	41.9
3/15/2010 14:50	610.7	696.4	659.8	41.0	42.1

3/15/2010 14:50	605.6	691.5	659.8	41.0	42.1
3/15/2010 14:50	601.9	687.9	659.8	41.0	42.1
3/15/2010 14:50	598.3	684.5	659.8	41.0	42.1
3/15/2010 14:50	594.1	679.8	659.8	40.8	42.1
3/15/2010 14:50	588.4	671.4	659.8	40.8	42.1
3/15/2010 14:50	582.3	667.2	659.8	40.8	42.1
3/15/2010 14:50	578.5	658.8	659.8	40.8	42.1
3/15/2010 14:50	572.4	657.7	659.8	40.6	42.1
3/15/2010 14:50	564.3	654.1	659.9	40.8	42.1
3/15/2010 14:50	560.7	651.6	659.8	40.6	42.1
3/15/2010 14:50	555.3	647.8	659.8	40.6	42.1
3/15/2010 14:50	552.9	642.9	659.8	40.6	42.1
3/15/2010 14:50	548.8	642.0	659.8	40.6	42.1
3/15/2010 14:50	542.3	641.5	659.8	40.6	42.1
3/15/2010 14:50	537.3	641.1	659.8	40.5	41.9
3/15/2010 14:50	532.4	638.6	659.8	40.5	42.1
3/15/2010 14:50	530.1	633.2	659.8	40.5	42.1
3/15/2010 14:50	527.9	627.1	659.9	40.5	42.1
3/15/2010 14:50	525.7	622.8	659.9	40.5	42.1
3/15/2010 14:50	523.6	613.8	659.9	40.5	42.1
3/15/2010 14:50	521.8	610.7	659.9	40.5	42.1
3/15/2010 14:50	519.6	609.3	659.9	40.5	42.1
3/15/2010 14:50	516.2	608.0	659.9	40.5	42.1
3/15/2010 14:50	511.7	601.2	659.8	40.5	42.1
3/15/2010 14:50	503.2	599.0	659.8	40.5	42.1
3/15/2010 14:50	494.6	596.3	659.8	40.5	42.1
3/15/2010 14:50	484.5	594.9	659.8	40.5	42.1
3/15/2010 14:50	475.7	594.1	659.9	40.5	42.1
3/15/2010 14:50	469.0	592.3	659.9	40.5	42.1
3/15/2010 14:50	460.9	590.5	659.9	40.5	41.9
3/15/2010 14:50	454.6	588.7	659.9	40.5	41.9
3/15/2010 14:50	449.4	582.8	659.9	40.5	41.9
3/15/2010 14:50	445.1	581.0	659.9	40.5	41.9
3/15/2010 14:50	440.4	577.9	659.9	40.5	41.9
3/15/2010 14:50	437.0	576.9	659.9	40.5	41.9
3/15/2010 14:50	431.6	573.4	660.0	40.5	41.9
3/15/2010 14:50	428.7	568.8	659.9	40.3	41.7
3/15/2010 14:50	423.3	564.6	659.9	40.3	41.5
3/15/2010 14:50	421.9	561.0	659.9	40.3	41.5
3/15/2010 14:50	421.5	557.6	659.9	40.3	41.5
3/15/2010 14:50	419.7	554.5	659.9	40.3	41.5
3/15/2010 14:50	419.4	548.8	659.9	40.5	41.7
3/15/2010 14:50	416.7	546.1	659.9	40.5	41.7
3/15/2010 14:50	414.1	542.3	659.9	40.6	41.9
3/15/2010 14:50	413.2	537.1	659.9	40.5	41.9
3/15/2010 14:50	411.1	535.8	659.9	40.5	41.9
3/15/2010 14:50	403.7	532.6	659.9	40.5	41.9

3/15/2010 14:50	396.0	528.6	660.0	40.5	41.5
3/15/2010 14:50	389.3	521.4	659.9	40.5	41.5
3/15/2010 14:50	382.1	514.4	659.9	40.3	41.7
3/15/2010 14:50	375.6	510.4	659.9	40.3	41.9
3/15/2010 14:50	370.9	505.9	659.9	40.3	41.9
3/15/2010 14:50	367.7	503.8	659.9	40.3	42.1
3/15/2010 14:50	364.1	503.8	659.9	40.3	42.1
3/15/2010 14:50	362.7	503.2	659.9	40.1	42.1
3/15/2010 14:50	363.0	501.6	659.9	40.1	42.1
3/15/2010 14:50	362.8	498.9	659.8	40.1	42.1
3/15/2010 14:50	361.6	496.2	659.8	40.1	42.1
3/15/2010 14:50	361.2	493.0	659.8	39.7	41.9
3/15/2010 14:50	360.1	488.9	659.8	39.7	41.9
3/15/2010 14:50	358.9	485.1	659.8	39.7	42.1
3/15/2010 14:50	356.7	479.3	659.9	39.7	42.1
3/15/2010 14:50	353.3	473.7	659.9	39.7	42.1
3/15/2010 14:50	351.3	471.0	659.9	39.7	42.1
3/15/2010 14:50	346.6	468.1	659.9	39.7	41.9
3/15/2010 14:50	346.5	465.3	659.8	39.7	41.9
3/15/2010 14:50	345.4	463.6	659.9	39.7	41.9
3/15/2010 14:50	344.7	462.6	659.8	39.7	41.9
3/15/2010 14:50	343.6	460.4	659.8	39.6	41.9
3/15/2010 14:50	342.5	457.5	659.8	39.7	41.9
3/15/2010 14:50	340.3	453.9	659.8	39.7	41.9
3/15/2010 14:50	338.4	449.4	659.8	39.7	41.9
3/15/2010 14:50	336.9	447.6	659.9	39.7	41.7
3/15/2010 14:50	331.9	446.4	659.8	39.7	41.7
3/15/2010 14:50	330.1	443.1	659.9	39.7	41.7
3/15/2010 14:50	329.4	442.6	659.9	39.7	41.7
3/15/2010 14:50	326.3	440.8	659.9	39.7	41.9
3/15/2010 14:50	322.7	437.0	659.9	39.7	41.9
3/15/2010 14:50	318.9	431.4	659.9	39.7	41.7
3/15/2010 14:50	317.1	425.7	659.9	39.7	41.7
3/15/2010 14:50	315.1	422.2	659.9	39.7	41.7
3/15/2010 14:50	313.9	418.3	659.9	39.7	41.7
3/15/2010 14:50	311.7	415.4	659.9	39.7	41.7
3/15/2010 14:50	308.5	413.1	659.8	39.7	41.5
3/15/2010 14:50	307.6	412.5	659.8	39.7	41.5
3/15/2010 14:50	305.1	410.4	659.8	39.7	41.5
3/15/2010 14:50	302.9	408.9	659.8	39.7	41.5
3/15/2010 14:50	302.9	407.5	659.8	39.7	41.7
3/15/2010 14:50	302.4	406.4	659.8	39.7	41.7
3/15/2010 14:50	301.1	407.3	659.9	39.7	41.9
3/15/2010 14:50	300.6	405.0	659.9	39.7	41.9
3/15/2010 14:50	300.0	404.4	659.9	39.7	41.9
3/15/2010 14:50	298.8	404.6	659.9	39.7	41.9
3/15/2010 14:50	297.9	403.9	659.8	39.7	41.9

3/15/2010 14:50	296.4	400.6	659.8	39.7	41.9
3/15/2010 14:50	295.2	397.4	659.8	39.7	41.9
3/15/2010 14:50	292.1	394.3	659.8	39.7	41.9
3/15/2010 14:50	291.4	393.8	659.8	39.9	42.1
3/15/2010 14:50	291.2	392.4	659.9	39.9	42.1
3/15/2010 14:50	290.3	390.0	659.8	40.1	42.1
3/15/2010 14:50	289.2	388.6	659.9	40.1	42.1
3/15/2010 14:50	288.5	387.1	659.9	40.1	42.1
3/15/2010 14:50	286.3	385.2	659.9	40.1	42.1

Vendor	GRAPHTEC Corporation	
Model	GL800	
Version	Ver1.62	
Sampling interval	500ms	
Total data points	2988.0	
Start time	40253.0	0.6
End time	40253.0	0.6
Trigger time	40253.0	0.6

Date&Time	Burner 1 Type K Thermocouple °F	Burner 3 Type K Thermocouple °F	Pyrometer - West Side °F	Thermocouple behind rear wall °F	Thermocouple behind rear wall °F
3/16/2010 14:13	48.4	46.8	660.0	45.0	45.7
3/16/2010 14:13	48.6	46.9	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.9
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.9
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.9
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.0	45.7
3/16/2010 14:13	48.4	47.1	660.0	45.0	45.5
3/16/2010 14:13	48.4	47.1	660.1	45.0	45.5
3/16/2010 14:13	48.4	47.1	660.0	44.8	45.5
3/16/2010 14:13	48.6	47.1	660.0	44.8	45.5
3/16/2010 14:13	48.6	47.1	660.1	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	660.1	45.1	45.7
3/16/2010 14:13	48.6	47.1	659.9	45.0	45.7
3/16/2010 14:13	48.7	47.1	660.0	45.1	45.7
3/16/2010 14:13	48.6	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.6	47.1	659.9	45.0	45.7
3/16/2010 14:13	48.6	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.4	47.1	659.9	44.8	45.7

3/16/2010 14:13	48.4	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.6	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.6	47.1	660.0	44.8	45.7
3/16/2010 14:13	48.6	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.6	47.1	660.0	44.8	45.7
3/16/2010 14:13	48.6	47.1	660.0	44.8	45.7
3/16/2010 14:13	48.6	47.1	659.9	44.8	45.7
3/16/2010 14:13	48.6	47.1	660.0	45.0	45.7
3/16/2010 14:13	48.6	47.1	660.0	44.8	45.9
3/16/2010 14:13	48.6	47.1	660.0	45.0	45.9
3/16/2010 14:13	48.6	47.1	660.0	45.0	45.9
3/16/2010 14:13	48.6	47.1	660.1	45.0	46.0
3/16/2010 14:13	48.6	47.1	660.0	45.1	46.0
3/16/2010 14:13	48.6	47.1	660.1	45.1	46.0
3/16/2010 14:13	48.6	47.1	660.0	45.1	46.0
3/16/2010 14:13	48.6	47.1	660.1	45.0	46.0
3/16/2010 14:13	48.6	47.1	660.0	45.0	46.0
3/16/2010 14:13	48.6	47.1	659.9	45.0	46.0
3/16/2010 14:13	48.6	47.1	660.0	44.8	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	47.1	660.0	44.8	46.0
3/16/2010 14:13	48.4	46.9	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.9	660.0	44.6	46.0
3/16/2010 14:13	48.6	46.9	660.0	44.6	46.0
3/16/2010 14:13	48.4	46.9	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.9	660.0	44.6	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	47.1	659.9	44.8	46.0
3/16/2010 14:13	48.6	46.9	660.0	44.8	46.0
3/16/2010 14:13	48.6	46.9	659.9	44.8	46.0
3/16/2010 14:13	48.6	46.9	659.9	44.8	46.2
3/16/2010 14:13	48.6	47.1	660.0	44.8	46.0
3/16/2010 14:13	48.6	46.9	659.9	44.8	46.0
3/16/2010 14:13	48.6	46.9	659.9	44.8	46.0
3/16/2010 14:13	48.6	46.9	660.0	44.8	46.2
3/16/2010 14:13	48.4	46.9	660.0	44.8	46.2
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.6	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.6	46.0
3/16/2010 14:13	48.6	46.8	660.0	44.6	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0

