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SANDIA LABORATORIES/ PRODUCTION AGENCY WEAPON WASTE MINIMIZATION PLAN

JULY 1991

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**SANDIA NATIONAL LABORATORIES/
PRODUCTION AGENCY
WEAPON WASTE MINIMIZATION PLAN**

Sandia National Laboratories

Abstract

This Plan describes activities to reduce the usage of hazardous materials and the production of hazardous material waste during the development, production, stockpile, and retirement phases of war reserve nuclear weapons and nuclear weapon test units. Activities related to the development and qualification of more benign materials and processes for weapon production and the treatment and disposal of these materials from weapon retirement are described in separate plans.

MASTER

Preface

The Weapon Waste Minimization Program described here will be funded by the DOE Office of Defense Programs and the DOE Office of Environmental Restoration and Waste Management (EM). Numerous processes and materials technology base activities will be performed. This Weapon Waste Minimization Program will use the technology base results from all these activities to ensure a common approach and avoid duplication of effort.

Some activities described in this Plan are being implemented at all Production Agencies. Other activities have been coordinated primarily with Pantex.

This Plan was prepared by A. C. Skinrood, 8166 and L. G. Radosevich, 8166. Task descriptions for Task 4 were provided by W. D. Ulrich, 5114 and Task 6 by M. W. Perra, 8314 and M. J. Cieslak, 1831.

**Sandia National Laboratories/
Production Agency
Weapon Waste Minimization Plan**

Introduction

Environment, Safety, and Health (ES&H) regulations have become increasingly stringent, and the effects of compliance with these regulations are being felt throughout the Nuclear Weapons Complex. This plan describes activities to address ES&H concerns at the Production Agencies (PAs) and Sandia National Laboratories (SNL) during weapon development, production, and retirement.

The weapon waste minimization activities addressed in this plan are grouped into four categories: (1) weapons which will be produced in the future; (2) weapons currently in production; (3) retired warheads and test units in Pantex custody; and, (4) retired components and test units in SNL custody. Although the last two activities are specific to Pantex and SNL, the approaches described here will be applicable to other agencies as well.

New weapon programs addressing ES&H concerns include, for example, the W89, the warhead for the strategic Short Range Attack Missile (SRAM), and the W91, a tactical SRAM. The development of the W89 and W91 programs was underway when their ES&H tasks were initiated. For warheads, which are already in production, such as the B83 and W88, in-production changes will be incorporated.

Meeting ES&H requirements is a standard element of each weapon program. ES&H regulations require that materials selection be given close scrutiny. Some mature technologies used in past programs are no longer acceptable under current regulations. ES&H regulations have eliminated materials and processes that were selected for their performance and unique properties. The result is that new materials and processes must be qualified for weapon use. The goal of this program is to use benign materials whenever possible. Where hazardous materials and processes must be used, precautions will be taken to protect personnel and minimize environmental effects.

ES&H regulations have impacted weapon disassembly and disposition of material. SNL and Pantex have severe difficulty in disposing of components and parts from weapons which are being retired or which have undergone testing. They must identify the type and quantity of hazardous material in each

item before any treatment or disposal action can be taken. They are storing the parts and components until the hazardous materials can be properly identified for safe disposal. The Pantex problem will become more severe when the quantity of retired weapons increases as a result of arms control agreements.

Accurate information on the type and quantity of hazardous material in each weapon is not readily accessible at the present time. First, many of the older weapons were designed and built before computerized data bases existed. Developing lists of the quantity and location of materials for these weapons will require examining thousands of drawings and specifications for each system. The SNL design definition system has evolved with time so that each weapon program will have to be treated individually. Access of information for newer systems will be easier but will still require considerable effort. Second, commercial parts have been used, and their material composition may be undefined or even proprietary.

New technology is needed to identify hazardous materials. SNL and the PAs will experimentally identify hazardous materials in components which cannot be adequately defined through reviews of drawings and specifications. In addition, we will develop methods for experimentally verifying that hazardous materials have been properly identified.

