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Solid Low-Level Waste Certification Strategy

M. A. Smith

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ORNL/TM-11307

OAK RIDGE NATIONAL LABORATORY
ENVIRONMENTAL AND HEALTH PROTECTION DIVISION
WASTE MANAGEMENT OPERATIONS PROGRAM
WASTE MANAGEMENT COORDINATION OFFICE

SOLID LOW-LEVEL WASTE CERTIFICATION STRATEGY

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS iii

LIST OF FIGURES v

ACRONYM LIST vii

PURPOSE AND SCOPE 1

DEFINITIONS 1

INTRODUCTION 3

ORGANIZATION 4

RESPONSIBILITIES 6

WASTE CERTIFICATION PROCESS 11

WASTE CHARACTERIZATION 13

GENERAL METHODS OF WASTE CHARACTERIZATION 13

PROCEDURE FOR CHARACTERIZING WASTE 14

Phase I - Gross Characterization 14
Phase II - Establish Baseline Characterization 16
Phase III - Implement Routine Characterization Program 16

OTHER CONSIDERATIONS IN WASTE CHARACTERIZATION 18

INSPECTIONS AND AUDITS 20

TRAINING 22

CONTROL OF FACILITIES, EQUIPMENT AND MATERIALS 22

DOCUMENT CONTROL 23

IMPLEMENTATION SCHEDULE 23

REFERENCES 24

APPENDIX A: ARTICLES PROHIBITED FROM SLLW 25

LIST OF FIGURES

Page

1. Line Management Structure of ORNL Solid Low-Level Waste Certification Program 5

2. Waste Generating Organization for SLLW Certification 6

3. Certification Process for Solid Low-Level Waste at ORNL 12

ACRONYM LIST

ALARA	As Low As Reasonable Achievable
DOE	Department of Energy
EPA	Environmental Protection Agency
GCO	Generator Certification Official
IWMF	Interim Waste Management Facilities
LCO	Laboratory Certification Official
LLN	Low-Level Number
LLW	Low-Level Waste
NARM	Naturally occuring and accelerated produced radioactive material
NDA	Nondestructive Assay
NRC	Nuclear Regulatory Commission
ORNL	Oak Ridge National Laboratory
ORO	Oak Ridge Operations
QA	Quality Assurance
QAS	Quality Assurance Specialist
RCRA	Resource Conservation and Recovery Action
RSWO	Radioactive Solid Waste Operations
RTR	Real-time Radiography
SLLW	Solid Low-Level Waste
SWSA	Solid Waste Storage Area
TRU	Transuranic
WEAF	Waste Examination and Assay Facility
WMCO	Waste Management Coordination Office

PURPOSE AND SCOPE

The purpose of the Solid Low-Level Waste Certification Program is to provide assurance that SLLW generated at the ORNL meets the applicable waste acceptance criteria for those facilities to which the waste is sent for treatment, handling, storage, or disposal. This document describes the strategy to be used for certification of SLLW at ORNL.

The SLLW Certification Program applies to all ORNL operations involving the generation, shipment, handling, treatment, storage, and disposal of SLLW. Mixed wastes, containing both hazardous and radioactive constituents, and TRU wastes are not included in the scope of this document.

DEFINITIONS

1. Disposal. Emplacement of waste in a manner that assures isolation from the biosphere for the foreseeable future with no intent of retrieval and that requires deliberate action to regain access to the waste.

2. Generator Certification Official. Individual designated by a waste generator to serve as the waste certification program coordinator for that generator.

3. Hazardous Waste. Those wastes that are designated hazardous by EPA regulations or that present sufficient potential threat to human health or the environment if improperly handled to merit management as hazardous waste under ORNL procedures.

4. High-Level Waste. The highly radioactive waste material that results from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid waste derived from the liquid, that contains a combination of TRU waste and fission products in concentrations requiring permanent isolation.

5. Laboratory Certification Official. Individual designated by ORNL to serve as the waste certification program coordinator for the Laboratory for a specific category of waste (e.g., TRU LCO, SLLW LCO, etc.)

6. Mixed Waste. Waste containing both radioactive and hazardous components as defined by definitions 9 and 3, respectively.

7. Package. The outside container together with its contents as presented for transfer, storage, or disposal.

8. Packet. Radioactive waste contained in a small container, usually a clear plastic bag, that is placed inside a larger container used for transfer, storage, or disposal.

9. Radioactive Waste. Material that contains radionuclides regulated under the Atomic Energy Act of 1954, as amended, and is of negligible value, considering costs of recovery. Only solid materials are included under this definition for the purposes of this document.

10. Solid Low-Level Waste. Radioactive solid waste that contains radioactivity and is not classified as high-level waste, TRU waste, spent nuclear fuel, or byproduct material as defined in section 11e(2) of the Atomic Energy Act of 1954 (42 U.S.C. 2014(e)(2)). Test specimens irradiated for research and development only, and not for the production of power or plutonium, may be classified as LLW, providing the concentration of nuclides meeting the definition of TRU waste is less than 100 nCi/g. In the ORNL waste management program, SLLW includes NARM, as described in DOE Order 5820.2A.

11. Storage. Retrievable retention of waste pending treatment or disposal.

12. Transuranic Waste. Without regard to source or form, waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g at the time of assay. Heads of DOE Field Elements can determine that other alpha contaminated wastes, peculiar to a specific site, must be managed as TRU waste.

13. Treatment. Any method, technique, or process designed to change the physical or chemical character of waste to render it less hazardous, safer to transport, store, or dispose, or reduced in volume.

14. Waste Certification. Verification that waste complies with the waste acceptance criteria for the facility or operation to which the waste is being transferred.