3/16/2010 14:13	48.4	46.8	660.0	44.6	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.6	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.8	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.8	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.8	46.0
3/16/2010 14:13	48.4	46.8	659.9	44.8	46.0
3/16/2010 14:13	48.4	46.8	660.0	44.8	46.0
3/16/2010 14:13	48.4	46.6	659.9	44.8	46.2
3/16/2010 14:13	48.4	46.6	660.0	44.8	46.2
3/16/2010 14:13	48.4	46.6	660.0	45.0	46.2
3/16/2010 14:13	48.4	46.6	659.9	45.0	46.2
3/16/2010 14:13	48.4	46.6	660.0	45.0	46.2
3/16/2010 14:13	48.4	46.6	659.9	45.1	46.2
3/16/2010 14:13	48.4	46.6	659.9	45.1	46.2
3/16/2010 14:13	48.4	46.6	660.0	45.1	46.0
3/16/2010 14:13	48.4	46.6	660.0	45.1	46.0
3/16/2010 14:13	48.4	46.6	660.0	45.1	46.0
3/16/2010 14:13	48.6	46.6	660.0	45.1	46.0
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3/16/2010 14:13	48.4	46.6	660.0	44.8	45.9
3/16/2010 14:13	48.4	46.6	660.0	44.8	45.9
3/16/2010 14:13	48.4	46.6	659.9	44.8	45.9
3/16/2010 14:13	49.3	46.6	660.0	44.8	45.9
3/16/2010 14:13	49.6	46.6	659.9	44.8	45.9
3/16/2010 14:13	50.5	46.6	660.0	44.6	45.9
3/16/2010 14:13	51.3	46.8	660.0	44.8	46.0
3/16/2010 14:13	51.6	46.8	659.9	44.8	45.9
3/16/2010 14:13	52.3	46.8	659.9	44.8	46.0
3/16/2010 14:13	55.8	46.8	659.9	44.8	45.9
3/16/2010 14:13	56.3	46.8	659.9	44.8	45.9
3/16/2010 14:13	56.5	46.8	660.0	44.8	46.0
3/16/2010 14:13	57.0	46.8	660.0	45.0	46.0
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3/16/2010 14:13	57.7	46.6	659.9	45.1	46.0
3/16/2010 14:13	58.1	46.6	660.0	45.1	46.0
3/16/2010 14:13	58.3	46.6	660.0	45.1	46.0
3/16/2010 14:13	58.8	46.6	660.1	45.1	46.0
3/16/2010 14:13	59.2	46.6	660.1	45.3	46.0
3/16/2010 14:13	59.4	46.6	660.0	45.5	46.0
3/16/2010 14:14	59.7	46.6	660.0	45.5	46.0
3/16/2010 14:14	75.0	46.8	2501.3	45.7	46.0
3/16/2010 14:14	182.8	117.5	2501.6	45.3	46.0
3/16/2010 14:14	267.4	188.4	2501.7	45.3	46.2
3/16/2010 14:14	332.2	184.6	2501.9	45.5	46.2
3/16/2010 14:14	394.9	180.0	2501.9	45.7	46.4
3/16/2010 14:14	457.5	177.3	2505.2	45.7	46.6

3/16/2010 14:14	521.8	188.1	2250.1	45.9	46.8
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3/16/2010 14:14	669.6	315.9	2266.2	46.2	46.9
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3/16/2010 14:14	1556.4	2025.7	2076.9	45.9	47.5

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3/16/2010 14:14	1704.7	2207.1	1971.0	46.0	47.5
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3/16/2010 14:14	1717.0	2208.0	1957.1	46.2	47.3
3/16/2010 14:14	1720.0	2208.6	2005.8	46.2	47.3
3/16/2010 14:14	1720.9	2200.3	1953.4	46.2	47.3
3/16/2010 14:14	1721.3	2192.4	1997.5	46.4	47.3
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3/16/2010 14:14	1722.7	2176.7	2106.0	46.4	47.5
3/16/2010 14:14	1723.1	2174.7	2023.8	46.4	47.5
3/16/2010 14:14	1725.6	2186.1	2021.5	46.4	47.5
3/16/2010 14:14	1729.0	2187.7	2054.7	46.4	47.5
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3/16/2010 14:14	1732.5	2195.4	1950.7	46.4	47.7
3/16/2010 14:14	1733.4	2186.4	1988.4	46.4	47.7
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3/16/2010 14:15	1693.9	2157.1	2137.3	47.3	47.7
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3/16/2010 14:15	1706.0	2149.9	1917.5	47.7	49.8
3/16/2010 14:15	1709.6	2133.9	2305.3	47.7	49.6
3/16/2010 14:15	1702.2	2136.4	2199.9	47.7	49.6
3/16/2010 14:15	1692.1	2149.7	2342.9	47.5	49.6
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3/16/2010 14:15	1697.9	2183.7	2311.2	47.8	50.7
3/16/2010 14:15	1692.5	2171.1	2144.1	48.0	50.5
3/16/2010 14:15	1682.6	2165.2	2507.5	48.0	50.4
3/16/2010 14:15	1670.4	2154.2	2298.8	48.0	50.2
3/16/2010 14:15	1664.8	2140.0	1920.7	48.0	50.2
3/16/2010 14:15	1667.1	2123.6	2050.4	48.0	50.2
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3/16/2010 14:15	1666.9	2068.7	2445.6	48.0	49.8
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3/16/2010 14:15	1647.1	2031.8	1906.7	47.8	49.6
3/16/2010 14:15	1641.7	2048.5	2209.6	47.8	49.6
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3/16/2010 14:15	1635.4	2095.5	2344.9	47.8	49.5
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3/16/2010 14:15	1641.6	2137.5	1879.2	47.8	49.5
3/16/2010 14:15	1645.2	2150.8	2407.1	47.8	49.5
3/16/2010 14:15	1647.3	2128.6	2432.4	48.0	49.5
3/16/2010 14:15	1645.2	2138.0	1961.2	48.0	49.6
3/16/2010 14:15	1650.7	2113.2	2075.1	48.0	49.6
3/16/2010 14:15	1656.5	2103.6	2303.5	47.8	49.5
3/16/2010 14:15	1664.4	2071.8	2339.2	47.7	49.5
3/16/2010 14:15	1672.3	2071.8	2228.7	47.7	49.3
3/16/2010 14:15	1677.2	2028.2	2104.2	47.7	49.3
3/16/2010 14:15	1683.3	2019.7	2225.9	47.7	49.3
3/16/2010 14:15	1684.9	2017.2	2060.7	47.7	49.5
3/16/2010 14:15	1687.5	2010.9	2200.7	47.7	49.3
3/16/2010 14:15	1690.0	2008.8	2292.2	47.7	49.3
3/16/2010 14:15	1690.2	2037.6	2146.5	47.7	49.3
3/16/2010 14:15	1696.8	2055.0	2138.8	47.7	49.3
3/16/2010 14:15	1699.7	2078.4	2277.2	47.7	49.3
3/16/2010 14:15	1701.9	2072.8	2006.0	47.7	49.1
3/16/2010 14:16	1705.5	2081.8	2102.4	47.7	49.1
3/16/2010 14:16	1710.3	2100.6	1930.9	47.5	49.1

3/16/2010 14:16	1712.5	2119.5	1970.6	47.7	49.1
3/16/2010 14:16	1715.2	2124.0	1954.4	47.7	49.1
3/16/2010 14:16	1717.3	2127.7	2042.1	47.7	49.1
3/16/2010 14:16	1718.2	2121.4	1853.7	47.7	49.1
3/16/2010 14:16	1719.5	2128.3	2272.7	47.7	49.1
3/16/2010 14:16	1725.3	2149.0	1926.1	47.7	49.1
3/16/2010 14:16	1728.0	2164.1	1990.5	47.7	49.1
3/16/2010 14:16	1728.3	2176.7	2069.5	47.5	49.1
3/16/2010 14:16	1728.0	2184.4	2174.9	47.5	48.9
3/16/2010 14:16	1729.0	2190.2	2058.7	47.3	48.9
3/16/2010 14:16	1731.6	2189.8	2006.6	47.3	48.9
3/16/2010 14:16	1731.9	2192.5	2026.6	47.3	48.7
3/16/2010 14:16	1732.8	2198.7	2038.7	47.1	48.6
3/16/2010 14:16	1735.3	2203.3	2107.0	47.1	48.6
3/16/2010 14:16	1732.5	2202.4	2063.0	47.1	48.6
3/16/2010 14:16	1732.3	2197.6	2058.6	47.1	48.6
3/16/2010 14:16	1732.5	2195.2	2101.9	46.9	48.6
3/16/2010 14:16	1732.1	2197.0	2213.9	46.9	48.4
3/16/2010 14:16	1733.0	2199.6	2130.4	46.8	48.4
3/16/2010 14:16	1734.1	2204.6	2197.0	46.9	48.4
3/16/2010 14:16	1733.4	2207.8	2216.4	46.8	48.4
3/16/2010 14:16	1733.0	2205.5	1969.5	46.8	48.4
3/16/2010 14:16	1733.4	2205.3	1893.7	46.8	48.4
3/16/2010 14:16	1736.4	2204.1	1937.1	46.8	48.0
3/16/2010 14:16	1737.1	2206.4	2047.7	46.8	48.0
3/16/2010 14:16	1737.7	2212.3	1951.9	46.8	48.0
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3/16/2010 14:16	1739.5	2211.8	2051.4	46.8	48.4
3/16/2010 14:16	1739.8	2208.2	2155.3	46.8	48.4
3/16/2010 14:16	1737.7	2207.5	2042.9	46.8	48.4
3/16/2010 14:16	1735.9	2198.7	2043.6	46.8	48.4
3/16/2010 14:16	1736.2	2187.9	2050.8	46.9	48.6
3/16/2010 14:16	1732.1	2188.6	2123.4	46.9	48.6
3/16/2010 14:16	1732.3	2174.4	1997.5	46.8	48.4
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3/16/2010 14:16	1733.2	2186.8	2141.7	46.8	48.4
3/16/2010 14:16	1732.8	2191.8	1991.7	46.8	48.4
3/16/2010 14:16	1733.9	2185.5	2162.5	46.8	48.4
3/16/2010 14:16	1729.8	2188.9	2054.7	46.8	48.6
3/16/2010 14:16	1724.5	2192.5	2040.9	46.8	48.6
3/16/2010 14:16	1726.2	2177.4	2091.9	46.8	48.6
3/16/2010 14:16	1728.3	2162.8	1951.0	46.8	48.4
3/16/2010 14:16	1732.3	2155.3	1998.4	46.8	48.6
3/16/2010 14:16	1736.4	2148.8	2050.5	46.8	48.6
3/16/2010 14:16	1740.2	2153.1	1963.5	46.8	48.6
3/16/2010 14:16	1745.6	2156.2	1895.9	46.8	48.6
3/16/2010 14:16	1748.1	2152.6	2058.4	46.8	48.6