Objective

The objective of this program is to reduce to a practical minimum the SNL and PA usage of hazardous materials and the production of waste from hazardous materials and processes used in developing, manufacturing, and retiring nuclear warheads. Accurately identifying the hazardous materials in weapons will make it possible to better classify and reduce the volume of hazardous waste generated by manufacturing, monitoring, and then retiring. The program addresses weapon system and component features under the design control of SNL.

Approach

This plan describes six major tasks that will accomplish the waste minimization program objectives. In the first task, SNL will work with the Production Agencies to define program activities and coordinate and monitor the work of the responsible SNL organizations. In the second task SNL project organizations will prepare and implement program plans that address ES&H issues for the B61-6,-8,-9, W61, W89, and W91 weapon programs now in development. New weapon programs, when initiated, will perform the activities described in this task. The third task will do the same for weapons now in production, such as the B61-7,-10, W80-0, B83 and W88.

In the fourth task SNL will develop a process for identifying hazardous materials contained in components and test units in SNL custody so that these units can be disassembled for safe treatment and disposal. The fifth task will identify hazardous materials in the components of retired weapons and test units under Pantex custody so Pantex can safely treat and dispose of the items. The sixth task will perform materials validation and analysis and long-term technology development, and development of components using low-hazard materials. The combined output of these tasks will be: (1) validation and implementation of materials and processes technology for new weapons; and, (2) identification of hazardous materials to facilitate the disassembly, treatment, and disposal of retired weapons, components, and test units.

Implementation

Figure 1 shows the relationship of the tasks. Organizational responsibilities for each task are described in the Management Plan section.

Task 1 - Program Definition and Coordination, Development of Data Base Format

Task 1a - Define and Coordinate Program Activities

SNL will coordinate weapon waste minimization program activities among all participating organizations in order to assure program objectives are being met, avoid duplication of effort, and ensure that common approaches are used. SNL will update this weapon waste minimization plan to reflect new activities, completed activities, and changes dictated by changes in weapon program development, production, and retirements. We will also establish ES&H task schedules with the SNL weapon project engineers and track progress of the work under Tasks 2 to 6. SNL will also coordinate between relevant activities funded by DOE/DP and DOE/EM.

Task 1b - Develop a Computerized Data Base

SNL will develop a computerized data base that permits storage and retrieval of hazardous material information. A data base structure will be selected based on the needs of SNL, Pantex, and other agencies and the findings of Tasks 2 to 5. Compatibility with data bases at the PAs will be an important consideration.

SNL will formally document the data base. Documentation and control of the hazardous material identification are desired to implement changes in material classifications and additions of new materials due to retrofits while still in service.

Task 2 - New Weapon Programs, Future Production

Task 2, which describes activities for weapons now in development or future new weapons, has four subtasks. Task 2a identifies hazardous material and processes while Task 2b sorts and prioritizes ES&H problems and schedules work to resolve them. Task 2c describes new ES&H related development while Task 2d describes implementation of the development into the normal warhead development and production cycle and the materials data base.

Subtask descriptions for Task 2 are generic. SNL will develop individual plans for each weapon program. Each program will define a structure and subtasks that address the specific needs of the program.

Task 2a - Identify Hazardous Materials and Processes

The PAs will identify the hazardous materials and processes of concern for their particular site or are expected to be of concern during the time frame for production of the weapon. The PAs will compile the initial data because the ES&H requirements vary by local as well as federal laws and regulations. In addition, ES&H compliance is an individual, plant responsibility and is linked to the plant's DOE contract performance award. The end product of this activity will be a component by component compilation of materials and processes that are ES&H concerns and must be addressed.

Task 2b - Sort and Prioritize ES&H Problems and Schedule ES&H Development Work

SNL and the PAs will examine the ES&H problems from two perspectives: at the component or MC level, and as a technical discipline. At the component level, we will determine whether the functionality or reliability of the component may be affected due to a change of material. We will also group problems by technical disciplines, such as coating and plating, soldering and cleaning electronic assemblies, plastics, encapsulants, and adhesives.