15. Waste Characterization. Determination of the physical, chemical, and radiological characteristics of waste.

16. Waste Generator. An organizational unit that is responsible for activities generating SLLW.

INTRODUCTION

In April 1986, SLLW disposal operations in SWSA 6 at ORNL were halted by order of the DOE-ORO. The order was issued because hazardous wastes were being disposed in SWSA 6 in violation of the RCRA. A SLLW certification program was instituted to improve the segregation of hazardous waste from SLLW and to provide assurance that the wastes were being managed properly. The certification program, which is still in effect, includes [Reference 1]:

- improved training for operators and supervisors in areas generating SLLW, with restrictions against untrained personnel being allowed to package SLLW,
- documentation to track the individual waste packets being placed into the SLLW container,
- SLLW generator program reviews, and
- verification of appropriate SLLW package contents by RTR.

In addition to being segregated from hazardous and nonradioactive wastes, SLLW is also sorted into categories based on the level of radiation hazard present and, in a few cases, on the type of material present in the waste, such as contaminated asbestos. Under the present system, the categorization is dependent on the external radiation levels measured at the surface of each disposal container. [Reference 2]

DOE Order 5820.2A requires SLLW disposal facilities to adhere to dose based performance objectives. An integral part of implementing that requirement is the development of a SLLW classification system designed to accommodate those performance objectives. While several parameters, such as the physical characteristics of the waste packages and the disposal site, determine the specific classification, the basis for SLLW characterization and certification is determining the concentration of radionuclides in the waste either through direct measurement methods or through indirect methods. This approach is a radical departure from the classification scheme based on external radiation hazard and estimated radionuclide concentrations. [References 3 and 4]

Due to the evolution of a more rigorous classification system for management of SLLW based on radionuclide concentration, redirection of the ORNL SLLW certification program is needed to provide the waste characterization needed. This document describes the process for adapting the current SLLW Certification Program into a form which will provide the necessary information. The SLLW certification program structure described in this document is patterned after similar operations for certification of TRU wastes at ORNL [Reference 4] and after the SLLW certification criteria for the Nevada Test Site [Reference 5].

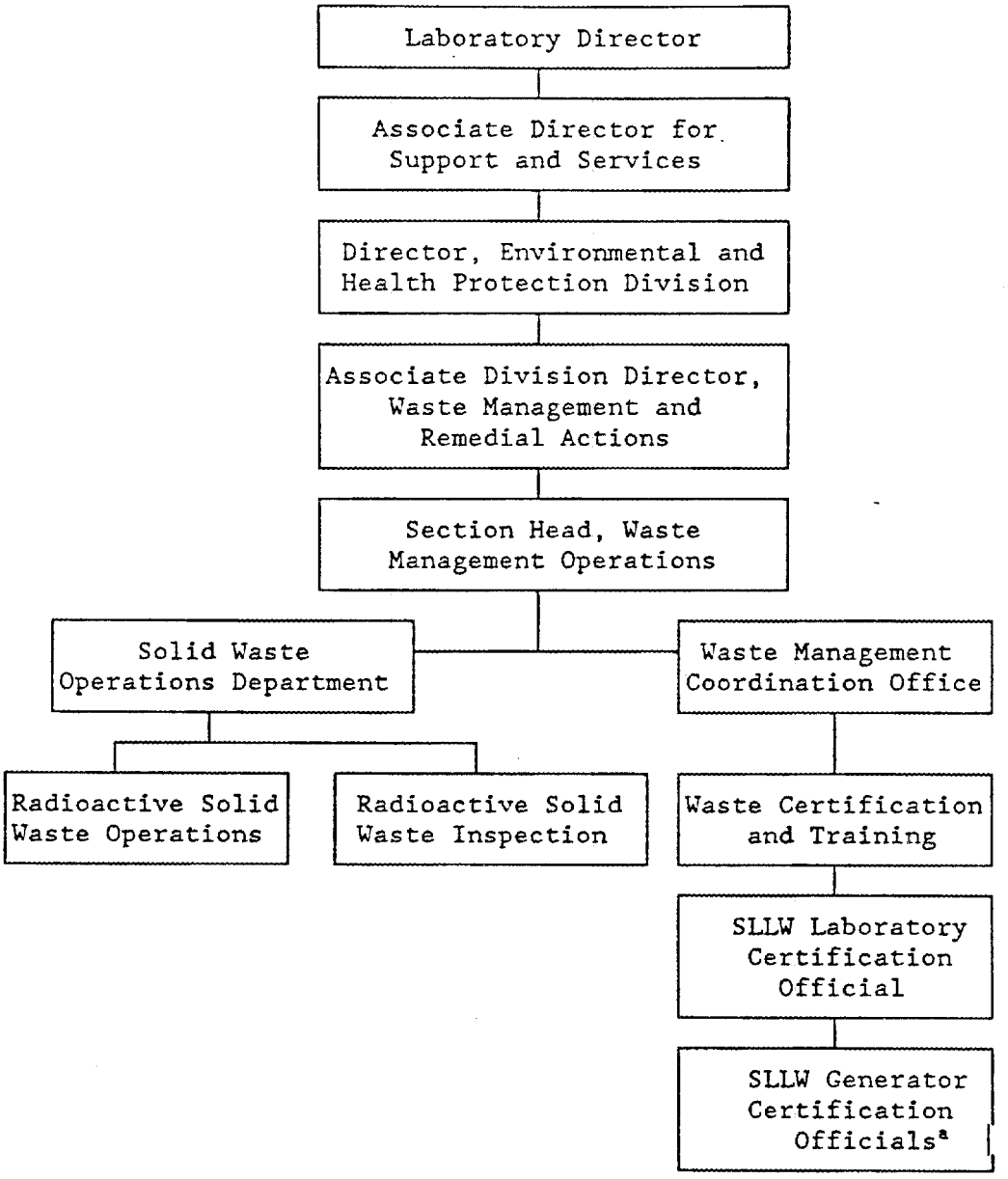
ORGANIZATION

ORNL is a multiprogram laboratory operated for the DOE by Martin Marietta Energy Systems, Inc., to conduct research and development activities for the DOE, for other U.S. government agencies, for private industry and for institutional organizations. The Laboratory Director and Deputy Director comprise the uppermost level of the ORNL organization, with the sequence of authority established in waste operation programs, in order, through the Associate Laboratory Director, Division Director, Associate Division Director, Section Head, Department Head, and Group Leader. Not all organizations at ORNL include all the levels of management listed.