3/16/2010 14:16	1748.3	2158.5	1850.5	46.8	48.6
3/16/2010 14:16	1747.9	2145.0	1841.0	46.8	48.6
3/16/2010 14:16	1748.7	2142.1	1951.7	46.8	48.6
3/16/2010 14:16	1750.1	2137.5	2198.8	46.8	48.6
3/16/2010 14:16	1750.3	2138.2	2183.5	46.8	48.6
3/16/2010 14:16	1750.8	2142.5	1969.0	46.9	48.6
3/16/2010 14:16	1750.3	2145.0	1970.3	46.9	48.6
3/16/2010 14:16	1749.6	2143.2	1943.9	46.9	48.7
3/16/2010 14:16	1747.4	2152.9	2110.6	46.9	48.7
3/16/2010 14:16	1750.5	2139.6	1913.1	46.9	48.7
3/16/2010 14:16	1753.2	2107.2	2248.2	47.1	48.7
3/16/2010 14:16	1753.9	2112.6	2184.6	47.1	48.9
3/16/2010 14:16	1756.2	2126.1	1941.2	47.1	48.9
3/16/2010 14:16	1756.6	2132.8	2109.1	47.1	48.9
3/16/2010 14:16	1756.9	2142.7	2506.0	47.1	48.7
3/16/2010 14:16	1756.2	2165.0	2225.3	47.1	48.9
3/16/2010 14:16	1754.4	2177.8	1983.3	47.1	48.9
3/16/2010 14:16	1753.2	2178.5	1957.9	47.1	48.9
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3/16/2010 14:16	1753.9	2181.7	1970.4	47.1	48.9
3/16/2010 14:16	1755.0	2188.2	1872.3	46.9	48.9
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3/16/2010 14:16	1760.5	2154.6	2176.3	46.9	48.9
3/16/2010 14:16	1762.7	2114.4	2301.4	46.9	48.9
3/16/2010 14:16	1763.1	2100.2	1969.6	47.1	49.1
3/16/2010 14:16	1766.7	2054.7	2024.3	47.1	49.1
3/16/2010 14:16	1768.6	2018.5	2001.7	46.9	48.9
3/16/2010 14:16	1769.2	1979.2	2184.2	46.9	48.9
3/16/2010 14:16	1769.7	1986.3	1947.5	46.9	49.1
3/16/2010 14:16	1767.9	2011.8	2020.1	46.9	48.9
3/16/2010 14:16	1771.2	1970.6	1993.1	46.9	49.1
3/16/2010 14:16	1769.7	1942.7	1904.2	46.9	49.1
3/16/2010 14:16	1767.0	1933.2	1989.4	46.9	49.1
3/16/2010 14:16	1765.8	1888.7	2039.3	46.9	49.1
3/16/2010 14:16	1766.3	1928.3	2224.1	46.9	49.3
3/16/2010 14:16	1768.6	1968.6	2002.1	46.9	49.1
3/16/2010 14:16	1769.2	1969.7	1933.5	46.9	49.1
3/16/2010 14:16	1770.3	1974.7	1966.0	46.9	49.1
3/16/2010 14:16	1766.5	1937.8	2053.0	46.9	49.1
3/16/2010 14:16	1764.0	1953.3	2215.2	46.9	49.1
3/16/2010 14:16	1764.1	1964.3	2156.3	46.9	49.1
3/16/2010 14:16	1758.7	1986.8	2151.4	46.9	48.9
3/16/2010 14:16	1761.8	1976.0	1947.3	47.1	49.3
3/16/2010 14:16	1764.3	1976.2	1838.5	46.9	49.1
3/16/2010 14:16	1762.5	1983.2	1977.0	46.9	49.1
3/16/2010 14:16	1764.1	2004.3	2101.1	46.9	49.1

3/16/2010 14:16	1764.7	2028.0	2003.6	46.8	49.1
3/16/2010 14:16	1765.2	2053.6	2002.3	46.8	49.1
3/16/2010 14:16	1766.3	2072.1	1957.9	46.8	48.9
3/16/2010 14:16	1767.4	2082.0	2229.6	46.8	48.9
3/16/2010 14:16	1765.2	2086.7	1882.4	46.8	48.9
3/16/2010 14:16	1756.6	2111.7	2260.1	46.8	48.9
3/16/2010 14:16	1753.5	2126.8	2342.8	46.8	48.9
3/16/2010 14:16	1747.2	2142.1	2174.8	46.8	49.1
3/16/2010 14:16	1741.8	2148.3	2160.1	46.8	48.9
3/16/2010 14:16	1730.1	2148.4	2483.3	46.8	48.9
3/16/2010 14:16	1725.1	2142.5	2308.5	46.8	48.9
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3/16/2010 14:16	1733.9	2106.1	2022.2	46.8	48.9
3/16/2010 14:16	1737.0	2110.1	1908.5	46.6	48.9
3/16/2010 14:16	1731.2	2078.6	2256.0	46.6	48.7
3/16/2010 14:16	1724.7	2075.9	2021.7	46.6	48.7
3/16/2010 14:16	1722.2	2071.4	2134.3	46.4	48.7
3/16/2010 14:16	1701.1	2050.9	2147.7	46.6	48.6
3/16/2010 14:16	1672.9	2028.0	2245.6	46.6	48.6
3/16/2010 14:16	1666.2	2016.9	2502.3	46.6	48.7
3/16/2010 14:16	1644.4	1986.6	2445.5	46.6	48.6
3/16/2010 14:16	1629.9	1947.6	2165.4	46.6	48.7
3/16/2010 14:16	1610.2	1916.2	2288.1	46.6	48.6
3/16/2010 14:16	1593.5	1891.6	2520.6	46.6	48.6
3/16/2010 14:17	1587.6	1899.3	2182.5	46.8	48.7
3/16/2010 14:17	1578.7	1877.7	2452.4	46.8	48.6
3/16/2010 14:17	1567.6	1836.5	2502.3	46.6	48.6
3/16/2010 14:17	1551.4	1770.1	1910.6	46.6	48.6
3/16/2010 14:17	1539.1	1758.9	2502.3	46.6	48.6
3/16/2010 14:17	1530.0	1747.4	2502.3	46.6	48.6
3/16/2010 14:17	1522.6	1724.9	2199.9	46.6	48.6
3/16/2010 14:17	1526.5	1722.0	2502.4	46.6	48.6
3/16/2010 14:17	1530.7	1702.9	2038.3	46.6	48.6
3/16/2010 14:17	1536.3	1656.9	2320.5	46.6	48.6
3/16/2010 14:17	1543.5	1629.0	2107.9	46.6	48.4
3/16/2010 14:17	1548.1	1687.8	2392.1	46.6	48.4
3/16/2010 14:17	1548.9	1726.5	2502.4	46.8	48.4
3/16/2010 14:17	1549.8	1741.1	2506.8	46.8	48.6
3/16/2010 14:17	1548.5	1766.3	2066.4	46.8	48.4
3/16/2010 14:17	1557.0	1811.8	2298.4	46.8	48.4
3/16/2010 14:17	1571.5	1856.5	1997.5	46.6	48.4
3/16/2010 14:17	1574.2	1860.1	2371.8	46.8	48.4
3/16/2010 14:17	1578.9	1873.4	2488.4	46.8	48.4
3/16/2010 14:17	1576.9	1917.5	2096.7	46.8	48.4
3/16/2010 14:17	1583.6	1927.0	2162.7	46.8	48.4
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3/16/2010 14:17	1607.7	1948.8	2492.7	46.9	48.6

3/16/2010 14:17	1615.6	1947.7	2316.0	47.1	48.6
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3/16/2010 14:17	1634.5	1906.5	2502.4	47.1	48.7
3/16/2010 14:17	1630.2	1837.9	2392.2	47.1	48.7
3/16/2010 14:17	1627.2	1799.8	2502.5	47.1	48.6
3/16/2010 14:17	1625.9	1820.7	1960.1	47.1	48.7
3/16/2010 14:17	1620.1	1793.5	2505.8	47.1	48.7
3/16/2010 14:17	1617.4	1740.0	2242.8	47.1	48.7
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3/16/2010 14:17	1624.5	1701.3	1923.4	47.1	48.7
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3/16/2010 14:17	1633.6	1655.4	2078.8	47.1	48.9
3/16/2010 14:17	1644.8	1596.4	2512.1	47.5	48.9
3/16/2010 14:17	1651.1	1589.0	2205.9	47.5	49.1
3/16/2010 14:17	1641.2	1570.1	2261.9	47.7	49.3
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3/16/2010 14:17	1619.4	1570.6	2197.3	48.0	49.5
3/16/2010 14:17	1624.8	1566.3	2007.8	48.2	49.5
3/16/2010 14:17	1628.1	1557.1	2453.9	48.4	49.5
3/16/2010 14:17	1630.0	1533.4	2338.1	48.4	49.5
3/16/2010 14:17	1637.2	1541.1	2051.5	48.4	49.6
3/16/2010 14:17	1645.5	1557.1	2122.4	48.4	49.6
3/16/2010 14:17	1657.4	1550.7	2048.9	48.4	49.8
3/16/2010 14:17	1667.8	1581.6	2145.5	48.4	49.8
3/16/2010 14:17	1677.2	1607.7	2131.6	48.6	49.8
3/16/2010 14:17	1684.6	1626.4	2078.5	48.6	49.8
3/16/2010 14:17	1680.8	1645.5	2429.9	48.6	49.8
3/16/2010 14:17	1682.6	1680.1	2162.7	48.6	49.8
3/16/2010 14:17	1688.5	1654.5	2198.6	48.6	49.8
3/16/2010 14:17	1691.1	1634.2	2236.8	48.4	49.6
3/16/2010 14:17	1682.1	1638.5	2224.0	48.4	49.6
3/16/2010 14:17	1671.6	1666.0	2036.3	48.4	49.5
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3/16/2010 14:17	1682.1	1719.3	2200.0	48.4	49.6
3/16/2010 14:17	1689.3	1710.7	2450.0	48.2	49.5
3/16/2010 14:17	1692.1	1683.7	2262.1	48.2	49.5
3/16/2010 14:17	1696.5	1689.4	2155.3	48.2	49.5
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3/16/2010 14:17	1701.0	1640.3	1996.5	48.2	49.6
3/16/2010 14:17	1705.5	1663.2	2045.2	48.0	49.5
3/16/2010 14:17	1711.0	1691.2	2033.5	48.0	49.5
3/16/2010 14:17	1715.5	1708.7	2153.1	48.0	49.5
3/16/2010 14:17	1718.6	1732.5	2074.0	48.0	49.5