After sorting we will prioritize each problem by assessing the likelihood of success in validating alternate materials and processes consistent with program schedules. Based on this assessment we will recommend that either a change be developed for warhead production or the ES&H requirements be fulfilled by implementing the necessary handling and protective procedures. Where necessary, program schedule modifications will be recommended.

For each recommendation, we will define a schedule, either for characterization and testing of a new material/process or the industrial engineering and procurement of the required handling facilities and equipment. As part of this task, we will identify long-term R&D needs and provide them to Task 6b.

Task 2c - Validate Materials and Processes

SNL and the PAs will validate the materials and processes identified in Task 2b. These activities will include any weapon performance, safety, and reliability qualification testing that is required as part of a weapon's normal development cycle.

Task 2d - Implement into War Reserve Documentation

SNL will write specifications for all materials and processes (as required) developed in Task 2c. The specifications will be implemented into the war reserve (WR) documentation and control systems at Sandia National Laboratories, Albuquerque (SNL,A) and Livermore (SNL,L). Materials information will be also be provided to Pantex for entry into the data base developed under Task 5. The data base will permit easy updating and retrieval of hazardous materials data.

Task 3 - Weapons Currently in Production

The activities under this task are similar to Task 2. However, activities are subject to the constraint that initial development has been completed.

Task 4 - Development of a Process for the Identification of Component and Test Unit Hazardous Material, SNL Custody

Task 4, which has seven subtasks, describes the activities needed to develop a process to identify hazardous materials in weapon assemblies, components, and piece parts at SNL,A. The items of interest are excess to current programmatic needs and are stored on site, in the GSA warehouse, and at Manzano Base. The process, when developed, will be applicable to SNL,L needs. Task 4 is complementary to Task 5 dealing with material in Pantex custody. The process will be developed under the auspices of a Process Development Team with members from Organizations 1800, 2300, 2500, 2800, 3200, 3400, 5100, 6600, and 7400 using Process Quality Management and Improvement (PQMI) principles where applicable. Because the extent of

hazardous materials identification required may depend upon available disposal options, this task will be closely coordinated with Organization 6600. Activities related to the declassification, treatment, and disposal of weapon waste material are described in a separate plan and in a project plan for the DOE/EM funded Integrated Demonstration for Weapon Dismantlement Waste.

Task 4a - Identify Materials Data Requirements for SNL

Hazardous material listings derived from federal regulations are presented in terms of complex chemical nomenclature requiring translation into common use terminology. The drawing search, Task 4c, will lead to SNL seven digit and public domain material specifications. SM4-11 is a compilation of such specifications. The primary element of Task 4a is to annotate SM4-11 to identify which materials are of interest from a regulatory viewpoint.

Other elements include determination of material quantity thresholds and specifically whether residue from process materials, such as solvents and mold release agents, must be considered. Elimination of process materials will have a major beneficial effect on the drawing search process.

Task 4b - Categorize Components for Disposal

Under this task we will group components and piece parts according to historical material content. This grouping will serve as input to the Organization 6600 treatment and disposal process and technology studies and to the Weapon Dismantlement Waste Integrated Demonstration. Typical groups might be metal parts, parachutes, plastic parts, cables, explosives, etc. Complex assemblies with considerable uniqueness are probably not applicable. A method will be devised to screen for exceptions to the rule. This concept will also require approval with respect to regulatory requirements.

Task 4c - Develop a Drawing Search Process

In this task we will perform an extensive search of drawing files for each component or part of interest. The output will be a list of product materials incorporated in the product and a list of process materials which might be present in residue quantities. Given such lists, correlation would then be made with the annotated SM4-11 addressed in Task 4a. Categorization with respect to hazard (corrosive, ignitable, reactive, toxic) can

then be accomplished. Task 4c is a direct corollary to Tasks 5b and 5c for Pantex material, much of which is expected to be common to SNL holdings.

Task 4d - Identify On-Site Analytical Techniques

This activity would start with a listing or catalog of currently available analytical techniques for material identification followed by trial applications where the results are compared to those obtained from drawing search on the same item. It relates to and in fact may be the same activity addressed in Task 6. Coordination between the two is needed to avoid duplication of effort and avoid confusion.