Coordination of the SLLW certification program is the responsibility of the Waste Management Coordination Office in the Waste Management Operations Section of the Environmental and Health Protection Division. Figure 1 is a schematic representation of the sequence of authority for the organization responsible for certifying SLLW at ORNL.

The GCOs, shown at the lower right of Figure 1, are not a part of the line management structure governing certification activities. Instead, each ORNL organization which generates SLLW must appoint an individual to serve in this capacity. That person is responsible for coordinating the certification activities within the organization, and may be appointed at the division level or at a lower level within the division, depending on the scope of operations. For example, if a division generates a single SLLW stream which can be characterized relatively easily, a single GCO should be able to serve the entire division. However, if there are several operating units within the division, such that many different waste streams are generated with different characteristics, it would be preferable to appoint a GCO for each of the smaller organizations within the division in order to ensure that the GCO was familiar with the SLLW being generated.

Persons serving in the capacity of GCO are responsible to their own line management, as shown in Figure 2, but also have matrix responsibilities to the LCO. In the SLLW certification program, the LCO establishes the criteria under which each generator must certify SLLW. In order to accomplish this, the LCO must work in conjunction with both the Waste Management Coordination Office, which serves the planning and development functions of waste management operations, with the Solid Waste Operations Department, which includes the operational responsibilities in waste handling, storage, inspection, and disposal, and with treatment, storage, and disposal site operators. (Refer to the following section on responsibilities.) The LCO provides direction and guidance to the GCOs, serving as a program administrator for SLLW certification.



[a] Programmatic relationship

Fig. 1. Line Management Structure of ORNL Solid Low-Level Waste Certification Program

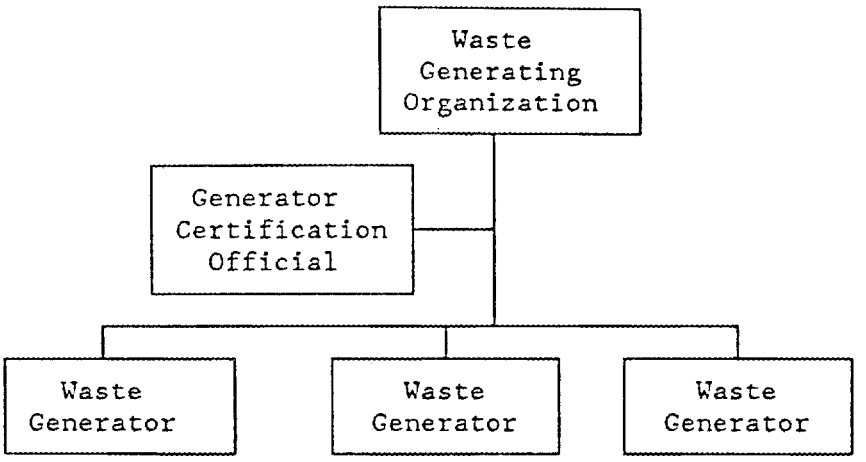


Fig. 2. Waste Generating Organization for SLLW Certification

Several organizations within Martin Marietta Energy Systems, Inc., and ORNL provide oversight of the SLLW certification program, including audits and procedure reviews. Some of these organizations may have interest in only a single aspect of the certification program, while others will be more comprehensively involved.

For facilities developed after the ORNL Interim Waste Management Facility, the Reservation Waste Management Division shown in the figure will be the operator of the facilities used for SLLW disposal on the Oak Ridge Reservation. However, since other facilities will also be involved in disposing of the SLLW that is unsuitable for handling on the Reservation, other disposal organizations will also have review and oversight responsibilities. The Central Waste Management Operations organization is a Martin Marietta Energy Systems Inc., coordinating and oversight group.

RESPONSIBILITIES

All individuals and organizations are responsible for maintaining quality assurance documents, standard operating procedures, and other documentation as required to perform their tasks.

1. SLLW Laboratory Certification Official

   a. Develop ORNL SLLW Certification Program according to criteria and guidelines established by treatment, storage, and disposal facilities.

   b. Certify that SLLW generated or packaged at ORNL meets the applicable waste acceptance criteria for treatment, storage, or disposal and that generation and packaging of wastes at ORNL follows a documented and approved certification program.

   c. Coordinate SLLW certification activities among generators, program office(s), other certification program participants, and treatment, storage, or disposal facilities.

   d. Maintain ORNL SLLW Certification Program documents in an approved document management system and update such documents as needed.

   e. Ensure that SLLW certification documents are prepared, updated, and approved for each SLLW generator.

   f. Resolve special issues in SLLW certification, SLLW characterization, and in SLLW generator training program as necessary.

   g. Distribute information on certification requirements to program participants and gathers information from participants as necessary, including reviewing trends in nonconformance reports.

   h. Perform evaluations, reviews, or audits of SLLW generator certification programs.

   i. Provide technical assistance in development of, reviews and approves, monitors, and updates the ORNL SLLW generator training program.

   j. Prepare reports on SLLW generation rates, treatment volumes, effectiveness of waste reduction techniques, or other parameters as necessary and appropriate.

   k. Review Nonconformance Reports and monitor trends.

2. Generator Certification Officials

   a. Certify that SLLW generated within assigned area of responsibility meets the pertinent waste acceptance criteria and that generation and packaging of wastes within area of responsibility follow a documented and approved certification program.

   b. Provide characterization of SLLW generated within assigned area of responsibility.

   c. Perform evaluations, reviews, or audits of SLLW generator certification programs within area of responsibility.

   d. Maintain SLLW certification documents applicable to area of responsibility in an approved document management system.

   e. Maintain training for generator personnel within area of responsibility.

   f. Review Nonconformance Reports and monitor trends.

   g. Review and approve all SLLW generation and transfer documentation and generator training records within area of responsibility.

   h. Minimize the generation of SLLW through recycle, material substitution, decontamination, or other methods as appropriate.

   i. Communicate with LCO and waste operations groups concerning SLLW generation and certification activities within area of responsibility.