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3/16/2010 14:17	1728.3	1823.7	2119.8	48.2	49.6
3/16/2010 14:17	1732.3	1831.3	2115.5	48.0	49.6
3/16/2010 14:17	1737.7	1812.0	1930.5	48.0	49.6
3/16/2010 14:17	1739.5	1835.6	2140.3	48.0	49.6
3/16/2010 14:17	1741.6	1892.3	2295.6	48.0	49.6
3/16/2010 14:17	1741.3	1934.1	2508.1	48.0	49.5
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3/16/2010 14:17	1751.4	1911.2	2029.9	48.0	49.5
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3/16/2010 14:17	1758.2	1979.8	2206.7	47.8	49.3
3/16/2010 14:17	1757.3	2005.5	2306.3	48.0	49.3
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3/16/2010 14:17	1746.1	2072.3	2047.4	47.8	49.3
3/16/2010 14:17	1744.5	2089.8	2212.3	47.7	49.3
3/16/2010 14:17	1747.4	2107.0	2171.1	47.7	49.5
3/16/2010 14:17	1748.5	2113.0	2203.8	47.7	49.5
3/16/2010 14:17	1747.4	2121.8	2334.3	47.7	49.5
3/16/2010 14:17	1749.7	2128.1	2021.8	47.7	49.5
3/16/2010 14:17	1750.8	2127.2	2174.1	47.7	49.3
3/16/2010 14:17	1749.0	2136.6	2124.2	47.7	49.3
3/16/2010 14:17	1749.4	2137.1	2105.8	47.7	49.3
3/16/2010 14:17	1747.4	2132.8	2105.9	47.7	49.3
3/16/2010 14:17	1749.9	2141.1	1900.6	47.5	49.1
3/16/2010 14:17	1750.8	2144.3	2247.7	47.5	49.1
3/16/2010 14:17	1749.4	2149.5	1970.0	47.5	49.1
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3/16/2010 14:17	1741.5	2140.7	2156.1	47.8	49.1
3/16/2010 14:17	1727.8	2152.4	2035.6	48.0	49.3
3/16/2010 14:17	1719.5	2121.4	2177.8	48.2	49.5
3/16/2010 14:17	1717.9	2082.0	1802.4	48.4	49.5
3/16/2010 14:17	1719.7	2093.5	2176.6	48.4	49.3
3/16/2010 14:17	1720.9	2109.4	2295.3	48.4	49.3
3/16/2010 14:17	1724.2	2126.1	2058.7	48.4	49.3
3/16/2010 14:17	1716.8	2129.9	2256.1	48.4	49.3
3/16/2010 14:17	1706.0	2152.0	2054.2	48.4	49.1
3/16/2010 14:17	1705.6	2166.3	1955.5	48.4	49.1
3/16/2010 14:17	1707.1	2173.5	2134.5	48.4	49.1
3/16/2010 14:17	1706.5	2178.9	1910.2	48.4	49.1
3/16/2010 14:17	1705.1	2181.7	2105.5	48.4	48.9
3/16/2010 14:17	1704.4	2185.7	2073.4	48.4	48.9

3/16/2010 14:17	1707.4	2184.1	1909.0	48.6	48.9
3/16/2010 14:17	1713.0	2183.0	1970.8	48.6	48.9
3/16/2010 14:17	1713.9	2184.6	2097.0	48.6	48.9
3/16/2010 14:18	1713.4	2192.2	1995.9	48.6	48.7
3/16/2010 14:18	1718.6	2184.1	2186.4	48.6	48.6
3/16/2010 14:18	1725.6	2179.2	2011.8	48.6	48.6
3/16/2010 14:18	1730.1	2157.1	1824.6	48.6	48.6
3/16/2010 14:18	1732.5	2165.9	1855.5	48.6	48.6
3/16/2010 14:18	1733.4	2168.1	1860.9	48.6	48.6
3/16/2010 14:18	1735.3	2172.7	2004.0	48.4	48.4
3/16/2010 14:18	1734.8	2167.3	1839.0	48.6	48.6
3/16/2010 14:18	1737.9	2160.9	2046.8	48.4	48.6
3/16/2010 14:18	1737.7	2150.4	2102.5	48.4	48.6
3/16/2010 14:18	1739.1	2152.6	1921.0	48.4	48.6
3/16/2010 14:18	1739.1	2163.2	2065.3	48.4	48.6
3/16/2010 14:18	1739.7	2165.9	1966.6	48.6	48.9
3/16/2010 14:18	1740.7	2164.5	2057.0	48.6	48.9
3/16/2010 14:18	1742.9	2171.8	1894.2	48.6	49.1
3/16/2010 14:18	1745.2	2180.1	1999.5	48.6	48.9
3/16/2010 14:18	1746.9	2174.0	2107.7	48.6	48.9
3/16/2010 14:18	1748.7	2132.8	1866.3	48.6	48.9
3/16/2010 14:18	1750.3	2120.0	1955.8	48.6	48.9
3/16/2010 14:18	1751.2	2128.6	1969.4	48.6	48.9
3/16/2010 14:18	1753.5	2131.3	2004.6	48.6	48.9
3/16/2010 14:18	1756.0	2108.7	1991.5	48.6	48.9
3/16/2010 14:18	1757.5	2106.7	2051.2	48.6	48.7
3/16/2010 14:18	1760.4	2099.5	2001.8	48.6	48.7
3/16/2010 14:18	1765.6	2054.8	2101.0	48.6	48.7
3/16/2010 14:18	1765.8	2032.9	2040.3	48.6	48.7
3/16/2010 14:18	1767.2	2047.5	1985.9	48.6	48.9
3/16/2010 14:18	1762.3	2077.3	2128.9	48.6	48.9
3/16/2010 14:18	1759.1	2106.9	1958.0	48.6	48.6
3/16/2010 14:18	1758.0	2129.7	1981.6	48.6	48.6
3/16/2010 14:18	1757.8	2144.3	1955.7	48.6	48.6
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3/16/2010 14:18	1760.9	2148.1	1981.6	48.7	48.6
3/16/2010 14:18	1761.3	2154.9	1977.7	48.6	48.6
3/16/2010 14:18	1760.9	2163.2	1881.0	48.6	48.6
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3/16/2010 14:18	1763.4	2174.5	1923.4	48.7	48.6
3/16/2010 14:18	1765.6	2158.0	2056.6	48.7	48.6
3/16/2010 14:18	1766.7	2155.8	2053.6	48.6	48.6
3/16/2010 14:18	1765.6	2157.4	1953.7	48.6	48.6
3/16/2010 14:18	1764.3	2160.5	2026.6	48.6	48.6
3/16/2010 14:18	1763.2	2124.3	2009.3	48.4	48.6
3/16/2010 14:18	1764.0	2082.0	2176.6	48.4	48.7

3/16/2010 14:18	1767.7	2045.8	1939.0	48.2	48.7
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3/16/2010 14:18	1765.2	1987.7	2060.9	48.4	48.7
3/16/2010 14:18	1767.6	1967.9	1854.5	48.4	48.7
3/16/2010 14:18	1765.6	1966.5	2022.1	48.4	48.6
3/16/2010 14:18	1766.8	1933.3	1931.8	48.2	48.6
3/16/2010 14:18	1770.4	1931.7	2157.1	48.0	48.7
3/16/2010 14:18	1772.8	1928.1	1951.9	48.0	48.9
3/16/2010 14:18	1774.0	1962.0	2089.0	48.0	48.9
3/16/2010 14:18	1777.1	1965.6	2063.1	48.0	49.1
3/16/2010 14:18	1778.9	2004.4	2011.0	48.0	49.3
3/16/2010 14:18	1778.2	2029.5	2221.1	48.0	49.3
3/16/2010 14:18	1774.6	2012.5	2195.7	48.0	49.3
3/16/2010 14:18	1762.9	1971.7	2205.8	48.0	49.3
3/16/2010 14:18	1751.7	1958.0	2282.1	48.0	49.3
3/16/2010 14:18	1744.9	1969.3	2392.7	48.0	49.3
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3/16/2010 14:18	1739.7	1970.6	2013.9	48.0	49.3
3/16/2010 14:18	1746.0	1946.8	2168.1	48.0	49.3
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3/16/2010 14:18	1761.3	1985.4	2221.1	47.7	49.1
3/16/2010 14:18	1762.2	1938.0	1933.6	47.8	49.3
3/16/2010 14:18	1762.2	1939.5	1893.4	47.8	49.3
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3/16/2010 14:18	1764.5	1976.0	2260.6	47.8	49.5
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3/16/2010 14:18	1765.2	2047.5	2502.3	47.8	49.6
3/16/2010 14:18	1753.2	2069.4	2372.1	47.8	49.6
3/16/2010 14:18	1741.8	2072.8	2066.4	48.0	49.6
3/16/2010 14:18	1743.8	2071.0	2027.5	48.0	49.5
3/16/2010 14:18	1747.4	2075.0	1975.5	48.0	49.5
3/16/2010 14:18	1753.7	2085.4	1951.6	48.0	49.5
3/16/2010 14:18	1754.6	2088.3	2123.3	47.8	49.3
3/16/2010 14:18	1755.5	2095.5	1974.9	47.8	49.3
3/16/2010 14:18	1754.1	2097.0	2032.4	48.0	49.3
3/16/2010 14:18	1754.6	2100.2	2128.2	47.8	49.3
3/16/2010 14:18	1754.4	2111.9	2074.1	47.8	49.3
3/16/2010 14:18	1755.7	2117.8	2008.3	48.0	49.5
3/16/2010 14:18	1748.3	2115.5	2196.9	48.0	49.5
3/16/2010 14:18	1749.4	2109.7	2193.4	48.0	49.5
3/16/2010 14:18	1750.5	2115.1	2035.3	48.0	49.5
3/16/2010 14:18	1746.3	2114.4	2189.4	48.0	49.5
3/16/2010 14:18	1745.6	2105.1	1989.8	48.0	49.5
3/16/2010 14:18	1747.0	2098.0	1978.0	48.2	49.5
3/16/2010 14:18	1746.5	2095.0	2090.7	48.2	49.5