Task 4e - Declassification

There are severe limitations on the disposal of classified and mixed (radioactive and other hazards) waste. This subtask will address identification of classifying features and removal of radioactive parts from excess components. Declassification through administrative downgrading and physical alteration of the material through disassembly or machining techniques will be addressed. Where applicable, separation of radioactive parts or materials through disassembly or machining processes will be assessed. Each component will require attention on an individual basis. This task will provide a valuable input to the DOE/EM funded Integrated Demonstration for Weapon Dismantlement Waste. Efforts in this task will supplement the weapon waste treatment and disposal activities described in the forthcoming Organization 6600 plan, particularly where physical alteration helps or hinders subsequent waste treatment or disposal or where regulations interpret physical alteration as waste treatment. Coordination between this plan, the 6600 plan, and the Integrated Demonstration Project plan will insure that all efforts are synergistic. Where successful, a significant reduction in classified or mixed waste will be achieved.

Task 4f - Establish Data Base

This activity will record the results of the several identification techniques and will provide for retrieval of hazardous material information for both on-site and Pantex use. It directly interfaces with Task 1b and may become one element in an overall Laboratory materials data base.

Task 4g - Validate the Process

The process will be run on a sufficient quantity of on-hand components and parts to establish process feasibility and identify areas requiring improvement. Proofing will include correlation between identification techniques as well as the capability for supplementing and working around difficulties encountered with a particular technique on a given item.

The process will be documented by the Process Development Team with recommendations for Laboratory-wide implementation. The process has an interface with Property Reapplication Organization 3414 who will be invited to participate as a consultant during process development.

Task 5 - Identification of Component and Test Unit Hazardous Material, Pantex Custody

Task 5, which has three subtasks, describes activities needed to facilitate the disposal of hazardous materials from retired warheads and test units at Pantex. Task 5a describes Pantex efforts related to the identification of hazardous materials from retired weapons and test units. Task 5b performs test cases to assess the feasibility of extracting hazardous material information from the SNL,A and SNL,L drawing systems. Finally, Task 5c includes the actual identification of materials and their incorporation into the data base. Similar to Task 4, activities related to the actual treatment and disposal of these materials are described in a separate plan being prepared by Organization 6600.

Task 5a - Define Pantex Activities Related to Hazardous Material Identification

Pantex will define a methodology for the identification and verification of hazardous materials in weapons and test units which are being disassembled for retirement. The definition will include:

- Organizational responsibilities at Pantex
- Information requirements for the Design Agencies
- Procedures to provide a written audit trail of the identification
- Methods to incorporate revised definitions of hazardous materials

Pantex will prepare a weapon retirement schedule consistent with the latest issue of the Program Control Document. Based on this schedule Pantex will prepare a comprehensive forecast of hazardous waste generated by retired weapon and test unit disposition. Pantex will clearly identify areas where information is lacking on hazardous materials.

Pantex will develop a materials data base format using the following approach:

- Survey PX, AL/AAO, LANL, LLNL, and SNL to identify desired data base attributes
- Configure data base for Pantex use only with materials data inputs to be provided by the Design Agencies
- Write software

This task does not include the entering of information from specific programs since this will be done on a weapon program basis. Finally, Pantex will define recommended follow-on activities including tasks, schedule, and costs.

Task 5b - Conduct a Trial Drawing Search for the W68 and Selected Component Test Cases

The drawing systems for the W68 and three selected components will be examined to assess the feasibility of extracting materials data from the SNL,A and SNL,L engineering drawing systems.

Task 5c - Identify Materials

The weapons and test unit drawings will be searched to identify the hazardous and non-hazardous materials contained in each component. Components will be searched according to the Pantex needs described in Task 5a and the search procedure that results from the completion of the W68 and component search test cases. The end product of this activity is a compilation of hazardous and non-hazardous materials for each Pantex specified component which Pantex can use to guide their disassembly operations.