3. Radioactive Solid Waste Operations

   a. Schedule and collect waste packages from SLLW generator facilities.

   b. Transport SLLW, including loading into any special transport containers, to treatment, storage, examination, or disposal facilities.

   c. Provide or arrange to provide SLLW treatment, including repackaging, storage, and disposal, either through on site or off site facilities, when applicable.

   d. Provide SLLW storage, including appropriate segregation of waste packages (e.g., physical or administrative separation of drums rejected by real time radiography from those accepted, etc.).

e. Audit and approve certification documents for each SLLW package prior to collection.

f. Visually inspect SLLW packages upon delivery to and receipt from waste generators.

g. Develop waste acceptance criteria for treatment, storage, and disposal facilities operated by RSWO.

h. Provide identification labeling for waste packages after collection from generator facility. (e.g., LLNs, labels required for disposal site shipments, etc.)

i. Provide specifications or instructions to SLLW generators for construction of special waste containers (i.e., plywood boxes).

4. Stores

a. Procure and distribute approved drums for SLLW packaging.

5. Data Base Management, Documentation Management Center

a. Maintain records of SLLW generation and handling.

b. Maintain and upgrade computerized data base as needed, in accordance with approved procedures.

6. Radioactive Solid Waste Inspection

a. Perform nondestructive assay and nondestructive examination of SLLW packages, as appropriate to facility operating procedures.

b. Audit SLLW certification documentation of waste received at facility.

c. Issue Nonconformance Reports for waste packages which do not meet specified waste acceptance criteria.

d. Complete certification for individual waste packages, including documentation of package weight, radionuclide assay, etc.

7. Waste Generator Training, Waste Certification and Training Program

a. Schedule and conduct SLLW generator training courses, including preparing and grading examinations, with assistance from other groups (e.g., LCO, RSWO, WEAF, etc.), as appropriate.

b. Maintain data base of personnel certified through SLLW generator training.

c. Provide periodic listings of trained personnel to RSWO, the LCO, and the GCOs.

d. Update SLLW generator training course as needed.

e. Maintain quality assurance documents and records as appropriate, including official copies of the training course materials as approved by the Waste Management Coordination Office and the Radioactive Solid Waste Operations Group.

8. Quality Assurance Specialists and Quality Assurance Representatives

a. Perform QA audits on all SLLW certification operations.

b. Review, monitor, and track corrective actions for Nonconformance Reports, audit findings, or other documented program deficiencies.

c. Review and provide comments on draft SLLW certification program documents and QA plans.

9. Environmental Monitoring and Compliance

a. Develop and promulgate ORNL environmental standards applicable to SLLW certification.

b. Review and provide comments on draft SLLW certification program documents.

c. Provide environmental sampling or monitoring for SLLW certification facilities, as needed.

d. Conduct environmental audits of SLLW certification program and facilities.

10. Radiation Protection Department

a. Develop and promulgate ORNL radiation protection standards applicable to SLLW certification.

b. Survey, monitor, and provide other health physics services to SLLW generators and SLLW certification activities.

11. Environmental Projects and Engineering

a. Incorporate design features necessary for SLLW characterization and certification into facilities under design and construction.

WASTE CERTIFICATION PROCESS

Figure 3 schematically represents the SLLW certification process at ORNL as described in this document.

The waste generator provides waste characterization data as specified by the LCO and waste management operations groups and certifies that the waste generated by that particular process meets the acceptance criteria established for transporting SLLW to treatment, storage, examination, assay, or disposal facilities. The generator certification program must be reviewed by the LCO and the RSWO Group before waste is received from the generator. The generator certification program must meet the established criteria before the waste being generated at that facility may be handled by waste management operations groups.

Assay facilities in the generator's area, as discussed in the next chapter, may be used to provide waste characterization data prior to the SLLW package being picked up by RSWO. As a part of the certification by the generator, appropriate documentation, the format and content of which will be determined by the waste operations and certification organizations, must be provided.

Additional provisions can be made for infrequent or occasional SLLW generators with small quantities of waste to manage. If the amount of waste being generated is below an as yet undetermined minimum quantity, and the generator does not produce SLLW on a routine basis, special consideration can be given. Rather than impose the rigorous administrative, procedural, and analytical requirements on the infrequent, small quantity generator that are imposed on the routine, larger quantity generators, the LCO and the RSWO Group can provide, based on the type and quantity of waste, the necessary characterization and certification functions normally provided by the generator.

Upon notification by the generator that a SLLW package needs to be removed from the generator facility, RSWO first verifies that the facility has an established SLLW certification program with an appropriately trained GCO and the necessary procedures. The documentation which is to accompany the particular waste package will be examined prior to scheduling transfer of the waste package. If the generator has developed the applicable procedures, established a certification program, and has properly completed the necessary documentation, transfer of the waste package from the generator facility is then scheduled. However, if there is a deficiency, such as improperly completed documentation, lack of a signature by an approved person, inadequate certification program, or untrained generator personnel, scheduling the transfer of that waste package must be postponed either until such deficiencies are corrected, or until adequate assurance that the waste package meets the acceptance criteria is provided.