3/16/2010 14:18	1741.5	2096.6	2161.1	48.4	49.5
3/16/2010 14:18	1742.5	2105.1	1933.9	48.4	49.5
3/16/2010 14:18	1744.0	2103.3	2044.4	48.6	49.5
3/16/2010 14:18	1739.1	2107.4	2005.3	48.4	49.3
3/16/2010 14:18	1736.6	2105.4	1976.5	48.4	49.3
3/16/2010 14:18	1729.6	2113.2	2051.2	48.4	49.3
3/16/2010 14:18	1727.2	2136.7	2042.1	48.4	49.5
3/16/2010 14:18	1732.5	2142.0	1929.2	48.4	49.5
3/16/2010 14:18	1724.4	2150.2	2051.9	48.4	49.5
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3/16/2010 14:18	1727.4	2141.8	2008.8	48.6	49.5
3/16/2010 14:18	1731.2	2132.4	2071.0	48.4	49.5
3/16/2010 14:18	1734.4	2125.8	2120.5	48.4	49.5
3/16/2010 14:18	1739.1	2130.6	2080.8	48.6	49.8
3/16/2010 14:18	1740.9	2117.8	1867.2	48.6	49.8
3/16/2010 14:18	1743.4	2116.0	2152.6	48.6	50.0
3/16/2010 14:18	1736.1	2115.9	1977.2	48.6	50.0
3/16/2010 14:18	1729.4	2109.0	2296.8	48.6	50.0
3/16/2010 14:18	1720.9	2104.0	2214.7	48.7	50.0
3/16/2010 14:18	1717.5	2106.9	1984.2	48.7	50.0
3/16/2010 14:18	1729.9	2113.3	2340.6	48.7	50.0
3/16/2010 14:18	1734.8	2133.5	2131.0	48.7	50.0
3/16/2010 14:18	1740.9	2132.4	2170.0	48.6	50.0
3/16/2010 14:18	1742.9	2143.2	1942.0	48.6	50.0
3/16/2010 14:18	1746.1	2143.2	1962.1	48.6	50.0
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3/16/2010 14:18	1747.4	2152.0	2073.8	48.6	49.8
3/16/2010 14:18	1750.5	2156.7	2005.6	48.6	49.8
3/16/2010 14:18	1747.8	2165.7	2516.1	48.6	49.8
3/16/2010 14:19	1744.0	2171.5	2187.7	48.6	49.8
3/16/2010 14:19	1746.9	2168.6	2198.0	48.6	50.0
3/16/2010 14:19	1747.0	2175.4	1995.3	48.6	50.0
3/16/2010 14:19	1749.2	2175.3	2059.5	48.6	50.0
3/16/2010 14:19	1738.0	2179.2	2108.6	48.7	50.0
3/16/2010 14:19	1726.5	2195.1	2305.8	48.7	50.0
3/16/2010 14:19	1720.4	2188.6	2008.5	48.7	50.2
3/16/2010 14:19	1721.7	2172.0	2000.4	48.6	50.0
3/16/2010 14:19	1719.5	2176.7	2502.4	48.6	50.0
3/16/2010 14:19	1709.1	2187.0	2364.2	48.6	50.0
3/16/2010 14:19	1706.0	2197.8	2101.6	48.6	50.0
3/16/2010 14:19	1706.7	2199.2	2124.6	48.6	50.0
3/16/2010 14:19	1701.9	2214.5	2238.4	48.6	50.0
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3/16/2010 14:19	1693.6	2213.8	2042.4	48.9	50.4
3/16/2010 14:19	1684.2	2201.5	2317.0	48.9	50.4
3/16/2010 14:19	1675.6	2200.8	2151.3	48.9	50.4
3/16/2010 14:19	1668.4	2205.7	2062.4	48.9	50.4

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3/16/2010 14:19	1671.4	2156.4	2206.6	48.9	50.4
3/16/2010 14:19	1672.2	2173.8	2142.0	48.9	50.4
3/16/2010 14:19	1677.4	2185.3	2285.2	48.9	50.4
3/16/2010 14:19	1677.6	2195.1	2390.3	48.9	50.4
3/16/2010 14:19	1674.1	2198.8	2462.3	48.9	50.4
3/16/2010 14:19	1665.1	2198.5	2507.6	48.9	50.5
3/16/2010 14:19	1665.0	2199.6	2197.4	48.9	50.5
3/16/2010 14:19	1663.3	2197.6	2220.1	49.1	50.5
3/16/2010 14:19	1664.6	2198.8	2126.9	48.9	50.5
3/16/2010 14:19	1662.6	2199.0	2264.4	49.1	50.5
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3/16/2010 14:19	1708.7	2144.1	1964.8	49.1	50.5
3/16/2010 14:19	1715.4	2135.7	1933.6	48.9	50.4
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3/16/2010 14:19	1732.5	2132.4	1818.4	48.9	50.4
3/16/2010 14:19	1738.2	2131.3	2035.2	48.7	50.2
3/16/2010 14:19	1744.3	2127.6	1958.5	48.7	50.4
3/16/2010 14:19	1746.0	2126.3	2040.5	48.6	50.4
3/16/2010 14:19	1750.3	2126.5	1984.0	48.6	50.2
3/16/2010 14:19	1751.2	2122.5	1908.8	48.4	50.2
3/16/2010 14:19	1752.8	2125.0	1827.2	48.4	50.0
3/16/2010 14:19	1756.0	2123.1	2014.5	48.4	50.0
3/16/2010 14:19	1756.9	2119.6	1839.2	48.2	50.0
3/16/2010 14:19	1759.5	2122.0	1877.5	48.0	49.8
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3/16/2010 14:19	1762.2	2121.3	1932.5	48.0	49.8
3/16/2010 14:19	1762.7	2121.6	1787.1	47.8	49.8
3/16/2010 14:19	1762.9	2125.8	1910.9	47.7	49.5
3/16/2010 14:19	1764.0	2120.0	2116.7	47.7	49.5
3/16/2010 14:19	1764.0	2115.1	2019.6	47.7	49.5
3/16/2010 14:19	1764.7	2119.5	2085.4	47.7	49.5
3/16/2010 14:19	1767.0	2120.9	1933.3	47.7	49.5
3/16/2010 14:19	1766.3	2115.9	1950.7	47.5	49.3
3/16/2010 14:19	1766.3	2111.5	2052.0	47.5	49.3
3/16/2010 14:19	1768.1	2110.5	2217.5	47.5	49.1
3/16/2010 14:19	1768.6	2107.6	2081.0	47.5	49.1
3/16/2010 14:19	1770.1	2110.1	2062.9	47.5	49.1
3/16/2010 14:19	1769.9	2108.3	2027.8	47.3	48.9
3/16/2010 14:19	1770.1	2103.4	2129.1	47.3	48.9
3/16/2010 14:19	1773.0	2109.0	2098.7	47.1	48.9
3/16/2010 14:19	1774.6	2112.6	2158.4	47.1	48.9

3/16/2010 14:19	1774.9	2121.8	2134.3	47.1	48.9
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3/16/2010 14:19	1776.2	2112.4	2044.7	47.1	48.9
3/16/2010 14:19	1777.6	2110.1	2078.3	46.9	48.6
3/16/2010 14:19	1778.2	2117.8	2016.2	46.8	48.8
3/16/2010 14:19	1779.3	2122.0	2068.0	46.8	48.8
3/16/2010 14:19	1779.6	2129.7	2221.2	46.8	48.6
3/16/2010 14:19	1780.9	2129.7	2020.8	46.8	48.4
3/16/2010 14:19	1783.4	2143.6	1933.1	46.9	48.4
3/16/2010 14:19	1786.1	2159.2	1977.5	46.8	48.4
3/16/2010 14:19	1787.5	2163.6	1886.7	46.8	48.4
3/16/2010 14:19	1784.3	2168.2	2129.8	46.8	48.4
3/16/2010 14:19	1783.4	2171.8	1960.6	46.8	48.2
3/16/2010 14:19	1785.2	2166.3	2197.6	46.6	48.0
3/16/2010 14:19	1783.0	2170.6	2039.8	46.6	48.2
3/16/2010 14:19	1780.3	2154.6	2168.4	46.6	48.0
3/16/2010 14:19	1778.5	2145.0	1942.6	46.6	48.0
3/16/2010 14:19	1779.1	2145.9	1934.2	46.6	48.0
3/16/2010 14:19	1777.3	2141.1	2048.4	46.6	47.8
3/16/2010 14:19	1775.5	2140.9	1890.7	46.6	47.8
3/16/2010 14:19	1775.1	2140.0	1923.2	46.6	47.8
3/16/2010 14:19	1775.8	2134.4	2067.3	46.6	47.8
3/16/2010 14:19	1775.3	2145.0	1935.2	46.6	47.8
3/16/2010 14:19	1774.8	2146.6	1819.6	46.6	47.7
3/16/2010 14:19	1774.4	2146.3	2072.5	46.4	47.7
3/16/2010 14:19	1775.1	2154.4	2064.8	46.4	47.7
3/16/2010 14:19	1775.5	2167.5	1986.1	46.4	47.5
3/16/2010 14:19	1776.0	2174.0	2011.6	46.2	47.5
3/16/2010 14:19	1775.3	2160.5	2110.7	46.4	47.5
3/16/2010 14:19	1774.4	2150.6	2020.8	46.6	47.5
3/16/2010 14:19	1774.4	2136.0	2019.0	46.4	47.1
3/16/2010 14:19	1774.8	2136.7	2118.8	46.6	47.1
3/16/2010 14:19	1768.6	2142.5	2088.9	46.6	47.1
3/16/2010 14:19	1752.1	2139.6	2224.4	46.8	47.3
3/16/2010 14:19	1741.3	2134.2	2266.9	46.8	47.3
3/16/2010 14:19	1748.1	2158.2	2063.2	46.8	47.5
3/16/2010 14:19	1749.0	2165.7	2278.9	46.9	47.5
3/16/2010 14:19	1751.7	2174.2	2172.3	47.1	47.7
3/16/2010 14:19	1743.1	2167.2	2196.3	47.1	47.7
3/16/2010 14:19	1732.1	2163.7	1987.7	47.1	47.8
3/16/2010 14:19	1720.0	2159.1	2020.6	47.3	48.0
3/16/2010 14:19	1707.6	2141.4	2064.7	47.1	47.8
3/16/2010 14:19	1700.2	2136.2	2155.6	47.3	47.7
3/16/2010 14:19	1696.1	2135.7	2230.8	47.3	47.8
3/16/2010 14:19	1689.3	2138.2	1988.3	47.3	47.8
3/16/2010 14:19	1692.3	2140.9	2193.3	47.3	47.8
3/16/2010 14:19	1699.7	2139.6	2098.2	47.5	48.0