Any obstacles to obtaining the needed information, such as missing data or proprietary data, will be reviewed with the SNL project engineer responsible for the weapon project under study and SNL materials experts. If feasible, further materials identification will be attempted using analytical tools being developed under Task 6. If the materials data cannot be obtained

from the drawing system, measurements, or other sources then a note will be added to the component materials description stating the reason for the problem and the solution.

Task 6 - Materials, Processes, and Component Technology

Development of analytical methods, validation of replacement materials, and design of new components to reduce hazardous and radioactive material usage will be done in this task. Priorities will be keyed to the needs of the individual weapon programs.

Task 6a - Perform Materials Analysis and Validation

This task includes activities to define and apply appropriate materials imaging and analytical methods to locate, identify and quantify radioactive and hazardous materials in retired and tested weapon components. These techniques are to be used on test cases to supplement and validate the search for radioactive and hazardous materials performed in Tasks 4c and 5c. These techniques will also be applied when the drawing search process proves insufficient to identify the type, quantity and location of these hazardous materials.

Materials experts will work closely with experienced component designers to match materials imaging and analytical tools to disassembly requirements, with the goal of establishing the simplest ways of positively distinguishing hazards and sorting unknown materials. Initially, a directory of the relevant imaging and analytical tools that will be needed to support Tasks 4 and 5 will be compiled for Pantex, SNL/A and SNL/L. This directory will provide an assessment of whether existing capabilities and expertise will be sufficient to provide the required identification functions.

Among the materials imaging tools required are high resolution film radiography and real-time radiography supplemented with digital image processing. These tools will be used to: establish the spatial relationships of subcomponents; reveal the locations of wires, switches, high Z materials, and potted subassemblies; locate any moving subcomponents and assess the state of damage in functioned or tested components. These imaging tools will permit the development of step-by-step disassembly or destruction procedures by Pantex and SNL/A. Radiometric methods will ascertain the presence or absence of radiation sources. Ion mobility spectrometers and neutron measurements may be required to identify explosives and certain liquids.

As specific unknown materials are exposed during component breakdown, appropriate analytical methods, such as IR spectroscopy, x-ray fluorescence, emission spectroscopy, and gas chromatograph mass spectroscopy, will be used to provide material identification.

The intelligent application of materials imaging and analysis tools will permit Pantex and SNLA to safely declassify, disassemble and dispose of materials from components that cannot otherwise be identified, and to validate the data obtained through drawing searches.

Task 6b - Develop New Technology and Incorporate into Component Designs

New technology development is of extreme importance since many present weapon manufacturing technologies employ materials and processes which are either known to be hazardous or are likely to be viewed as such in the future. From this perspective, present materials, processing, and component problems need to be solved. But in addition, in order to be able to respond in a timely manner to evolving environmental realities, forward-looking and anticipatory technology development will be required.

Technology development for the major areas of organic solvents, polymer processing, and electroplating and surfacing are major elements of the DOE/EM funded waste minimization program. The long term strategy for each of these areas is addressed in Waste Stream Strategy documents being prepared at the request of DOE/EM. Technology which anticipates future requirements will be developed under DOE/DP sponsorship.

Materials and processes for component-specific problems are funded by DOE/DP. Materials and processes will be implemented after the necessary testing and validation have been completed. Development of new component designs to eliminate hazardous and radioactive material usage will be done where the technology base makes this possible. Materials and processes for electronic components will be demonstrated in the DOE/EM sponsored Integrated Demonstration for Environmentally Conscious Manufacturing of Electronics.

Management Plan

The lead organization for each task will prepare a multi-year task plan. This plan will include a definition of tasks, responsibilities, schedules, and resources required. The target date for the multi-year plans is December 1991.