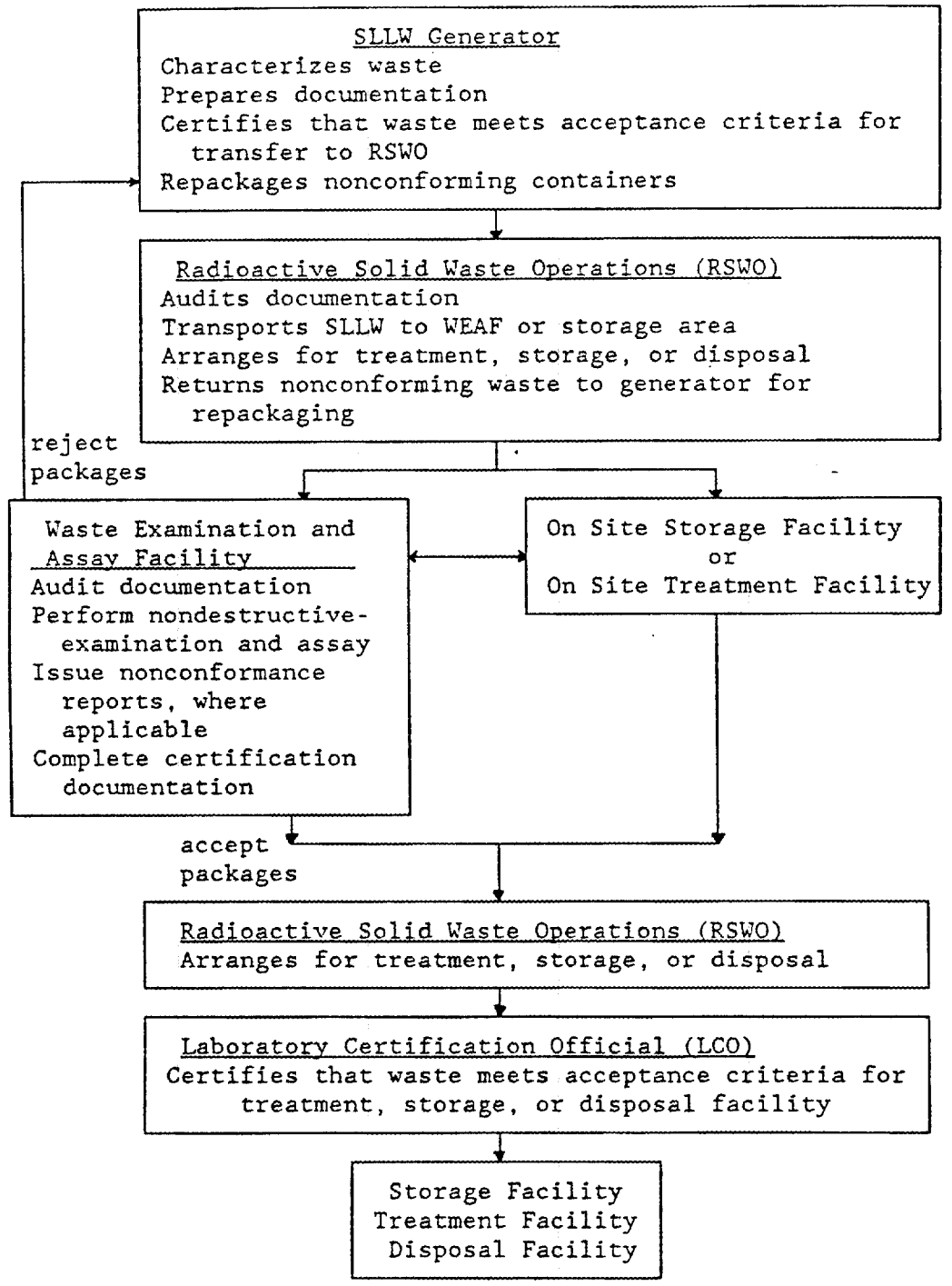


Fig. 3. Certification Process for Solid Low-Level Waste at ORNL

When the waste package is transferred from the generator facility, those packages meeting the acceptance criteria for the WEAF, or its successor facilities, will be scheduled for nondestructive examination. Pertinent acceptance criteria for the WEAF are the size, shape, weight, and surface exposure rate of the waste package and the composition of the SLLW. In some cases, such as with drums containing sludges, resins, or soils, or with packages having a surface exposure rate of greater than 200 mR/h, the acceptance criteria for the WEAF will not be met. Although those packages may meet the acceptance criteria for treatment, storage, and disposal facilities, they will not be processed through the WEAF.

The final certification documentation, including the manifest described in DOE Order 5820.2A, is prepared by combining data supplied by the generator with that provided by local assay facilities and the WEAF. The documents may be prepared by compiling data from these sources, through electronic data bases, hard copy, or any combination. Final certification of a waste package is performed by the LCO.

WASTE CHARACTERIZATION

The most important part of the SLLW certification program based on radionuclide concentration limits is characterizing waste streams. In addition to characterization of waste according to its radionuclide content, this part of the program must also provide assurance that prohibited constituents are being excluded. Appendix A includes a list of several items which are to be excluded from SLLW, based on current and draft waste acceptance criteria. Additional items may be included on the prohibition list as the waste acceptance criteria for new treatment, storage, and disposal facilities are developed.

GENERAL METHODS OF WASTE CHARACTERIZATION

According to guidance given by the NRC [Reference 6] and reinforced by DOE [Reference 7], the acceptable techniques for characterizing wastes are:

1. Measurement

   Either direct or indirect measurement may be used. Direct measurement would include techniques such as gamma spectroscopy on waste packets or waste packages or sampling the waste stream. Indirect methods may include using gross measurements, such as surface exposure rates, in conjunction with scaling factors. The indirect methods would be applicable to a well defined waste stream and would have to be substantiated through use of direct measurement techniques.

2. Material Accountability

   Essentially a bookkeeping method, accountability uses the difference between material input for a process and the amount of that material that is present in the product, including the amounts known to be consumed or converted in the process and the quantity remaining as contamination on surfaces or inside pipes and ducts. To be used as a basis for waste characterization, material accountability would have to be substantiated through direct measurement techniques.

3. Process Knowledge

   Through an understanding of the material input to a process and the manner in which the material is manipulated or handled, the waste may be characterized by use of a model which accounts for the quantities which will be included in the waste from that process. The model may be rather simple or complex, depending on the process involved, but also must be substantiated.

   NOTE: The NRC lists this as a separate characterization technique, while DOE Order 5820.2A presumes it to be a subset of material accountability.