3/16/2010 14:19	1701.1	2125.8	1944.5	47.5	48.0
3/16/2010 14:19	1693.8	2129.0	2247.2	47.5	48.2
3/16/2010 14:19	1688.7	2142.5	2127.9	47.3	48.2
3/16/2010 14:19	1686.9	2155.5	2405.1	47.3	48.2
3/16/2010 14:19	1684.0	2169.3	2137.4	47.3	48.2
3/16/2010 14:19	1687.8	2175.6	2208.2	47.3	48.2
3/16/2010 14:19	1688.7	2184.1	1968.0	47.3	48.0
3/16/2010 14:19	1687.6	2179.2	2164.0	47.3	48.0
3/16/2010 14:20	1688.4	2187.9	1916.3	47.3	48.0
3/16/2010 14:20	1691.2	2189.3	2065.9	47.3	48.0
3/16/2010 14:20	1691.1	2184.8	2018.6	47.3	48.0
3/16/2010 14:20	1702.9	2175.6	2052.3	47.3	48.0
3/16/2010 14:20	1713.4	2175.1	2152.2	47.3	48.0
3/16/2010 14:20	1723.8	2171.5	2078.4	47.3	48.2
3/16/2010 14:20	1732.1	2119.6	1898.2	47.3	48.0
3/16/2010 14:20	1740.7	2021.0	1897.5	47.3	48.2
3/16/2010 14:20	1744.7	1930.5	1867.1	47.3	48.0
3/16/2010 14:20	1750.1	1851.4	1922.3	47.3	48.0
3/16/2010 14:20	1754.1	1798.3	2002.6	47.3	48.0
3/16/2010 14:20	1756.6	1752.1	1926.2	47.3	48.2
3/16/2010 14:20	1758.0	1713.9	1986.9	47.3	48.2
3/16/2010 14:20	1761.6	1674.7	1870.1	47.5	48.4
3/16/2010 14:20	1763.6	1635.8	1970.5	47.3	48.4
3/16/2010 14:20	1767.0	1595.7	1908.3	47.3	48.4
3/16/2010 14:20	1770.3	1555.9	1858.0	47.3	48.4
3/16/2010 14:20	1770.3	1517.9	2022.4	47.5	48.6
3/16/2010 14:20	1774.8	1481.0	1887.3	47.5	48.6
3/16/2010 14:20	1776.4	1447.5	2005.0	47.5	48.6
3/16/2010 14:20	1776.0	1415.3	1917.5	47.5	48.6
3/16/2010 14:20	1776.4	1396.8	1980.6	47.7	48.6
3/16/2010 14:20	1777.3	1370.7	1936.5	47.5	48.6
3/16/2010 14:20	1778.2	1392.8	2129.8	47.5	48.6
3/16/2010 14:20	1782.1	1398.2	1869.2	47.5	48.6
3/16/2010 14:20	1786.8	1422.5	2076.3	47.5	48.6
3/16/2010 14:20	1781.2	1448.1	2398.2	47.5	48.6
3/16/2010 14:20	1782.1	1472.0	2148.8	47.5	46.6
3/16/2010 14:20	1781.2	1491.3	2188.0	47.5	48.6
3/16/2010 14:20	1788.8	1502.8	1735.8	47.5	48.6
3/16/2010 14:20	1790.4	1484.8	1828.4	47.5	48.6
3/16/2010 14:20	1791.9	1446.6	1777.2	47.5	48.6
3/16/2010 14:20	1790.6	1423.2	1817.1	47.3	48.6
3/16/2010 14:20	1791.5	1399.1	2105.1	47.1	48.6
3/16/2010 14:20	1790.1	1369.4	1920.7	47.1	48.7
3/16/2010 14:20	1791.1	1356.1	1787.2	47.1	48.7
3/16/2010 14:20	1787.9	1380.9	1868.3	46.8	48.6
3/16/2010 14:20	1787.4	1398.4	1775.1	46.8	48.7
3/16/2010 14:20	1785.0	1362.2	1795.1	46.8	48.7

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3/16/2010 14:20	1787.7	1324.4	1837.7	46.8	48.7
3/16/2010 14:20	1791.3	1281.6	1872.4	46.8	48.7
3/16/2010 14:20	1789.7	1248.6	1846.0	46.8	48.6
3/16/2010 14:20	1787.2	1229.4	2163.4	46.6	48.6
3/16/2010 14:20	1771.0	1197.3	1484.5	46.6	48.6
3/16/2010 14:20	1733.5	1163.5	1362.2	46.6	48.6
3/16/2010 14:20	1699.7	1137.6	1336.8	46.8	48.9
3/16/2010 14:20	1671.4	1117.2	1321.3	46.9	48.9
3/16/2010 14:20	1645.3	1099.2	1308.3	46.9	48.7
3/16/2010 14:20	1622.1	1082.3	1285.5	46.9	48.7
3/16/2010 14:20	1601.6	1064.1	1249.1	46.9	48.7
3/16/2010 14:20	1578.7	1052.2	1223.2	46.9	48.7
3/16/2010 14:20	1560.7	1042.3	1209.2	47.1	48.7
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3/16/2010 14:20	1510.5	998.1	1171.8	47.1	48.7
3/16/2010 14:20	1496.7	982.8	1162.5	47.1	48.7
3/16/2010 14:20	1482.3	961.5	1155.7	46.9	48.7
3/16/2010 14:20	1467.0	951.3	1135.1	46.9	48.6
3/16/2010 14:20	1453.3	952.3	1119.9	46.9	48.6
3/16/2010 14:20	1439.6	937.9	1114.9	46.9	48.6
3/16/2010 14:20	1425.9	920.1	1112.6	46.9	48.6
3/16/2010 14:20	1414.2	907.0	1102.4	46.9	48.6
3/16/2010 14:20	1402.9	896.4	1108.7	46.9	48.6
3/16/2010 14:20	1391.9	885.4	1110.2	46.9	48.6
3/16/2010 14:20	1381.8	877.8	1094.5	46.9	48.4
3/16/2010 14:20	1372.1	868.1	1094.3	46.9	48.4
3/16/2010 14:20	1360.9	870.3	1090.2	46.8	48.2
3/16/2010 14:20	1350.6	869.7	1083.6	46.8	48.2
3/16/2010 14:20	1338.1	869.9	1066.7	46.8	48.0
3/16/2010 14:20	1326.4	868.7	1069.1	46.6	48.0
3/16/2010 14:20	1314.1	859.8	1056.2	46.6	47.8
3/16/2010 14:20	1303.5	853.7	1058.3	46.4	47.7
3/16/2010 14:20	1294.9	843.6	1041.7	46.4	47.5
3/16/2010 14:20	1286.2	832.6	1038.6	46.2	47.5
3/16/2010 14:20	1276.5	817.0	1038.9	46.2	47.5
3/16/2010 14:20	1267.5	806.9	1029.2	46.2	47.3
3/16/2010 14:20	1258.2	797.7	1025.1	46.0	47.3
3/16/2010 14:20	1249.9	787.8	1020.9	46.0	47.1
3/16/2010 14:20	1241.4	776.8	1025.8	46.0	47.1
3/16/2010 14:20	1234.6	766.9	1036.5	46.0	47.1
3/16/2010 14:20	1226.5	755.6	1054.0	46.0	47.1
3/16/2010 14:20	1216.9	747.7	1035.2	46.0	46.9
3/16/2010 14:20	1208.3	740.7	1034.2	45.9	46.9
3/16/2010 14:20	1200.9	734.7	1044.0	45.9	47.1
3/16/2010 14:20	1193.9	732.0	1060.0	45.7	46.9

3/16/2010 14:20	1186.2	728.8	1037.9	45.7	46.9
3/16/2010 14:20	1179.1	721.4	1035.6	45.9	46.9
3/16/2010 14:20	1172.3	715.6	1047.1	45.9	46.9
3/16/2010 14:20	1166.2	710.8	1035.8	45.7	46.9
3/16/2010 14:20	1159.5	707.0	1036.1	45.7	46.9
3/16/2010 14:20	1154.3	701.1	1035.1	45.9	47.1
3/16/2010 14:20	1148.2	694.9	1030.3	45.9	47.1
3/16/2010 14:20	1143.0	690.1	1034.9	45.9	47.1
3/16/2010 14:20	1137.6	685.9	1036.7	46.0	47.1
3/16/2010 14:20	1131.3	682.7	1017.8	46.0	47.1
3/16/2010 14:20	1123.5	678.6	1010.4	46.2	47.1
3/16/2010 14:20	1118.3	674.4	1017.9	46.2	47.1
3/16/2010 14:20	1113.6	672.4	1008.4	46.2	47.3
3/16/2010 14:20	1107.1	668.5	989.5	46.2	47.3
3/16/2010 14:20	1101.4	662.0	990.4	46.4	47.3
3/16/2010 14:20	1097.8	651.4	990.4	46.4	47.3
3/16/2010 14:20	1094.0	644.5	1002.8	46.4	47.1
3/16/2010 14:20	1089.5	634.3	996.7	46.4	47.1
3/16/2010 14:20	1084.3	625.6	1019.3	46.4	47.1
3/16/2010 14:20	1081.6	619.2	1008.1	46.4	47.1
3/16/2010 14:20	1077.8	613.2	993.5	46.2	47.1
3/16/2010 14:20	1074.0	604.2	995.0	46.4	47.1
3/16/2010 14:20	1070.6	590.7	998.5	46.2	47.1
3/16/2010 14:20	1065.7	583.3	1005.2	46.2	47.1
3/16/2010 14:20	1062.9	573.4	1002.0	46.2	47.1
3/16/2010 14:20	1058.2	564.3	1011.6	46.2	47.1
3/16/2010 14:20	1051.5	554.9	1027.8	46.2	47.1
3/16/2010 14:20	1046.8	545.4	1014.5	46.2	47.1
3/16/2010 14:20	1044.0	539.4	1029.5	46.2	47.1
3/16/2010 14:20	1037.8	539.4	1051.0	46.2	47.1
3/16/2010 14:20	1031.5	540.5	1080.6	46.0	47.1
3/16/2010 14:20	1026.3	539.8	1097.2	46.0	47.1
3/16/2010 14:20	1021.1	533.8	1119.0	45.9	46.9
3/16/2010 14:20	1015.9	535.6	1134.6	45.9	47.1
3/16/2010 14:21	1011.7	532.4	1119.3	45.9	47.1
3/16/2010 14:21	1007.8	530.2	1127.2	45.9	47.1
3/16/2010 14:21	1003.3	529.2	1137.1	46.0	47.1
3/16/2010 14:21	999.0	528.8	1122.6	46.0	47.1
3/16/2010 14:21	994.5	528.6	1108.7	46.2	47.3
3/16/2010 14:21	991.4	528.8	1086.4	46.2	47.3
3/16/2010 14:21	986.7	528.6	1054.4	46.0	47.3
3/16/2010 14:21	982.4	527.4	1037.1	46.0	47.1
3/16/2010 14:21	979.2	524.5	1056.4	46.0	47.1
3/16/2010 14:21	974.7	524.5	1062.8	45.9	46.9
3/16/2010 14:21	970.3	525.6	1046.2	45.9	46.9
3/16/2010 14:21	968.2	522.3	1019.3	45.9	47.1
3/16/2010 14:21	965.8	519.4	1016.2	45.9	47.1