Task 1 - Program Definition and Coordination, Development of Data Base Format

Lead Organization - Division 8166
Schedule - Continuing

Task 2 - New Weapon Programs, Future Production

Lead Organization - B61-6, -8, - Division 5111
B61-9 - Division 5113
W61 - Division 5111
W89 - Department 8150
W91 - Department 5160
Support - All Production Agencies
Schedule - W89 - Completed plan 5/91

Task 3 - Weapons Currently in Production

Lead Organization - B61-7, B61-10 - Division 5111
B83 - Division 8162
W80-0 - Division 5113
W88 - Department 5150

Task 4 - Development of a Process for the Identification of Component and Test Unit Hazardous Material, SNL Custody

Lead Organization - Division 5114

**Task 5 - Identification of Component and Test Unit Hazardous Material,
Pantex Custody**

Lead Organization for 5100 Activities - Division 5114

Lead Organization for 8100 Activities - Division 8166

**Task 5a - Define Pantex Activities Related to Hazardous Material
Identification**

Lead Organization - Pantex

Coordination with SNL - Division 8166

Schedule - Complete 10/91

**Task 5b - Develop a Drawing Search Process for the W68 and Selected
Component Test Cases**

Lead Organizations - Division 5114, Division 8166

Task 5c - Identify Materials

Lead Organization - The organization at SNL responsible for a specific weapon will be the lead for all activities for that weapon.

Task 6 - Materials, Processes, and Component Technology

Setting priorities - Organizations 5100 and 8100.

Lead Organizations will be by the designated 1800, 2500, 6600, 7400, 8300 Organization

Deliverables

The following deliverables will be provided for the activities funded under this plan:

1. Annual revision of this overall program plan
2. Quarterly status reports

3. Documentation of computerized data base structure and instructions for use
4. Computerized listings of hazardous materials for retired weapon and test unit components in Pantex and SNL custody (weapons in development and production not included - listings for these will be provided by the individual project groups)
5. Materials, processes, and components technology development reports (number and subject to be determined)

Weapon Waste Minimization Plan

APPROVED BY:

G. N. Beeler (Actg) 5100

J. B. Woodard, 6600

E. E. Ives, 8100

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U. S. Department of Energy (3)
P. O. Box A
Germantown, MD 20874
Attn: C. Frank
Col. D. Garcia, USAF
K. E. Hain

U. S. Department of Energy (18)
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, NM 87115
Attn: K. Agogino
M. C. Baca
K. A. Carlson
J. J. Chavez/OCC
W. J. Conklin/WPD
J. M. Eckhart
J. M. Evett/WMOSD
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R. L. Lopez/WQD
D. D. Monette/WPD
P. E. O'Guin/WPD
G. N. Pappas
P. A. Saxman/EM
H. T. Season, Jr.

U. S. Department of Energy (4)
Amarillo Area Office
P. O. Box 30030
Amarillo, TX 79120
Attn: J. J. Kaltefleiter
L. M. Paradee
K. S. Rutz
N. E. Williams

U. S. Department of Energy (2)
Dayton Area Office
P. O. Box 66
Miamisburg, OH 45342
Attn: D. V. Eckman
T. Frazier

U. S. Department of Energy (2)
Kansas City Area Office
P. O. Box 202
Kansas City, MO 64141
Attn: D. Caughey
G. M. Jones

U. S. Department of Energy
 Oak Ridge Operations Office
 P. O. Box 2001
 Oak Ridge, TN 37831-8764
 Attn: R. J. Spence

U. S. Department of Energy
 Rocky Flats Area Office
 P. O. Box 928
 Golden, CO 80401
 Attn: L. Kwei

U. S. Department of Energy (2)
 Pinellas Area Office
 P. O. Box 2900
 Largo, IL 34294
 Attn: F. E. Davis
 G. Schmidtke

U. S. Department of Energy (2)
 Savannah River Operations Office
 P. O. Box A
 Aiken, SC 29802
 Attn: P. Jenkins
 M. L. Toole

Allied-Signal, Inc (14)
 Kansas City Division
 P. O. Box 419159
 Kansas City, MO 64141-6159
 Attn: P. C. Black