PROCEDURE FOR CHARACTERIZING WASTE

Waste characterization is the responsibility of the waste generator, with guidance and assistance from the waste operations and certification groups. While the final characterization technique for a specific waste generator will be dependent on the process generating waste, the approach to developing characterization data will be a phased process.

Phase I - Gross Characterization

The initial information for SLLW characterization describes the gross character of specific waste streams. This information may be gathered through review of previously collected data, including the radioactive waste data base system, or through questionnaires and interviews with waste generators.
Phase I consists of two actions:

1. Identify and categorize the waste stream

   Identification of the waste stream may be the building, process, or any other label which will readily identify the waste generator and will be specific to a particular waste stream. At this point, categorization of the waste stream consists of sorting the process into the broad categories: homogeneous or heterogeneous with respect to the physical composition, consistent or inconsistent over time with respect to the constituency and concentration, and generated as a result of routine operation or from a specific campaign. In implementing the SLLW certification strategy, these terms will be defined more rigorously. However, for the purpose of describing the strategy itself, only the concepts are presented.

Homogeneity or heterogeneity of the waste physical form is based on the gross characteristics of a "typical" waste package generated through that process. While there will never be any waste package that is completely homogeneous, in that small discontinuities exist in any physical field, the waste should be categorized according to the degree of difficulty involved in obtaining a representative sample of the waste. For example, a container of analytical laboratory wastes (syringes, gloves, reagent bottles, etc.) could be considered heterogeneous, while a more uniform material such as ion exchange resins could be considered homogeneous, since a representative sample of the former would be difficult, if not impossible, to obtain, but might be obtained relatively easily from the latter.

The constancy or inconstancy in the composition of a waste stream may also be considered in the context of the difficulty in obtaining a representative sample of the waste stream. If a routine sampling program were to be established for the waste stream in question, the degree of constancy would be directly tied to the frequency with which samples would have to be collected in order to be representative. For example, a waste stream that routinely has a wide variation in the constituent type and quantity, such that samples would have to be collected on a weekly, or more often, basis in order to be representative, would be considered inconstant. However, a waste stream that does not have as great a variation, such that annual samples would be adequately representative, would be considered constant.

The distinction between operational waste generation and waste generated from a specific campaign is related to the length of time the generating process is in operation. Short-term projects would be considered campaigns, and processes that will continue for longer terms would be considered operational.

Therefore, the result of this phase of waste characterization would be to group each waste stream into one of the following categories:

a. homogeneous form, constant composition, operationally generated
b. homogeneous form, inconstant composition, operationally generated
c. homogeneous form, constant composition, generated in campaign
d. homogeneous form, inconstant composition, generated in campaign
e. heterogeneous form, constant composition, operationally generated
f. heterogeneous form, inconstant composition, operationally generated
g. heterogeneous form, constant composition, generated in campaign
h. heterogeneous form, inconstant composition, generated in campaign

Note that, in actual practice, categories c. and g. will probably not exist, since the definition of "constant" conflicts to some degree with the use of the term "campaign." However, during longer campaign-type operations, these categories may be useful. Consequently, they are included here for completeness.

2. Determine the possible constituency of the waste stream

Each SLLW generator will develop a process flow diagram to describe the type and quantity of various material that may be present in SLLW generated through that process. The flow diagram will show the input material for the process, material which may be created through the process, and the portion of that which may be present in the SLLW generated by the process, including supplies and equipment used for cleaning and decontamination. For example, an analytical chemistry laboratory process flow diagram would show the various chemicals that are used in the analytical procedure, the changes that occur in chemical composition as a result of the analytical process itself, and the type and approximate quantity of those materials that may be present in the waste stream. For the initial phase of waste characterization, the quantitation would not need to be rigorous, but would be designed to show what material will constitute the major portion of the waste and which will be present in only trace quantities. The emphasis in developing such a flow diagram is to identify those prohibited constituents that may be present in the waste, but that can be eliminated through administrative and process controls.

Phase II - Establish Baseline Characterization

After obtaining the gross information from Phase I, a thorough sampling and analysis campaign will be instituted to determine the baseline SLLW characterization data, with the purpose of developing routine procedures for certifying the waste at the generator level. The specific parameters to be included in this sampling campaign will be decided for each waste stream, based on the information provided in the gross characterization study, with the type and quantity of samples dependent on the categorization data. For example, a SLLW stream that is homogeneous, constant, and operationally generated should be sampled more thoroughly than a heterogenous, inconstant, campaign waste stream, since the data will be of more use in establishing routine certification procedures in the former than in the latter.

Phase III - Implement Routine Characterization Program

With the baseline established, a routine program for obtaining waste characterization data must be developed for each SLLW generator. The specific procedures will be dependent on the individual waste stream involved, but must be one of the three techniques listed earlier in this section. In all cases, the individual technique must be substantiated to provide the necessary assurance for certification.

Statistical confidence levels, tolerance bounds, or accumulated statistical confidence levels may be used to provide the necessary level of assurance. In some cases, where sampling and analysis of the waste stream is the preferred method of characterization, the confidence level for a set of samples may be specified as integral to the certification process. For waste streams which are constant over long times and which have received an adequate initial characterization, a tolerance bound can be used, incorporating previous sample results with current analyses to provide a higher degree of confidence with a smaller uncertainty interval. In most cases, however, the accumulated confidence level for characterization of a waste stream must include a subjective evaluation of the uncertainties associated with process controls, administrative controls, performance on audits or assessments, documentation, and other techniques which improve process knowledge. The combination of uncertainties from subjective evaluation of these parameters with the available objective data from measurement techniques will provide an accumulated confidence level which can be used to provide the needed level of assurance in waste characterization. [Reference 8] Which of these techniques will be appropriate for each ORNL SLLW generator must be evaluated on an individual waste stream basis during the transition from the current certification program to the strategy being described in this document.