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3/16/2010 14:21	963.5	513.3	1006.9	46.0	47.1
3/16/2010 14:21	960.8	507.9	1018.7	46.0	47.1
3/16/2010 14:21	959.2	501.4	1014.4	46.0	47.1
3/16/2010 14:21	957.4	493.9	1014.8	46.0	47.1
3/16/2010 14:21	955.8	486.5	1013.8	46.0	47.1
3/16/2010 14:21	954.5	480.2	1014.0	46.0	47.1
3/16/2010 14:21	952.5	474.3	1014.0	46.0	47.1
3/16/2010 14:21	950.0	470.5	1017.3	46.0	47.1
3/16/2010 14:21	948.0	469.6	1035.1	46.0	47.1
3/16/2010 14:21	943.0	467.1	1055.8	46.0	47.1
3/16/2010 14:21	939.2	463.6	1086.8	46.2	47.1
3/16/2010 14:21	935.8	460.8	1083.9	46.2	47.3
3/16/2010 14:21	933.1	458.1	1069.7	46.2	47.3
3/16/2010 14:21	930.0	453.7	1061.9	46.2	47.3
3/16/2010 14:21	927.1	448.9	1059.6	46.0	47.1
3/16/2010 14:21	926.2	444.0	1043.1	46.0	47.1
3/16/2010 14:21	924.1	439.0	1021.3	46.0	47.1
3/16/2010 14:21	921.2	430.7	1005.5	46.0	47.1
3/16/2010 14:21	919.2	424.6	992.1	46.2	47.1
3/16/2010 14:21	915.3	420.8	996.1	46.2	47.1
3/16/2010 14:21	911.8	414.3	996.5	46.2	47.3
3/16/2010 14:21	910.0	409.3	1002.8	46.2	47.3
3/16/2010 14:21	908.1	404.4	1004.7	46.4	47.5
3/16/2010 14:21	906.6	401.2	992.0	46.4	47.5
3/16/2010 14:21	905.0	398.8	982.6	46.4	47.5
3/16/2010 14:21	901.8	394.3	970.8	46.4	47.5
3/16/2010 14:21	899.6	390.6	971.4	46.4	47.5
3/16/2010 14:21	898.3	386.8	980.6	46.6	47.5
3/16/2010 14:21	898.2	382.3	993.2	46.4	47.5
3/16/2010 14:21	895.1	377.2	988.0	46.4	47.3
3/16/2010 14:21	891.5	374.2	974.4	46.4	47.3
3/16/2010 14:21	889.7	371.8	982.3	46.4	47.3
3/16/2010 14:21	888.6	369.9	972.7	46.4	47.3
3/16/2010 14:21	887.4	368.1	964.8	46.4	47.5
3/16/2010 14:21	885.0	366.4	963.0	46.4	47.3
3/16/2010 14:21	882.1	361.6	959.5	46.6	47.5
3/16/2010 14:21	880.2	356.9	959.2	46.4	47.5
3/16/2010 14:21	876.6	353.3	954.1	46.4	47.5
3/16/2010 14:21	874.0	352.8	951.7	46.2	47.5
3/16/2010 14:21	869.2	353.5	963.7	46.2	47.5
3/16/2010 14:21	865.2	352.0	976.5	46.2	47.5
3/16/2010 14:21	862.0	350.6	963.3	46.0	47.5
3/16/2010 14:21	859.8	349.7	962.4	46.0	47.5
3/16/2010 14:21	858.0	349.3	964.3	45.9	47.1
3/16/2010 14:21	853.7	348.4	958.0	45.9	47.1
3/16/2010 14:21	851.9	347.4	949.0	45.7	47.1
3/16/2010 14:21	849.6	345.9	974.7	45.7	47.1

3/16/2010 14:21	848.3	344.8	972.8	45.7	47.1
3/16/2010 14:21	846.1	345.6	964.2	45.7	46.9
3/16/2010 14:21	842.9	345.6	965.4	45.7	46.8
3/16/2010 14:21	839.7	343.9	949.7	45.7	46.8
3/16/2010 14:21	837.0	342.9	954.0	45.9	46.9
3/16/2010 14:21	835.7	340.0	970.2	45.9	46.9
3/16/2010 14:21	834.4	336.4	972.2	45.9	46.9
3/16/2010 14:21	833.9	334.6	958.9	45.9	46.9
3/16/2010 14:21	833.4	334.2	951.2	45.9	46.8
3/16/2010 14:21	832.5	335.5	950.6	45.9	46.9
3/16/2010 14:21	830.5	335.1	941.2	45.7	46.9
3/16/2010 14:21	826.2	333.3	953.0	45.9	46.9
3/16/2010 14:21	823.3	333.9	957.3	45.7	47.1
3/16/2010 14:21	820.8	332.8	984.5	45.9	46.9
3/16/2010 14:21	818.6	331.3	991.1	45.9	47.1
3/16/2010 14:21	818.1	328.1	995.6	46.0	47.1
3/16/2010 14:21	816.6	328.1	1007.3	46.0	47.1
3/16/2010 14:21	817.0	325.6	999.1	46.0	47.1
3/16/2010 14:21	816.4	321.4	999.2	46.0	47.1
3/16/2010 14:21	815.9	320.5	982.3	46.0	47.1
3/16/2010 14:21	815.5	316.2	965.3	46.0	47.1
3/16/2010 14:21	815.2	311.0	963.2	46.0	47.3
3/16/2010 14:21	813.6	309.4	959.5	46.2	47.5
3/16/2010 14:21	811.8	307.4	958.0	46.2	47.5
3/16/2010 14:21	809.2	307.2	952.6	46.0	47.5
3/16/2010 14:21	808.5	302.0	972.7	46.0	47.5
3/16/2010 14:21	807.3	299.1	952.8	46.2	47.5
3/16/2010 14:21	805.5	295.2	959.2	46.0	47.3
3/16/2010 14:21	804.9	291.9	963.5	46.0	47.3
3/16/2010 14:21	803.1	293.5	954.3	46.0	47.3
3/16/2010 14:21	802.9	293.5	956.7	45.9	47.1
3/16/2010 14:21	802.6	294.3	963.7	45.9	47.3
3/16/2010 14:21	801.3	293.5	968.7	45.7	47.1
3/16/2010 14:21	799.3	293.0	976.3	45.7	47.1
3/16/2010 14:21	797.5	293.5	976.2	45.7	47.1
3/16/2010 14:21	795.9	293.5	979.5	45.7	47.1
3/16/2010 14:21	794.7	293.7	973.6	45.9	47.1
3/16/2010 14:21	792.5	294.4	983.3	45.9	47.1
3/16/2010 14:21	791.4	293.4	973.6	45.9	47.1
3/16/2010 14:21	791.2	288.9	967.2	45.9	47.1
3/16/2010 14:21	790.7	283.5	962.1	45.9	47.1
3/16/2010 14:21	789.1	279.1	960.1	45.9	47.1
3/16/2010 14:21	787.8	275.9	970.0	45.9	47.1
3/16/2010 14:21	786.9	272.5	965.3	45.7	47.1
3/16/2010 14:21	786.7	268.9	971.4	45.7	47.1
3/16/2010 14:21	785.1	265.6	967.0	45.7	47.1
3/16/2010 14:21	782.8	262.0	951.5	45.7	47.1

3/16/2010 14:21	781.0	258.6	956.8	45.7	47.1
3/16/2010 14:21	779.4	256.1	950.3	45.9	47.5
3/16/2010 14:21	778.3	253.4	952.1	46.0	47.5
3/16/2010 14:21	779.0	251.4	960.6	46.0	47.7
3/16/2010 14:21	777.0	248.9	956.1	46.0	47.5
3/16/2010 14:21	775.4	247.5	946.4	46.0	47.5
3/16/2010 14:21	774.5	245.8	954.3	46.0	47.5
3/16/2010 14:21	772.2	247.1	962.7	45.9	47.1
3/16/2010 14:21	770.2	247.3	961.7	45.9	47.1
3/16/2010 14:21	768.9	247.3	956.4	45.9	47.3
3/16/2010 14:21	766.6	248.2	960.6	45.9	47.1
3/16/2010 14:21	765.5	248.0	955.7	46.0	47.1
3/16/2010 14:21	763.3	247.1	953.1	46.0	47.1
3/16/2010 14:22	760.3	247.6	955.8	45.9	47.1
3/16/2010 14:22	757.9	247.8	945.9	46.0	47.1
3/16/2010 14:22	756.9	247.8	937.6	46.0	47.1
3/16/2010 14:22	756.0	248.2	941.2	46.2	47.3
3/16/2010 14:22	755.6	246.0	946.8	46.2	47.3
3/16/2010 14:22	754.5	244.6	948.0	46.2	47.5
3/16/2010 14:22	754.0	241.9	946.0	46.2	47.5
3/16/2010 14:22	754.2	239.9	957.6	46.2	47.5
3/16/2010 14:22	752.7	234.7	943.7	46.2	47.5
3/16/2010 14:22	748.8	232.0	945.1	46.4	47.5
3/16/2010 14:22	748.2	230.0	949.4	46.6	47.7
3/16/2010 14:22	746.8	226.6	944.8	46.6	47.7
3/16/2010 14:22	745.9	225.5	949.4	46.4	47.5
3/16/2010 14:22	745.9	224.6	945.0	46.6	47.7
3/16/2010 14:22	745.5	225.0	946.0	46.4	47.5
3/16/2010 14:22	744.1	223.9	950.7	46.6	47.7
3/16/2010 14:22	743.0	223.5	947.0	46.6	47.5
3/16/2010 14:22	740.3	223.0	929.8	46.8	47.5
3/16/2010 14:22	736.5	221.4	932.5	46.8	47.7
3/16/2010 14:22	732.7	220.8	944.3	46.9	47.7
3/16/2010 14:22	729.1	218.7	935.6	46.9	47.7
3/16/2010 14:22	728.6	214.5	948.9	46.9	47.7
3/16/2010 14:22	727.3	214.2	949.5	46.9	47.8
3/16/2010 14:22	725.9	213.6	954.8	46.9	48.0
3/16/2010 14:22	725.4	214.7	955.2	47.1	48.0
3/16/2010 14:22	724.8	213.6	946.4	47.1	48.0
3/16/2010 14:22	724.8	213.8	956.5	47.1	48.0
3/16/2010 14:22	723.4	213.8	942.5	47.1	48.2
3/16/2010 14:22	721.9	210.7	962.1	47.1	48.0
3/16/2010 14:22	721.2	209.1	955.2	47.1	48.2
3/16/2010 14:22	721.8	208.2	936.6	46.9	48.2
3/16/2010 14:22	721.0	205.5	937.8	46.9	48.2
3/16/2010 14:22	720.5	205.3	949.3	46.8	48.2
3/16/2010 14:22	720.3	205.0	941.4	46.8	48.0