W. G. Cooper
 D. A. Cummings
 D. E. Ellis
 D. Huyett
 C. F. Kircher
 J. A. Knuth

J. C. Lankford
 A. L. Levine
 D. E. Long
 J. E. O'Hara
 R. E. Schmidt
 D. L. Stoltz
 A. K. Thoeni

Camargo Associates, Jacobs Engineering Group
 P. O. Box 465600
 Cincinnati, OH 45240
 Attn: N. M. Motz

EG&G Mound Applied Technologies (7)

P. O. Box 3000

Miamisburg, OH 45343-3000

Attn: C. S. Friedman
 J. Griffin
 J. F. Lemming
 D. E. Michel

R. A. Neff
 D. Organ
 W. H. Smith

EG&G Rocky Flats Inc. (11)

Rocky Flats Plant

P. O. Box 464

Golden, CO 80402-0464

Attn: A. H. Burlingame
 D. W. Croucher
 J. Cuicci
 D. L. Gibbs
 T. J. Healy
 J. M. Kersh

J. R. Majestic
 R. V. Morgan
 G. L. Potter
 D. B. Van Leuven
 B. P. Warner

G. E. Aerospace Neutron Devices (10)

Pinellas Plant

P. O. Box 2908

Largo, FL 34649-2908

Attn: R. C. Abington
 D. Delaneuville
 R. A. Fleming
 U. Harder
 W. E. Neacy

J. B. Neale
 W. C. Pijawka
 G. Smith
 T. E. Wagner
 E. H. Wegman

Jacobs Engineering Group, Inc.

5301 Central Avenue NE, #1600

Albuquerque, NM 87108

Attn: J. F. Graff

Los Alamos National Laboratory (6)

P. O. Box 1663

Los Alamos, NM 87545

Attn: W. Crisman
 T. Drypolcher
 M. Fletcher

G. Mortensen
 E. Plassman
 L. Salazar

Martin Marietta Energy Systems, Inc. (12)

Y-12 Plant

P. O. Box 2009

Oak Ridge TN 37831

Attn:	J. Bailey	T. R. Chilcoat (3)
	C. R. Bieber	W. D. Davis
	D. B. Bopp	G. Hackett
	D. J. Bostock	J. W. Koger
	W. Brosey	J. Skinner

Mason & Hanger Silas Mason Co., Inc. (19)

Pantex Plant

P. O. Box 30020

Amarillo, TX 79177

Attn:	J. R. Allen	T. F. Hall, Jr.	S. A. Mullins
	C. D. Alley	J. E. Hemphill	R. Ortiz
	R. J. Ballard	J. C. Hood	R. H. Pankratz
	J. G. Burr	D. C. Hugus	D. D. Salmon
	B. D. Faubion	M. S. Johnson	R. J. Slape
		T. R. Jones	D. E. Whitson
		W. L. Matthews	T. D. Youngblood

University of California (5)

Lawrence Livermore National Laboratory

P. O. Box 808

Livermore, CA 94550

Attn:	D. B. Frischknecht, L-125
	R. F. Hatfield, L-125
	W. H. Hubbell, L-125
	J. L. Robbins, L-125
	R. D. Stoddard, L-125

Westinghouse (10)

Savannah River Co.

P. O. Box 616

Aiken, SC 29808

Attn:	F. H. Brown	L. M. Papouchado
	J. T. Buckner	P. J. Rowan
	E. H. Dicks	M. A. Schmitz
	T. A. Manglesdorf	C. P. Thompson
	W. R. Morris	M. W. Walcher

20	O. E. Jones	5145	D. H. Schroeder
1000	V. Narayanamurti	5147	G. L. Maxam
1800	R. J. Eagan	5150	K. D. Hardin
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3200	N. R. Ortiz	5166	R. C. Hartwig
3221	S. L. Chavez	5166	T. D. Hernandez
5000	H. Schmitt (A)	5167	D. F. McVey
5100	G. N. Beeler (A)	5170	M. J. Eaton
5110	C. C. Burks	5171	E. A. Chipman
5111	R. E. Kreutzfeld	5172	R. F. Glaser
5111	W. J. Patterson	5173	P. D. Merillat
5113	R. W. Jorgensen	5174	B. N. Malm
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