OTHER CONSIDERATIONS IN WASTE CHARACTERIZATION

In addition to the objective data on the waste stream categorization and baseline analyses, the following criteria must also be considered in establishing a routine characterization program:

1. Personnel exposures and contamination control

   Prior to implementing a routine program, the personnel exposures which may result from characterization activities such as sampling and analysis must be evaluated. If the potential or expected personnel exposures are unacceptably high, a different characterization technique should be used in accordance with the ORNL commitment to maintain exposures ALARA. [Reference 9]

2. Available technology

   In some cases, instrumentation and monitoring techniques which can be applied to waste characterization may be commercially available. However, for some waste streams, such as those involving the production of radionuclides having only weak beta emissions (e.g., tritium), characterization through direct or indirect measurement may not be possible.

3. Cost

The cost of providing complete waste characterization data must be balanced against the consequences of not having the information available. For example, an operation that generates only a small amount of SLLW will not be able to offset the expense of instruments needed to completely characterize the waste stream.

One approach to dealing with the impediments to complete waste characterization posed by limiting personnel exposure and by cost-benefit analysis is to establish "regional" SLLW characterization facilities to provide measurement capability to a group of generators. The viability of such an approach will be dependent on the type and quantity of SLLW being generated, and can be evaluated more thoroughly after the Phase I and Phase II studies described above.

Waste characterization will be more easily accomplished if SLLW can be segregated according to certain parameters. Some of the distinctions are inherent in the waste acceptance criteria being established, such as the necessity of segregating hazardous wastes from radioactive wastes, while others would make characterization measurements of the waste containers easier, or would have a significant effect on the manner in which wastes are categorized. The following are several parameters which must be considered in establishing a waste characterization program.

1. Segregation by concentration

The acceptance criteria for all disposal sites developed under DOE Order 5820.2A will rely on the concentration of radioactive contaminants in waste to determine the classification of that waste. Since the performance objectives for the facility will be based on dose limitation, separate facilities will be developed to handle disposal of high activity waste and lower activity waste, with maximum allowable radionuclide concentrations specified for each facility. [Reference 10] Segregation of the waste at the generator according to concentration will facilitate later classification of those wastes.

2. Segregation by isotope

Where practical, segregation according to the radioisotopes comprising the waste contaminant will allow for easier classification of the waste, since the concentration limits will follow a "sum of fractions" rule where each radionuclide present in the waste is divided by the concentration limit for that nuclide. The sum of all such fractions for all radionuclides in the waste must be less than 1. [Reference 10]

3. Segregation by radioactive half-life

The concentration limits for disposal sites will be based on a performance assessment for the disposal facility. The relationship between activity of a given radionuclide and the resulting dose from having that activity released from a disposal site is dependent on the half-life of the radioisotope, among other things. If a waste contains relatively short half-life isotopes (e.g., ^{137}Cs) but is also contaminated with some long-lived material (e.g., uranium), a small concentration of longer lived isotope could cause significant differences in the method of managing the waste, since the concentration limits for long-lived isotopes (e.g., uranium) are comparatively lower than for shorter lived isotopes.

4. Segregation by radiation type

NDA of waste packages is dependent on the type of radiation being emitted by the radioactive contaminants in the waste. If a package contains only gamma-emitting radionuclides, the likelihood of being able to perform NDA on the drum or box containing the waste is increased, which may allow easier characterization of the waste with a higher degree of assurance than possible through administrative characterization techniques. If, however, the waste contains only beta-emitting radionuclides, NDA of that package is possible only before the waste is placed into the container. Combinations of gamma-emitters with other radionuclides may be difficult as well. Unless the ratio between the gamma-emitting and other radionuclides is well established, the characterization data may be difficult to obtain.

INSPECTIONS AND AUDITS

Since the characterization process provides an objective assessment of the composition of a waste stream, there is a finite confidence level associated with any waste characterization efforts, i.e., a probabilistic determination. However, the act of certifying whether a waste package meets the applicable acceptance criteria is, by definition, a deterministic process, that is, either the waste does meet the criteria or it does not. While the uncertainty associated with characterization must be considered in certification, the final act of certification must be a true/false determination. Therefore, to account for the uncertainty associated with characterization and to maximize the systematic confidence level for certification, an integral part of the SLLW Certification Program is a series of inspections, reviews, and audits of the certification process to provide assurance that the confidence level remains high. These may be performed at various levels, depending on the particular aspect of the program which is to be verified.

Audits, evaluations, assessments, inspections, or other types of reviews can also improve characterization by providing additional or better administrative and process control of the waste generating process. An audit can reveal discrepancies in the methods used to segregate wastes or to control the type of material that goes into the waste packages. Feedback from audits and inspections must be incorporated into the generator certification program, whether that involves improvement in the process controls or amendments to administrative procedures.

GCOs, by the nature of their responsibilities, must perform an essentially continuous review of the individuals generating waste within their organizational unit. These reviews may or may not be formal audits, but should encompass the entire certification process from the point of waste generation until possession of the waste package is relinquished. Any deficiencies or activities which may cause a larger uncertainty in the characterization procedures should be documented and addressed. In some cases, it may not be possible to correct all such items due to limitations of technology, funding, or ALARA considerations. In such circumstances, the problem should be noted and included in the estimate of characterization confidence level.

The SLLW LCO is responsible for reviewing or auditing the generator programs on a periodic basis. These reviews are for the purpose of verifying that the individual generator certification program provides the necessary confidence level in waste characterization, through measurements, administrative controls, or by other means, and that the generator program follows the guidelines and requirements established for the ORNL SLLW certification Program. The LCO must provide documentation of any observations or deficiencies noted in these reviews and ensure that any problems are adequately addressed. In extreme cases, the LCO has the authority to revoke or temporarily suspend authorization of the generator to certify wastes, i.e., until defined deficiencies are corrected, the waste generated by that program is considered uncertified and cannot be collected and handled by the waste management organizations.

Waste management organizations (i.e., the persons handling, transporting, storing, treating, examining, or disposing of the waste) may conduct reviews separate from those done by the LCO. These organizations, with the concurrence of the LCO, may suspend or revoke a generator's authorization to certify SLLW.