3/16/2010 14:22	719.2	205.3	940.3	46.8	48.0
3/16/2010 14:22	717.4	206.2	948.7	46.6	48.0
3/16/2010 14:22	714.7	208.4	924.6	46.6	48.2
3/16/2010 14:22	712.9	208.9	935.8	46.4	48.2
3/16/2010 14:22	713.7	208.6	942.1	46.4	48.0
3/16/2010 14:22	712.6	209.5	935.0	46.4	48.0
3/16/2010 14:22	713.3	208.8	938.0	46.4	48.0
3/16/2010 14:22	711.9	208.4	910.9	46.4	48.2
3/16/2010 14:22	708.6	207.9	919.7	46.4	48.2
3/16/2010 14:22	706.1	207.5	934.6	46.4	48.4
3/16/2010 14:22	703.4	207.1	917.1	46.2	48.4
3/16/2010 14:22	701.6	207.1	949.9	46.2	48.4
3/16/2010 14:22	701.4	207.5	909.5	46.4	48.4
3/16/2010 14:22	701.1	208.6	924.5	46.4	48.4
3/16/2010 14:22	700.3	208.8	935.1	46.4	48.4
3/16/2010 14:22	699.6	209.1	924.1	46.4	48.4
3/16/2010 14:22	699.6	209.1	924.8	46.4	48.6
3/16/2010 14:22	700.2	206.6	942.8	46.4	48.4
3/16/2010 14:22	699.8	206.8	939.2	46.4	48.6
3/16/2010 14:22	697.1	206.6	949.3	46.6	48.6
3/16/2010 14:22	696.4	207.5	964.2	46.4	48.6
3/16/2010 14:22	694.4	208.2	929.3	46.4	48.6
3/16/2010 14:22	695.1	208.4	950.6	46.4	48.6
3/16/2010 14:22	694.9	208.0	921.4	46.4	48.6
3/16/2010 14:22	695.5	208.2	898.1	46.4	48.7
3/16/2010 14:22	695.3	207.9	929.4	46.4	48.7
3/16/2010 14:22	695.3	208.6	914.5	46.6	48.7
3/16/2010 14:22	695.3	208.4	920.3	46.6	48.7
3/16/2010 14:22	695.8	208.8	917.3	46.6	48.7
3/16/2010 14:22	694.8	208.9	918.8	46.6	48.7
3/16/2010 14:22	694.2	208.8	912.9	46.6	48.9
3/16/2010 14:22	693.1	208.8	919.4	46.6	48.9
3/16/2010 14:22	690.4	208.6	918.1	46.6	48.9
3/16/2010 14:22	690.1	207.5	925.6	46.6	48.9
3/16/2010 14:22	686.8	207.1	914.4	46.6	48.9
3/16/2010 14:22	685.4	205.7	941.1	46.6	48.9
3/16/2010 14:22	685.0	203.5	928.8	46.6	48.9
3/16/2010 14:22	685.4	204.4	931.8	46.6	48.9
3/16/2010 14:22	686.1	205.0	931.5	46.6	48.9
3/16/2010 14:22	684.9	204.6	945.2	46.6	49.1
3/16/2010 14:22	684.9	203.5	930.9	46.8	49.1
3/16/2010 14:22	683.8	200.5	922.8	46.8	49.1
3/16/2010 14:22	683.2	200.1	947.2	46.8	49.1
3/16/2010 14:22	682.9	199.2	941.7	46.8	49.1
3/16/2010 14:22	683.1	196.9	930.0	46.9	49.3
3/16/2010 14:22	682.5	194.2	932.0	46.9	49.3
3/16/2010 14:22	681.3	190.9	932.9	46.9	49.3

3/16/2010 14:22	678.7	189.5	941.4	46.9	49.3
3/16/2010 14:22	678.9	187.7	915.7	46.9	49.1
3/16/2010 14:22	678.0	184.5	945.3	46.9	49.3
3/16/2010 14:22	676.4	180.9	932.4	46.9	49.3
3/16/2010 14:22	674.2	180.3	929.6	46.9	49.3
3/16/2010 14:22	674.2	181.2	947.9	46.9	49.3
3/16/2010 14:22	674.8	181.2	928.7	46.9	49.5
3/16/2010 14:22	674.1	181.0	930.7	46.9	49.5
3/16/2010 14:22	674.1	181.6	917.5	46.8	49.5
3/16/2010 14:22	673.9	181.9	936.9	46.9	49.5
3/16/2010 14:22	673.5	181.9	925.2	46.9	49.5
3/16/2010 14:22	673.5	182.3	909.7	46.9	49.5
3/16/2010 14:22	672.6	181.9	949.7	46.8	49.5
3/16/2010 14:22	671.9	181.6	920.5	46.8	49.5
3/16/2010 14:22	671.2	181.2	891.6	46.6	49.5
3/16/2010 14:22	669.9	181.2	936.9	46.6	49.5
3/16/2010 14:22	668.5	181.0	927.4	46.6	49.5
3/16/2010 14:22	668.8	181.6	918.3	46.6	49.5
3/16/2010 14:22	666.9	182.1	945.6	46.4	49.5
3/16/2010 14:22	664.0	182.7	935.6	46.4	49.5
3/16/2010 14:22	662.7	183.2	946.0	46.4	49.5
3/16/2010 14:22	662.2	183.4	964.1	46.2	49.3
3/16/2010 14:22	662.9	181.8	957.2	46.2	49.3
3/16/2010 14:22	660.7	182.1	945.4	46.4	49.5
3/16/2010 14:22	660.6	181.8	945.5	46.2	49.5
3/16/2010 14:22	660.2	180.3	829.6	46.2	49.5
3/16/2010 14:22	660.2	181.0	938.4	46.2	49.5
3/16/2010 14:22	659.8	180.9	838.3	46.2	49.3
3/16/2010 14:22	659.7	180.7	935.9	46.2	49.3
3/16/2010 14:22	659.3	181.0	943.8	46.2	49.3
3/16/2010 14:22	659.7	181.4	960.9	46.2	49.1
3/16/2010 14:22	660.0	181.8	952.4	46.2	48.9
3/16/2010 14:22	659.3	181.4	822.6	46.2	49.1
3/16/2010 14:22	659.3	181.4	895.6	46.2	49.1
3/16/2010 14:22	658.6	181.0	729.7	46.2	48.9
3/16/2010 14:22	658.0	181.2	920.5	46.2	49.1
3/16/2010 14:22	658.2	179.2	942.1	46.2	49.1
3/16/2010 14:22	657.9	176.9	961.6	46.2	49.1
3/16/2010 14:22	657.7	174.4	838.6	46.2	49.1
3/16/2010 14:23	658.0	172.6	872.1	46.2	48.9
3/16/2010 14:23	657.3	171.7	939.8	46.2	48.9
3/16/2010 14:23	657.0	171.9	930.4	46.2	48.9
3/16/2010 14:23	656.4	171.5	760.5	46.2	48.9
3/16/2010 14:23	655.2	171.0	882.2	46.2	48.9
3/16/2010 14:23	654.4	171.1	660.0	46.4	48.9
3/16/2010 14:23	653.0	172.2	828.2	46.2	48.7
3/16/2010 14:23	652.3	170.4	927.9	46.2	48.6

3/16/2010 14:23	651.4	168.6	657.2	46.2	48.6
3/16/2010 14:23	650.7	168.8	660.1	46.2	48.6
3/16/2010 14:23	650.3	169.9	660.1	46.2	48.6
3/16/2010 14:23	649.6	170.6	660.1	46.2	48.6

Clip of open burning treatment activity at TA-16-388

(LA-UR-08-05503)

Soil sampling locations for 2009 at the TA-16 Burn Ground

(From LA-UR- 10-00086)

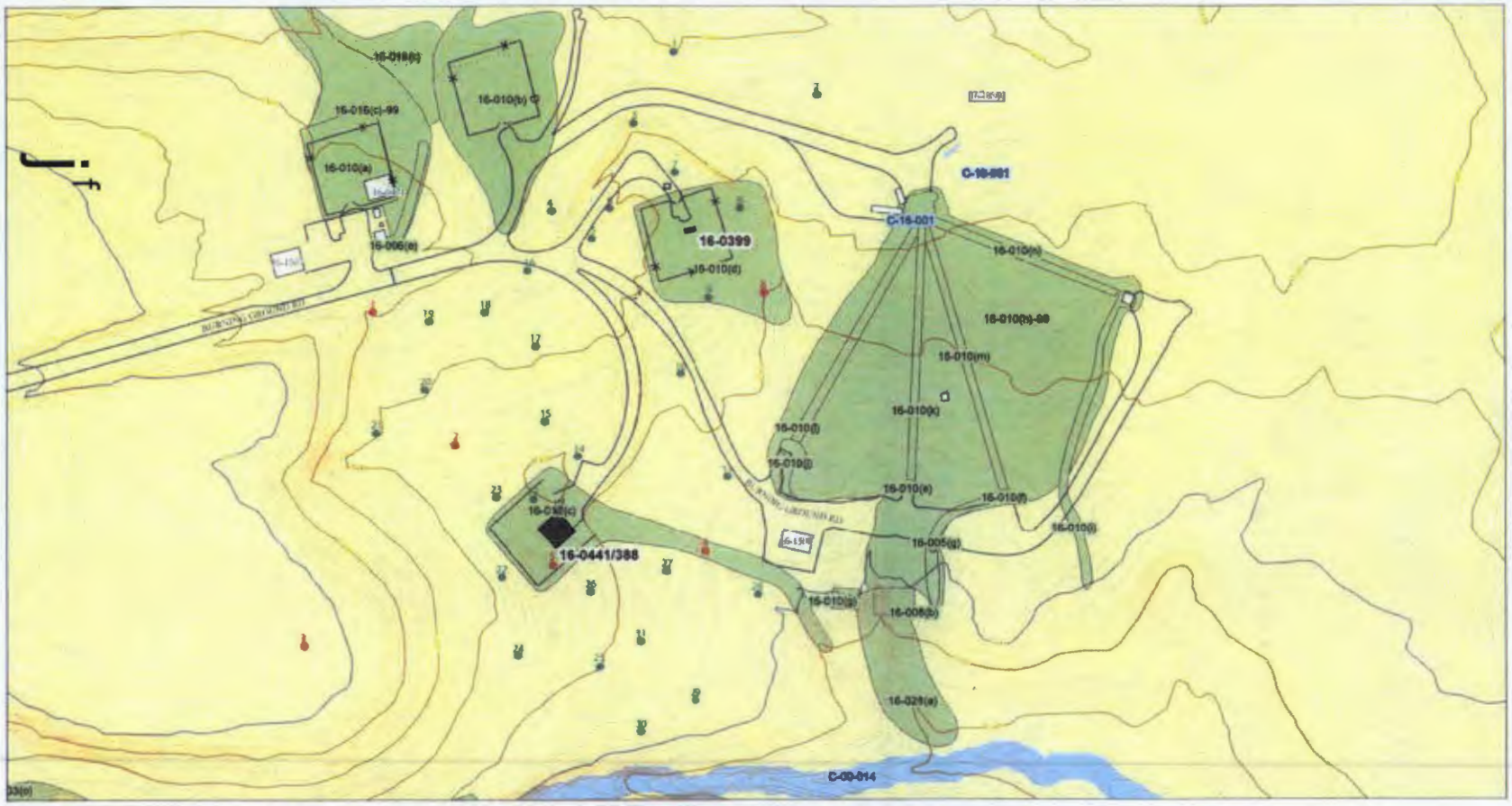

Figure 1.2-1: Technical Area 16 Burn Ground Soil Sample Locations For 2009 Soil Sample Collection Events

100-ft Contour
20-ft Contour
10-ft Contour
2-ft Contour

Fences
Roads, Paved

PRS and Areas of Concern
AOC
SWMU
08/26/09 Soil Sample Location
06/08/09 Soil Sample Location

RCRA waste management units
RWMU Structure
Other Structures

DISCLAIMER
This map was created for work processes associated with the LANL Hazardous Waste Permit Facility Permit. All other uses for this map should be confirmed with LANL, ENV Division, Water Quality & RCRA.

1:1,600
0 45 90 180 Feet
Meters
0 9.57 14 21 28

1983 North American Datum
State Plane Coordinate System
New Mexico Central Zone (US Feet)

DATA SOURCES

RCR00092.002