The Quality Department will conduct periodic audits of the SLLW Certification Program in accordance with the procedures established for QA audits, using its discretion as to what specific items in the program are of interest in any particular audit. The entire program, from the point of waste generation to waste disposal is subject to these audits.

The ORNL SLLW Certification Program is also subject to audits and reviews by outside organizations. Any disposal facility handling ORNL waste must be given the authority to review the ORNL program to ensure that it is in accordance with the facility's requirements. The Martin Marietta Energy Systems, Inc., Central Waste Management Organization may also conduct periodic audits of the program. Such reviews or audits by organizations outside of ORNL will be performed in accordance with the auditing organization's procedures.

TRAINING

All persons involved in certification of SLLW are required to have specific training relevant to those responsibilities. A SLLW generator training module was developed in 1986 as a part of the initial certification program. The program was modified as requirements and procedures evolved, with the most substantial revision occurring in 1988. [Reference 11] Implementation of the certification process described in this document will require substantial changes in the existing SLLW generator training module.

Apart from the formal education and training required of their respective positions, all persons involved with the generation of SLLW, including chemical operators, technicians, GCOs, the LCO, or any other individuals who take part in SLLW management from generation to disposal, must be certified through the SLLW generator training program. At any time an individual is involved with the SLLW certification process, that person must have attended and been certified by passing the appropriate written examination, within the last two years, in both the ORNL SLLW Generator Training Course and the ORNL Waste Minimization Training course.

Additional training in procedures specific to a generator or in other procedures relevant to ensuring that the individual is capable of adhering to SLLW management procedures are the responsibility of that individual's line management. Each SLLW GCO has the responsibility of ensuring that the appropriate persons within the GCO's organization have received the necessary training.

CONTROL OF FACILITIES, EQUIPMENT AND MATERIALS

Although beyond the scope of this strategy document, implementing procedures for the SLLW certification program must address control and quality assurance for instrument calibration, drum or other waste container procurement, construction of boxes to be used as waste containers, design and construction of facilities, administrative and process controls, and other items as outlined in QA requirements. A separate QA plan will be prepared for the SLLW Certification Program.

DOCUMENT CONTROL

This document, along with subsequent SLLW Certification Program plans, will be managed as regulated documents. The procedure and process for the Waste Management Operations Section documentation management system [Reference 12] will be followed. However, because the procedures generated by SLLW generators will not be under the administrative control of the Waste Management Operations Section, but will be considered "quality-related documents" as far as implementation of the SLLW Certification Program is concerned, the generator certification procedures will be controlled through each division's documentation management system.

IMPLEMENTATION SCHEDULE

The current SLLW management strategy [Reference 13] calls for the certification system described in this document to be phased into routine operations beginning late in FY 1990. Full implementation of the SLLW Certification Program should be achieved by FY 1994. Partial implementation, to certify wastes for the IWMF, will occur by the end of FY 1991. Therefore, the studies described in the section on waste characterization must begin early in FY 1990. The gross characterization described as Phase I should be completed within the first quarter of FY 1990, with Phase II begun as soon as reasonable thereafter. Full implementation of the certification program described in this document is dependent on the preliminary waste characterization work being done. The SLLW generator training program will be updated as necessary to remain current with the developing certification program.

REFERENCES

1. J. D. Sease and L. C. Williams, "Solid Low-Level Waste Certification Program at ORNL," presented at the Oak Ridge Model Conference, October 1987.

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3. U. S. Department of Energy, Order 5820.2A, "Radioactive Waste Management," September 26, 1988.

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5. J. H. Smith, et. al., "Oak Ridge National Laboratory Transuranic Waste Certification Program," ORNL/TM-10322/R1, August 1988.

6. U. S. Department of Energy, Nevada Operations Office, and Reynolds Electrical and Engineering Co., Inc., "Nevada Test Site Defense Waste Acceptance Criteria, Certification, and Transfer Requirements," NVO-325, UC-70B, October 1988.

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11. Edith Jones and Mike Moreland, "Waste Generator Training Program, Solid Low-Level Waste Generator Training Program, Revision 1," June 1988.

12. Environmental and Health Protection Division, Waste Management Operations Section, "Documentation Management System - Operating and Management Procedure," Procedure WM-DMC-101, March 1, 1989.

13. J. S. Baldwin, T. E. Myrick, C. M. Kendrick, L. D. Bates, "Oak Ridge National Laboratory Implementation Plan for DOE Order 5820.2A," ORNL/TM-11166, April 28, 1989.

APPENDIX A: ARTICLES PROHIBITED FROM SLLW

Based on current and proposed waste acceptance criteria for disposal sites on the Oak Ridge Reservation, the following articles and material are not allowed in SLLW generated at ORNL.

- free liquids
- oils and oily wastes
- PCB contaminated materials
- pesticides (herbicides, insecticides, etc.)
- compressed gases
- pyrophoric materials
- chelating agents in excess of 0.1% by weight of the waste
- respirable particles in excess of 1% by weight of the waste
- pathogenic, infectious, toxic, or poisonous materials
- explosive materials
- hazardous waste as defined in RCRA, including, but not limited to:
    - arsenic
    - barium
    - cadmium
    - chromium
    - lead
    - mercury
    - selenium
    - silver
    - toxicity characteristic compounds
    - ignitable waste
    - reactive waste
    - corrosive waste
    - cyanide or sulfur bearing waste

INTERNAL DISTRIBUTION

1. J. R. Forgy
2-3. C. M. Kendrick
4. M. W. Tull
5. Central Research Library, ORNL
6. ORGDP Library
7. Y-12 Technical Library
8-9. ORNL Laboratory Records
10. Laboratory Records - RC
11. ORNL Patent Office

EXTERNAL DISTRIBUTION

12. Office of Deputy Assistant Manager for Energy Research and Development, U.S. Department of Energy, P.O. Box 2008, Oak Ridge, TN 37831-6269
13-14. Office of Scientific and Technical Information, U.S. Department of Energy, P.O. Box 62, Oak Ridge, TN 37831